

Fabrication of Topical Piroxicam Emulgel: *In Vitro* and *Ex Vivo* Assessments

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Abstract

Emulgel (Emulsion in gel) have emerged as one of the most interesting topical drug delivery system as it has dual release control system i.e. emulsion and gel. Also the stability of emulsion is increased when it is incorporated in gel. Piroxicam is an orally or topically active NSAID. The objective of this work was to develop an emulgel for control delivery for Piroxicam. In present work we prepare emulsion and then incorporated in gel base. An attempt has been made to make use of three different gelling agents, which will release the drug effectively on the surface when it is applied topically. Twelve semisolid formulations belongs to HPMC, Poloxamer 407 and Carbopol 934 (0.5%w/w) were prepared and evaluated for various physicochemical parameters like physical appearance, pH, extrudability, drug content uniformity, spreadability and viscosity. *In vitro* drug release rate was determined through diffusion method using pre-hydrated cellophane membrane. *Ex vivo* studies were performed through rat skin by using Franz diffusion cell. The results of studies revealed that the optimized emulgel indicated 1-35 μ m globule size. The pH were found in the range of 6.7 (F11) to 7.4 (F2). The optimized formulation F2 showed good spreadability as well as maximum drug content. The optimized emulgel showed 75.6% release in 8 hours. The optimized emulgel showed drug permeation through rat skin up to 36.5%. Hence it can be concluded that emulsion based system is more effective and safe system for sustain delivery of NSAID(s).

Introduction

When gels and emulsions are used in combined form the dosage forms are referred as "EMULGEL" [1]. As the name suggest they are the combination of emulsion and gel. In recent years, there has been great interest in the use of novel polymers with complex functions as emulsifiers and thickeners because the gelling capacity of these compounds allows the formulation of stable emulsions and cream by decreasing surface and interfacial tension and at the same time increasing the viscosity of the aqueous phase [1]. In fact, the presence of a gelling agent in the water phase converts a classical emulsion into an emulgel. Both oil-in-water and water-in-oil emulsions are used as vehicles to deliver various drugs to the skin. Emulsions possess a certain degree of elegance and are easily washed off whenever desired. They also have a high ability to penetrate the skin. Emulgel for dermatological use have several favourable properties such as being thixotropic, greaseless, easily spreadable, easily removable, emollient, non-staining, water-soluble, longer shelf life, bio-friendly, transparent and pleasing appearance [2].

Use of topical agents requires an appreciation of the factors that influence percutaneous absorption. Molecules can penetrate the skin by three routes: through intact stratum corneum, through sweat ducts, or through the sebaceous follicle. The surface of the stratum corneum presents more than 99% of the total skin surface available for percutaneous drug absorption. Passage through this outermost layer is the rate-limiting step for percutaneous absorption [3]. The major steps involved in percutaneous absorption include the establishment of a concentration gradient, which provides the driving force for drug movement across the skin, release of drug from the vehicle (partition coefficient), and drug diffusion across the layers of the skin (diffusion coefficient) [4]. Preferable characteristics of topical drugs include low molecular mass (600Da), adequate solubility in oil and water, and a high partition coefficient. Except for very small particles, water soluble ions and polar molecules do not penetrate intact stratum corneum. Topical formulation can be used to manipulate the barrier function of the skin, for example, topical antibiotics and antibacterials help a damaged barrier to ward off infection, sun screening agents and the horny layer protect the viable tissues from ultraviolet radiation and emollient preparations restore pliability to a desiccated horny layer [5,6].

Number of medicated products is applied to the skin or mucous membrane that either enhances or restores a fundamental function of skin or pharmacologically alters an action in the underlined tissues. Such products are referred as topical or dermatological products. Many widely used topical agents like ointments, creams; lotions have many disadvantages [7,8]. They have very sticky causing uneasiness when applied to the patient skin. Moreover, these formulations also have lesser

spreading coefficient and need to apply with rubbing as well as they exhibit the problem of stability on to the patient skin. Due to all these factors within the major group of semisolid preparations, the use of transparent gels has expanded both in cosmetics and pharmaceutical preparations.

A gel is colloid that is typically 99% wt liquid, which is immobilized by surface tension between it and a macromolecular network of fibres built from a small amount of a gelating substance present. In spite of many advantages of gels a major limitation is in the delivery of hydrophobic drugs. So to overcome this limitation an emulsion based approach is being used so that even a hydrophobic therapeutic moiety can be successfully incorporated and delivered through gels [9].

