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Formulation and Evaluation of Ketoprofen Emulgels by Model Independent Approach

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ABSTRACT

In the current study, ketoprofen emulgels were prepared using Sodium CMC, Sodium alginate and Hibiscus as gelling agents in order to overcome gastric side effects and to achieve pharmacological response. Pre formulation parameters were performed to know the compatibility of pure drug ketoprofen with polymers CMC, Na alginate, hibiscus prior to the preparation of Emulgel. It indicates that no change was observed in the peak values of the drug in the physical mixture thus providing that both the drug and polymer were said to be compatible with each other. Emulgel of ketoprofen 2.5% w/w was prepared in 3 steps i.e., Preparation of gel, emulsion phases separately and incorporate both phases in homogenizer for a period of 45 min and stabilized it for 2 hrs. The prepared emulgels were evaluated for physical characteristics, drug content, pH, spreadability and *in-vitro* permeation studies. The physical appearance of all the formulations was creamy white, consistent, homogenous and stable. The pH of the prepared emulgels was found well within the range of 6-7. Release rate kinetics of the drug was studied with *in vitro* drug permeation data for all the formulations F1 to F9 and results were stated the best fit model for selected formulation F6 were found to be Zero order model with non-fickian diffusion. The formulations were compared with the reference product. The *in-vitro* dissolution of F6 was nearest to the reference product F10 (f_2 = 85.17).

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INTRODUCTION

Ketoprofen belongs to NSAIDs that is widely used as analgesic for rheumatic disease and also for joint disorders such as any losing spondylitis, osteoarthritis. It is insoluble in water and is freely soluble in acetone, ethanol and ethylene chloride. In order to eliminate the adverse effects of NSAIDs, the development of transdermal formulations was employed. Several topical dosage forms may be utilized to deliver NSAIDs. One of the best topical dosage forms is emulgel [1]. The absorption of a drug into the blood requires dissolution and release of the drug thus partitioning and diffusion

and finally into the aqueous epidermis is possible. By adding a chemical permeation enhancer in the formulation it will improve or increase drug partitioning into the subcutaneous. Examples are alcohols, polyalcohol's, amides, pyrrolidones, fatty acids and surfactants. A jellified emulsion (Emulgel) is prepared by mixing an emulsion i.e. water-in-oil (W/O) type or O/W along with a gelling agent. The main advantage of the emulgel is that the lipophilic drugs can be easily formulated into gels. Advantages for emulgels are increased stability, superior loading efficiency, high production with less cost [2]. The main constituents in emulgel preparation include water, oils mainly mineral oils as paraffin oil either used alone or mixed with Vaseline or wax, emulsifiers, gelling Agent, and permeation enhancers. The aim of the current work is to formulate ketoprofen emulgel so that GIT side effects can be eliminated and to incorporate this insoluble drug in a hydrophilic gel matrix, and to enhance the percutaneous absorption [3].

MATERIALS AND METHODS

Ketoprofen was received as free sample from GlaxoSmithKline, Mumbai, Sodium citrate, starch, Magnesium chloride used to be acquired from SD fine chemicals Ltd., Mumbai. All abundant chemical as well as chemical agent utilized in this study are of analytical grade.

Preformulation Studies

Melting point determination

Small quantity of drug was taken in a capillary tube and it is closed at one end and the temperature at which the drug melts was recorded. The studies were performed thrice and average values were recorded [4].

Derived Properties of Powder

Powder Flow Property of the dried powder as follows [5]

Angle of repose: $\theta = \tan^{-1}$ (h/r)

Bulk density = Weight of powder/ Bulk volume

Tapped density = Weight of powder/ Tapped volume

Carr's Index (I) = (Tap ed Density -Bulk Density)/(Tapped Density)x100

Hausner's ratio = Tapped density/ Bulk density

Drug - Excipient Compatibility Study

KBr was allowed to mix with drug and excipients in 1:1 ratio. FT-IR spectrum of Ketoprofen was compared with Drug and also with excipients for compatibility [6].

Methodology

Formulation design for Ketoprofen emulgel preparation

The formulation code was designed based on the concentration of gelling agents: Sodium carboxyl methyl cellulose, sodium alginate, hibiscus dry powder [7, 8].

Gel preparation

Gel was prepared by dissolving gelling agent(s) (Na CMC, Na Alginate, hibiscus) in hot water until it attains gel consistency.