Several advantages have been associated with the emulgel as a drug delivery system, which are as follows: (i) Hydrophobic drugs can be easily incorporated into gels using W/O/W emulsions: Most of the hydrophobic drugs cannot be incorporated directly into gel base because solubility act as a barrier and problem arises during the release of the drug. Emulgel helps in the incorporation of hydrophobic drugs into the oil phase and then oily globules are dispersed in aqueous phase resulting in o/w emulsion. And this emulsion can be mixed into gel base. This may be proving better stability and release of drug than simply incorporating drugs into gel base, (ii) Better stability: Other transdermal preparations are comparatively less stable than emulgels. Like powders are hygroscopic, creams shows phase inversion or breaking and ointment shows rancidity due to oily base, (iii) Better loading capacity: Other novel approaches like niosomes and liposomes are of nano size and due to vesicular structures may result in leakage and result in lesser entrapment efficiency. But gels due to vast network have comparatively better loading capacity, (iv) Production feasibility and low preparation cost: Preparation of emulgels comprises of simpler and short steps which increases the feasibility of the production. There are no specialized instruments needed for the production of emulgels. Moreover materials used are easily available and cheaper. Hence, decreases the production cost of emulgels, (v) No intensive sonication: Production of vesicular molecules need intensive sonication which may result in drug degradation and leakage. But this problem is not seen during the production of emulgels as no sonication is needed, and (vi) Controlled release: Emulgels used as a controlled delivery system to enhance the half-life of the drug [10-15].

In the present investigation, we have developed an emulgel based drug delivery system of NSAID as a model drug, Piroxicam. We were using three different varieties of gelling agents, to control the drug release, when applied topically. The prepared emulgels were evaluated for several physicochemical parameters such as physical appearance, pH, extrudability, drug content, uniformity, spreadability, rheological properties and viscosity. Further, we were evaluated the in vitro drug release study and in vitro diffusion studies using diffusion method (semi-permeable membrane) followed by in vitro release kinetics and Franz diffusion cell apparatus, respectively. Furthermore, we were performed the *ex vivo* drug permeation study using rat skin model.

Materials and Methods

Piroxicam, HPMCK4M, carbopol 943 and Poloxamer 407 was gifted by Reddy's laboratory, Hyderabad, India. Emulsifying wax, cetostearyl alcohol, propylene glycol, sodium hydroxide, sodium lauryl sulfate were purchased from INR Chemicals, Hyderabad, India.

Nanofree™ quality water (Barnstead, Dubuque, IA) was used for all studies. All other chemicals used during the study were obtained commercially as analytical-grade.

Methods

Preparation of emulsion: Emulsifying wax and cetostearyl alcohol were mixed and warm to about 75°C to gets melted oil phase. Disperse drug (Piroxicam) into the propylene glycol, add 1N sodium hydroxide, sodium lauryl sulfate and small quantity of water to the above dispersion then warm it upto 75°C for 10 min. Further, added aqueous phase to the oil phase stirred using digital over head stirrer (WiseStir® HS-100D, Germany), the mixing speed was 1000±200RPM for 10-15 min, until it gets congealed [13].

Preparation of gel bases:

Preparation of HPMCK4M gel: Weighed quantity of HPMCK4M is added in small amounts to the distilled water using digital over head stirrer, the mixing speed was 1200±300RPM for 10-15 min. After smooth dispersion is obtained, the preparation is allowed to stand. triethanolamine was added into the gel to adjust pH upto 7.4 [16].

Preparation of carbopol 934 gel: A small amount of carbopol 934 were added into the solvent and stirred using digital over head stirrer, stirring speed is 1000±200RPM for 10 min to form smooth dispersion. The preparation is allowed to stand, permitting entrapped air to separate. Then gelling agent triethanolamine is added drop-wise while stirring with a plastic spatula to avoid entrapment the air. The remaining water was then incorporated [16].

Preparation of Poloxamer 407 gel: Poloxamer 407 was added in small quantities to 4°C water using a high speed digital over head stirrer, stirring speed is 1000±200RPM for 10 min. The preparation is allowed to stand in refrigerator, permitting entrapped air to separate. Then gelling agent triethanolamine is added drop wise while stirring with a plastic spatula to avoid entrapment the air [16].

Preparation of Emulgel: Individually added different gel base to the emulsion under continuous mixing using mechanical stirrer (RQT-124A) at 5000-6000 RPM for about 30-45 min [17]. The formulation compositions of the different batches of emulgel are summarized in Table 1.

Evaluation of the prepared formulations:

Physical appearance: The physical appearance was visually checked for the texture of formulations and observations [18].

Globule size and its distribution in emulgel: A 1.0 g sample was dissolved in purified water and agitated to get homogeneous dispersion. Sample was observed under Optical microscope (5000 DTM). Mean globule diameter and distribution was obtained [19,20].

pH of the formulations: The pH measurements were done using a pH-meter (Inolab WTW Series pH 720, Germany) at room temperature (25± 2°C) after preparation of emulgel. Samples were prepared by dilution of 1 g of emulgel to 10 mL with purified water before the experiment. Measurements were taken in triplicates [21].