Emulsion preparation

The oily phase of the emulsions have been prepared by adding span 20 in light liquid paraffin and was heated up to 70^{O}C– 80^{O}C. Aqueous phase was prepared by dissolving Ketoprofen in propylene glycol. Then Tween was added to it and heated up to 70^{O}C - 80^{O}C. Methylparaben was added to the prepared aqueous phase. Then aq. phase was allowed to mix slowly with oil phase and final volume was made with purified water.

Emulgel preparation

The prepared emulsion was allowed to mix with the gel and required weight was maintained with water and kept for homogenization for a period of 45 min in order to obtain Ketoprofen emulgel [Table 1].

Morphological Characters of Emulgel

Scanning Electron Microscopy

The surface morphology of the Emulgel was obtained by using SEM [9].

Evaluation of Ketoprofen Emulgels

Physical appearance

The prepared formulations have been inspected for properties like color, homogeneity, consistency and phase separation [10].

pH

The emulgel pH must be 5-7 to adjust to the skin conditions. pH of prepared emulgel must not be acidic or basic as it may cause irritation upon the skin [11]. The values were recorded in triplicate.

Rheological studies

The viscosity of gel during preparation and stability should be given an almost importance [12]. Using Falling sphere viscometer the viscosity of different formulations were measured at 25^{0}C.

Spreadability test

It expresses the exposed area on which the prepared gel spreads on applying to skin. The drug efficiency

Table 1: Formulation of ketoprofen Emulgel preparation

Ingredients (%w/w)	F1	F2	F3	F4	F5	F6	F7	F8	F9
Ketoprofen	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Na CMC	10.0	15.0	20.0	-	-	-	-	-	-
Na Alginate	-	-	-	10.0	15.0	20.0	-	-	-
Hibiscus	-	-	-	-	-	-	10.0	15.0	20.0
Light liquid paraffin	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3
Tween 20	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Span 80	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Propylene glycol	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3
Methylparaben	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Purified water	q.s	q.s	q.s	q.s	q.s	q.s	q.s	q.s	q.s

depends on the spreadability values. Spreadability was given by:

$$S = M \times L/T$$

Where,

M = weight to be taken, L = length of slide, T = time

The 0.5g of the sample was placed on lower plate and upper plate was placed on the top of the sample. Force was generated by adding increasing weight slowly at 1 minute interval into the pan connected to the upper plate, each sample was tested three times at constant temperature and exerted weight and the mean values of the spread surface area on lower plate were calculated [13].

Drug content

Ketoprofen content in emulgel was measured by taking the absorbance of the sample was measured at 261nm by using UV-Visible spectrophotometer 1700. The test was conducted in triplicate and the average % drug content was determined [14].

***In-vitro* drug permeation study**

The test was performed by using Franz diffusion cell. Egg membrane was isolated and used for the study. The egg membrane was clamped between donor and receptor compartment. The receptor compartment was filled with 100ml of 7.4pH phosphate buffer maintained at room temperature and stirred by using magnetic stirrer [3]. Pre weighed (1.0g) emulgel was taken on the egg membrane. The sample (5ml) was collected for an interval of every one hour and analyzed for drug content by UV-Visible Spectrophotometer 1700 at 261nm after appropriate dilutions.

Kinetic Treatment

The data obtained from *in vitro* dissolution studies acquire kinetic track record analysis [15].

Zero-order kinetics: $Q_t = Q_o + K_o t$

First-order kinetics: $Q_t = \log Q_o + K_1 t/2.303$

Higuchi model: $Q_t = K_H \cdot t^{1/2}$

Korsmeyer-Peppas release model: $Mt / M_\infty = K \cdot t^n$

Comparison of diffusion profiles

Model independent approach

According to US FDA guidance for dissolution data equivalence, model independent approach is acceptable. This involves the use of similarity (f_2) and dissimilar factor (f_1) which provides simple means to compare the dissolution data [16, 17].

Similarity factor (f_2)

The similarity factor f_2 was defined as a logarithmic reciprocal square root transformation of the sum of squared error and is a measurement of the similarity in the percent (%) dissolution between the two curves. It was calculated data according to the following equation:

$$f_2 = 50 \times \log \{[1 + (1/n) \sum t = 1\ n\ (Rt - Tt)2]^{-0.5} \times 100\}$$

Where,

n = No. of full time points

Rt = Reference profile at the time point t

Tt = Test profile at the same point

The method is more adequate to compare the dissolution profiles when more than three or four dissolution time points are available and can be applied if average difference between Rt and Tt is >100.