Determination of spreadability: Two glass slides of standard dimensions were selected. The formulation whose spreadability had to be determined was placed over one of the slides. The second slide was placed over this slide in such a way that the formulation was

Table 1: Formulation composition of the Emulgel (w/w).

Formulation Code	Emulsifying wax (g)	Cetosteryl alcohol (g)	Propylene glycol (g)	SLS (g)	Drug (g)	HPMCK4M (g)	Poloxamer 407 (g)	Carbopol 934 (g)
F1	4	3	6	0.5	0.5	0.5	-	-
F2	4	3	6	0.5	0.5	1	-	-
F3	4	3	6	0.5	0.5	2	-	-
F4	4	3	6	0.5	0.5	3	-	-
F5	4	3	6	0.5	0.5	-	5	-
F6	4	3	6	0.5	0.5	-	7.5	-
F7	4	3	6	0.5	0.5	-	10	-
F8	4	3	6	0.5	0.5	-	12.5	-
F9	4	3	6	0.5	0.5	-	-	0.25
F10	4	3	6	0.5	0.5	-	-	0.5
F11	4	3	6	0.5	0.5	-	-	0.75
F12	4	3	6	0.5	0.5	-	-	1

sandwiched between them across a length of 6 cm along the slide. 100 g weight was placed upon the upper slide so that the formulation between the two slides was pressed uniformly to form a thin layer. The weight was removed and the excess of the formulation adhering to the slides was scrapped off. The lower slide was fixed on the board of the apparatus and one end of the upper slide was tied to a string to which 20 g load could be applied with the help of a simple pulley. The time taken for the upper slide to travel the distance of 6 cm and separate away from lower slide under the direction of the weight was noted. The experiment was repeated and the average of six such determinations was calculated for each formulation [22].

$$\text{Spreadability} = M.L/T$$

Where, M = Wt. tied to the upper slide (20 g)

L= Length of glass slide (6cm)

T = Time taken in seconds.

Rheological studies: Brookfield viscometer (DVII +PRO, 25±1°C) was used to determine viscosity. The sufficient quantity of ointments, gels and creams were filled in wide mouth jar, separately. The height of the ointments were filled in the jar should sufficiently allow to dip the spindle. The RPM of the spindle was adjusted. The viscosities of the emulgel formulations were recorded [23].

Estimation of drug content: For estimating the drug content of the formulations from F1 to F12 the common procedure was followed. The 100 mg of the above formulations were separately weighed and then each formulation is separately dissolved in 10 ml of methanol. Then the above volumetric flasks containing formulation should shake for 15 minutes for the extraction of drug from the bases. Then read the absorbance of above solution measured using UV-visible spectrophotometer (UV-3200) against methanol as a blank. The amount of Piroxicam present was calculated using the calibration curve [23-25].

In vitro diffusion studies: Franz diffusion cell (with effective diffusion area 3.14 cm² and 15.5 ml cell volume) was used for the drug release studies. The cellophane membrane approximately 25 cm² was taken and washed in the running water. It was then soaked in distilled water for 24 hours, before used for diffusion study. Gellified Emulsion (200

mg) was applied onto the surface of Cellophane membrane evenly. The cellophane membrane was clamped between the donor and the receptor chamber of diffusion cell. The receptor chamber was filled with freshly prepared Phosphate buffer (pH: 7.4) solution to solubilize the drug. The receptor chamber was stirred by magnetic stirrer. The samples (1.0 ml aliquots) were collected at suitable time interval. Samples were analysed for drug content by UV Visible Spectrophotometer at 352 nm [26-29].

Ex vivo studies:

Percent amount of drug release from rat skin: Drug permeation study was performed after obtaining the approval of the institutional animal's ethical committee in accordance with disciplinary principles and guidelines of the Committee For The Purpose of Control and Supervision of Experiments on Animals (CPCSEA) (II/IAEC/LCP/037/WR24).

The amount of drug release from rat skin was determined by using franz diffusion cell. The dorsal skin of Wister rat (4-6 weeks old) was placed between donor and receptor compartments of diffusion cell with the stratum corneum side facing upwards. The receptor chamber was filled with 30 ml pH 7.4 phosphate buffers. Emulgel equivalent to 1gm was applied onto the surface of skin evenly. The receptor chamber was stirred by a magnetic stirrer rotating at 500rpm and kept at 37±1°C. The samples (1.5ml) were collected at suitable time interval. Samples were analysed for naproxen content by UV visible spectrophotometer (Lab India 3200) at 352 nm after making proper dilutions. Data obtained from in vitro release studies were fitted to various kinetic equations to find out the mechanism of Piroxicam release from Emulgel [30-36].

In vitro release kinetics: An appropriate drug release test is required to characterize the drug product and ensure batch to batch reproducibility and consistent pharmacological/biological activity and to evaluate scale up and post approval changes such as manufacturing site changes, component and composition changes. The release of drug from a sustained release formulation is controlled by various factors through different mechanism such as diffusion, erosion or osmosis. Several mathematical models are proposed by many researchers to describe the drug release profiles from various systems [36].

Table 2: log cumulative percentage drug release versus log time.

Release exponent (n)	Drug transport mechanism	Rate as a function of time
0.5	Fickian diffusion	$t^{0.5}$
$0.5 < n < 1.0$	Anomalous transport	t^{n-1}
1	Case-II transport	Zero-order release
Higher than 1.0	Super Case-II transport	t^{n-1}

In order to characterize the kinetics of drug release from dosage forms several model dependent methods are reported by various researchers. The model dependent methods all rely upon a curve fitting procedure. Different mathematical functions have been used to model the observed data [36]. Both the linear and non-linear models are being used in practice for modelling. Linear models include Zero order, Higuchi, Hixson - Crowell, Quadratic and Polynomials, whereas the nonlinear models include First order, Weibull, Korsmeyer-Peppas, and Logistic etc.

Zero-order model: Drug dissolution from dosage forms that do not disaggregate and release the drug slowly can be represented by the equation:

$$Q_0 - Q_t = K_0 t$$

|Rearrangement of equation yields:

$$Q_t = Q_0 + K_0 t$$

Where, Q_t is the amount of drug dissolved in time t ,

Q_0 is the initial amount of drug in the solution (most times, $Q_0 = 0$)

K_0 is the zero order release constant expressed in units of conc./time.

First order model: This model has also been used to describe absorption and/or elimination of some drugs, although it is difficult to conceptualize this mechanism on a theoretical basis. The release of the drug which followed first order kinetics can be expressed by the equation:

$$Dc/dt = -kc$$

Where, K is first order rate constant expressed in units of time^{-1} .

Higuchi model

The first example of a mathematical model aimed to describe drug release from a matrix system was proposed by Higuchi in 1961. In a general way it is possible to simplify the Higuchi model as (generally known as the simplified Higuchi model):

$$f t = Q = K_H t^{1/2}$$

Where, K_H is the Higuchi dissolution constant.

Korsmeyer-Peppas model: Korsmeyer et al. derived a simple relationship which described drug release from a polymeric system equation.

To find out the mechanism of drug release, first 60% drug release data were fitted in Korsmeyer-Peppas model

$$M_t / M_\infty = K t^n$$

Where, M_t / M_∞ is a fraction of drug released at time t ,

k is the release rate constant and

n is the release exponent.

In this model, the value of n characterizes the release mechanism of drug as described in Table 2. To study the release kinetics, data obtained from *in vitro* drug release studies were plotted as log cumulative percentage drug release versus log time.

Hixson-Crowell model: Hixson and Crowell recognized that the particles regular area is proportional to the cube root of its volume.

They derived the equation:

$$W_0^{1/3} - W_t^{1/3} = \kappa t$$

Where, W_0 is the initial amount of drug in the pharmaceutical dosage form

W_t is the remaining amount of drug in the pharmaceutical dosage form at time t

κ (kappa) is a constant incorporating the surface-volume relation.

Accelerated stability studies of emulgel: The prepared Piroxicam emulgel formulations were stored away from light in collapsible tube at $25 \pm 2^\circ\text{C}$, $40 \pm 2^\circ\text{C}$ and $4 \pm 2^\circ\text{C}$ for 45 days. After storage, the samples are tested for their physical appearance, pH, rheological behaviour and drug content.

Results and discussion

Physical appearance

The physical appearance of all the formulations of the emulgel was found to be within the limits. All the parameters are summarized in Table 3.

Globule size and particle size distribution

Globule size/average droplet size is also considered to be an important factor in context of physical stability of the product. Therefore, mean globule size was calculated for the prepared emulgels. Mean globule size is affected by a number of process and formulation variables. Since, our study focused on the effect of formulation variables, the findings of average globule size determination may be correlated with the surfactants used in the formulations. As given in literature, incorporation of non-ionic surfactants tends to lower the droplet size in the emulsions stabilized by HPMCK4M. Formulation F2, prepared with non-ionic surfactants, had the lowest average globule diameter of $1-35 \mu\text{m}$ (88.7%), which supports the findings cited in the literature [23-25].

pH determination

Emulgel formulations from F1-F12 were prepared with a neutralized gel phase based on HPMCK4M, Poloxamer 407 and Carbopol 934. After the addition of the oil phase, the pH of emulgel

Table 3: Physical appearance of the several formulations.

Formulation code	Colour	Homogeneity	Consistency	Phase separation
F1-F4	Pale yellow	Excellent	Excellent	None
F5-F8	Yellow	Excellent	Excellent	None
F9-F12	Pale yellow	Excellent	Good	None

Table 4: pH values of the various emulgel formulations.

Formulation code	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12
pH values	7.2	7.4	6.7	6.9	6.8	7.3	7.1	6.9	7.0	6.8	6.7	6.9

formulations was in the range of 6.7 (F11) to 7.4 (F2) as shown in Table 4. This is considered acceptable for avoiding the risk of skin irritation. The oxidation process and the formation of oxidation products in the oil phase might be the reason for the slight reduction in pH values [35-37] (Figure 1).

Spreadability

Spreadability test was carried out for all the emulgel formulations as depicted in Figure 2.

We found that emulgel formulation F2 (18.2 g.cm/sec) and F6 (17.8g.cm/sec) presented good spreadability as compared to other emulgel formulations. The spreadability indicates that the emulgel is easily spreadable by small amount of shear. Spreadability of the emulgel decreases with the increase in the concentration of the polymer such as HPMCK4M and Poloxamer 407, respectively. The spreadability is very much important as it shows the behavior of emulgel when it comes out from the tube [38].

Rheological studies

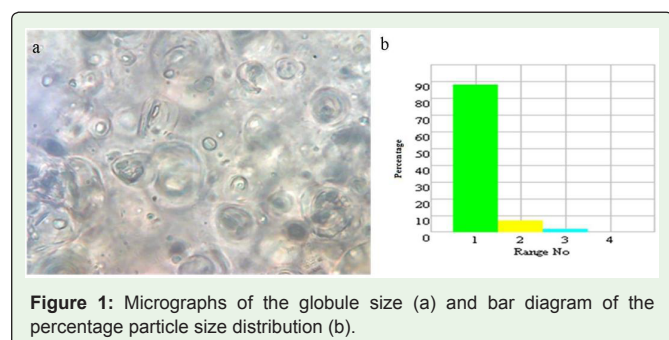
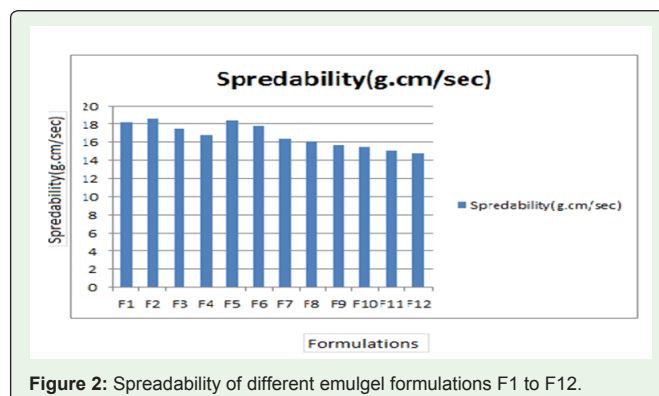
Neutralizing the gel phase before adding the emulsion phase was not necessary only for appropriate pH, but also for achieving maximum viscosity in the final emulgel formulation. In our study, emulgel formulation F8 showed the highest viscosity among the twelve formulations as indicated in Figure 3. The increase in viscosity followed the order F8>F12> F7>F4>F6>F3>F11>F5>F10>F2>F1>F9. The highest viscosity was found in formulation F8 it may be due to high level of both the polymer concentration (Poloxamer 407) and emulsifying agent concentration. The lowest viscosity was found in formulation F9 it may be due to low level of the polymer concentration (Carbopol 934) and emulsifying agent [39,40].

Drug content

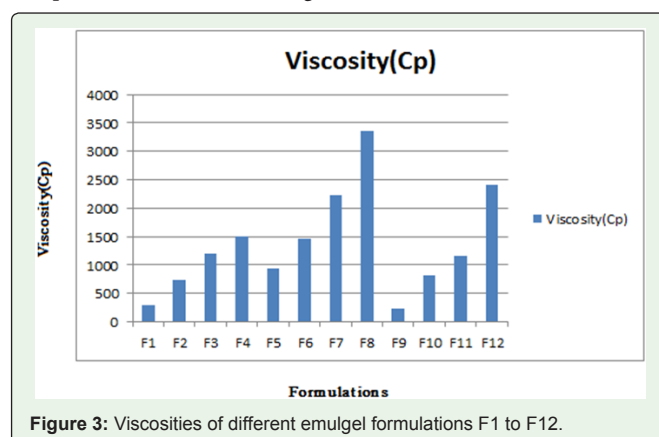
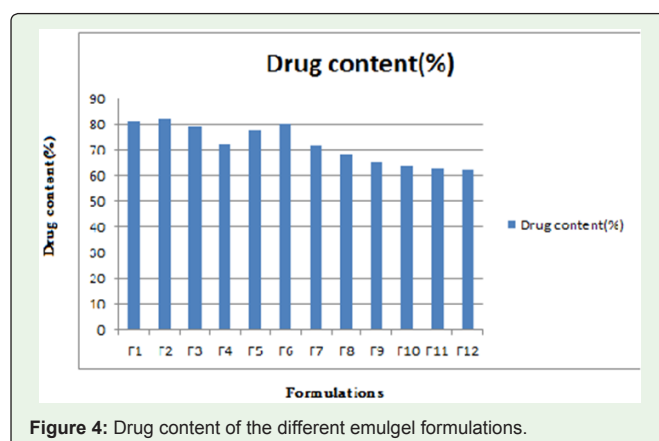
The drug content is other evaluation parameters for emulgel formulations. The drug content of the formulated emulgel from F1 to F12 was estimated by UV spectrophotometrically. The results were found to be within the limits as shown in Figure 4. The highest drug content was found in the formulation F2 [41].

In vitro diffusion studies

The in vitro release profiles of piroxicam from its various emulgel


Figure 1: Micrographs of the globule size (a) and bar diagram of the percentage particle size distribution (b).

Figure 2: Spreadability of different emulgel formulations F1 to F12.

formulations are represented in Figure 5-7. It was observed that all the formulation had become liquified and diluted at the end of the experiments, indicating water diffusion through the membrane. The release of the drugs from its emulgel formulations can be ranked as F2>F1>F5>F6>F3>F4>F7>F8>F9>F10>F11>F12, where the amount of drug release after 8-10h were ranked as 75.6>72.7>71.4>67.7>67.6>64>63.9>61.9>59.1>56.9>52.7>50.1, respectively. So, formulation F2 showed significantly ($p<0.05$) higher percentage of drug release as compared with the other emulgels formulations.


Figure 3: Viscosities of different emulgel formulations F1 to F12.

Figure 4: Drug content of the different emulgel formulations.

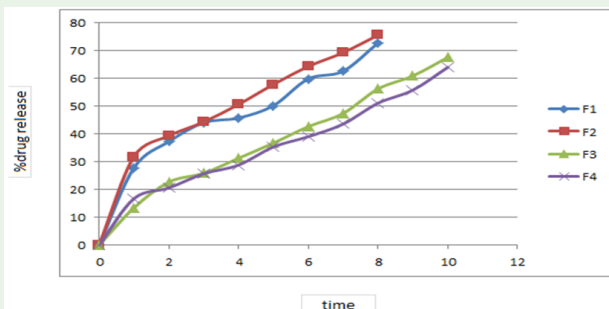


Figure 5: *In vitro* release of drug from HPMCK4M emulgel formulations of F1 to F4.

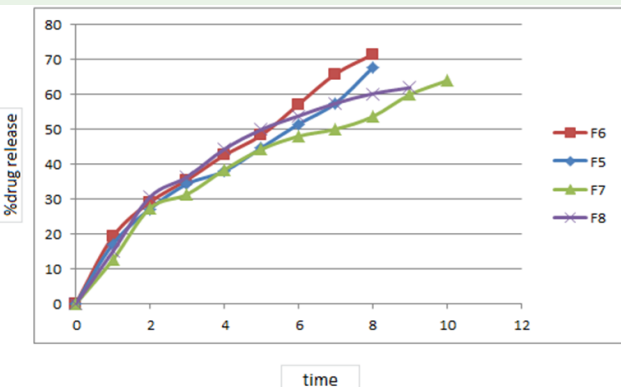


Figure 6: *In vitro* release of drug from poloxamer 407 emulgel formulations of F5 to F8.

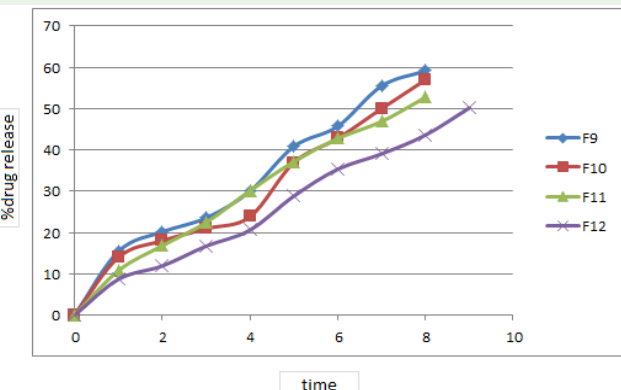


Figure 7: *In vitro* release of drug from carbopol 934 emulgel formulations of F9 to F12.

When the comparison of the release profile of drug through the cellophane membrane for the different formulation was done, the 1% HPMCK4M and 7.5% Poloxamer 407 showed the better release compared with other formulations as depicted in Figure 5 and 6, respectively. Whereas, carbopol 934 formulation has shown low drug release compared to other formulations as presented in Figure 7.

It is clear from the drug release profiles that, with increase in the concentration of the carbopol, the steady-state flux (permeability

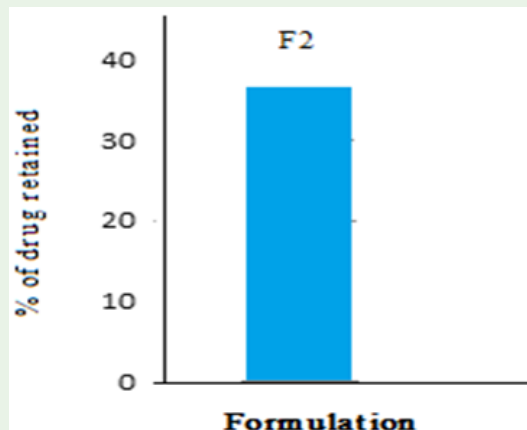


Figure 8: Percentage of drug retain on the rat skin of the optimized emulgel formulation F2.

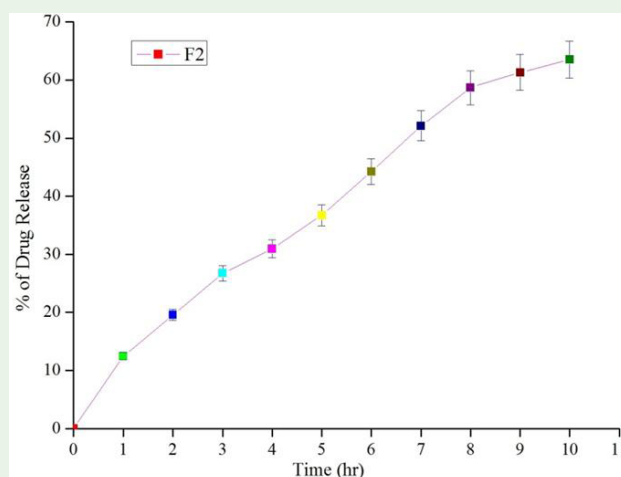


Figure 9: Percentage of drug permeation through the rat skin of the optimized emulgel formulation F2, vertical error bars represent mean \pm SEM; n=6.

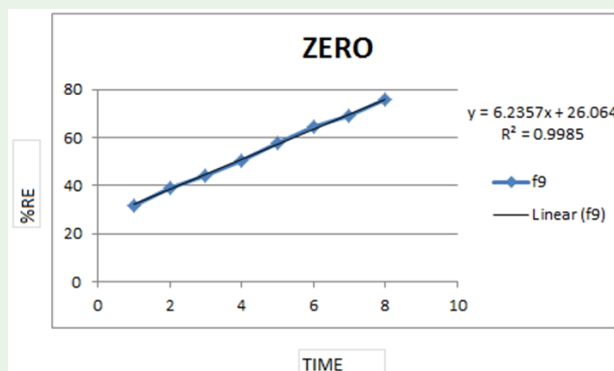


Figure 10: Zero order kinetics of optimized emulgel formulation.

coefficient and drug release) values were found lower for the formulation in which polymer concentration was kept high. In addition, viscosity increased as polymer concentration increased.

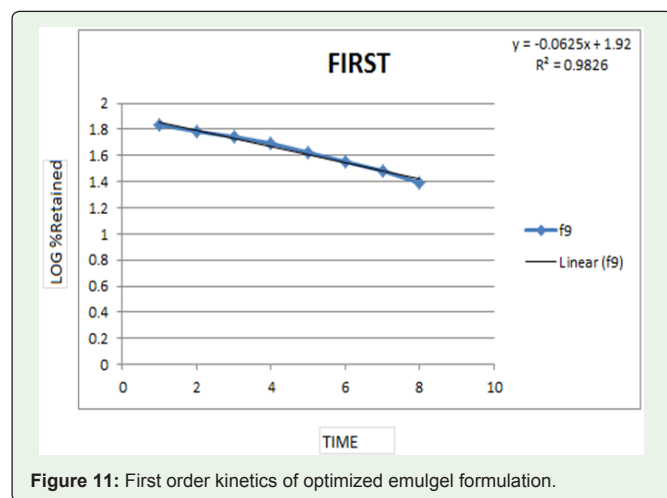


Figure 11: First order kinetics of optimized emulgel formulation.

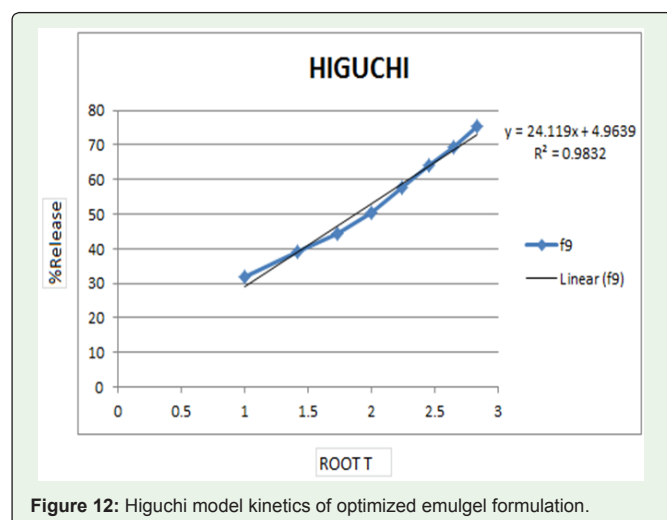


Figure 12: Higuchi model kinetics of optimized emulgel formulation.

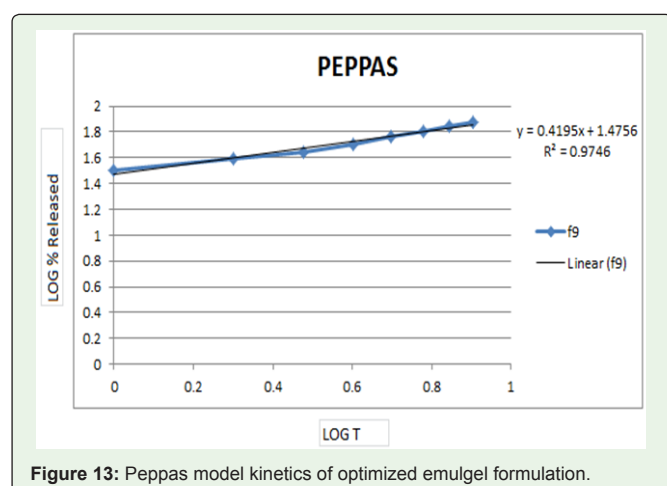


Figure 13: Peppas model kinetics of optimized emulgel formulation.

Viscosity is negatively related to the release of active substance from formulations and its penetration through the diffusion barriers. Thus, both high concentration of polymer and high viscosity compete each other in decreasing the release of active substance from the formulation [41].

Ex vivo studies

Drug permeation studies using rat skin: Results from Figure 8 showed that about 36.5% of drug from Emulgel deposited on rat skin. Results of this study clearly indicate that the amount of drug retained in the skin was considerably higher. This shows that Emulgel help to localise the drug within the skin indicating sustain release of drug at site which prevents further inflammation as shown in Figure 9 [42].

Release kinetics

The mechanism of release kinetic from the optimized emulgel formulation based on various regression coefficient (R^2) values is presented in Figure 10-13, for most of the emulgel formulation having R^2 value less than 1. Hence it can be concluded that the drug release follow peppas model.

The n value of peppas model of the emulgel formulations are in the range of 0.1 to 0.5 which confirms that release of emulgel formulation was follows fickian diffusion mechanism [41-45].

Stability studies

Stability studies of optimized formulation were performed as per ICH guideline (International Conference on Harmonization). It can be observed that the emulgel formulation showed no major alteration in relation to the pH, consistency, Viscosity and Drug content. The formulation shows stability for the period of 45 days [44].

Conclusion

When semisolid preparations of drugs are used for the external application to the skin, the choice of the suitable base plays an important role in delivering the drug to the skin. Piroxicam is one of the recent NSAIDs, which has its non-selective COX inhibiting activity. The semisolid preparation of Piroxicam can help in local delivery of the drug to skin, which further reduces the incidence of any side effects associated with systemic delivery.

From above results, we can conclude that Piroxicam Emulgel formulations prepared with three different gelling agents: carbopol 934, HPMCK4M and Poloxamer 407 showed acceptable physical properties and drug release study. All prepared Emulgel showed acceptable physical properties concerning colour, homogeneity, consistency, spreadability and pH value. Among all gel formulations, HPMCK4M Emulgels shows superior drug release after that Poloxamer 407 shows decreasing order of drug release. In all this Emulgel formulation, the drug release was decreased with increase in gelling agent concentration because polymer concentration increases, viscosity increases. Viscosity is negatively related to the release of active substance (Piroxicam) from formulations. Stability studies in all gel formulations showed that, the physical appearance, drug content, pH, rheological properties, and drug release in all gel formulations remain unchanged upon storage for two months.

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