Dissimilarity factor (f_1)

It is also called as Difference factor. It describes the relative percentage error between two dissolution profiles. The percent error is zero when the test and reference profiles are identical and increases

the proportionality with the dissimilarity between the two profiles.

$f_1 = \{[\sum t = 1\ n\ (Rt - Tt)]\ /\ \sum t = 1\ n\ Rt]\} \times 100$

RESULTS & DISCUSSION

Characterization of API

The melting point of the ketoprofen was determined by capillary tube method and was found to be 98^{o}C $\pm$ 0.56^{o}C. From the below results, it was concluded that the API, Ketoprofen exhibited Poor flow property [Table 2].

Drug - Excipient compatibility studies

Preformulation parameters were carried out for studying the compatibility of pure drug ketoprofen with polymers CMC, Na alginate, hibiscus prior to the preparation of Emulgel [Tables 1, 2, 3 and 4]. It indicates that there was no change in the peak values of the drug in the physical mixture thus providing that drug and polymer were compatible with each other [Table 3].

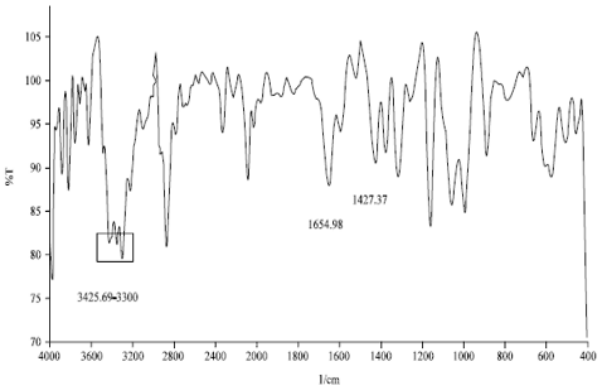

Figure 1: FTIR Spectra of Ketoprofen

As there was no interaction between the drug and other excipients, the excipients were found to be compatible with the drug.

From the FTIR spectra of drug [Figures 1, 2, 3 and 4], it was found that Ketoprofen gave principle peaks at wave numbers 3425.69 Cm^{-1}, 1790.49 Cm^{-1}, 1582.35 Cm^{-1}, 1536.94 Cm^{-1}. Principal peaks were present in drug and excipients physical mixture. This indicates that there was no interaction between the drug and excipients. From the results obtained for Drug- excipients compatibility study, it was found that the drug was compatible with the other excipients under evaluation. So that chosen excipients can be used in the formulation trails.

Scanning electron microscope studies

The surface morphology of the Emulgel was obtained by using SEM of best formulation F6 [Table 5, Figure 5].

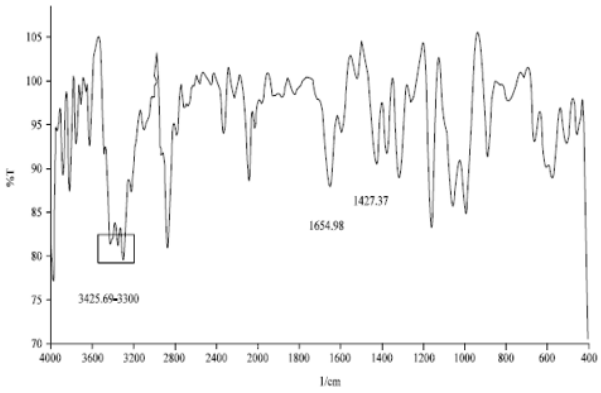

Figure 2: FTIR Spectra of Ketoprofen and Sodium CMC

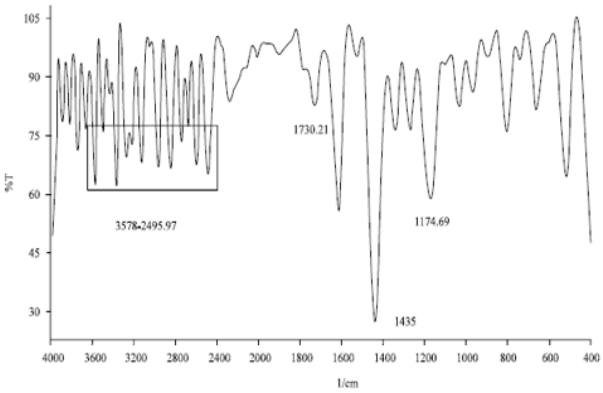

Figure 3: FTIR Spectra of Ketoprofen and Sodium alginate

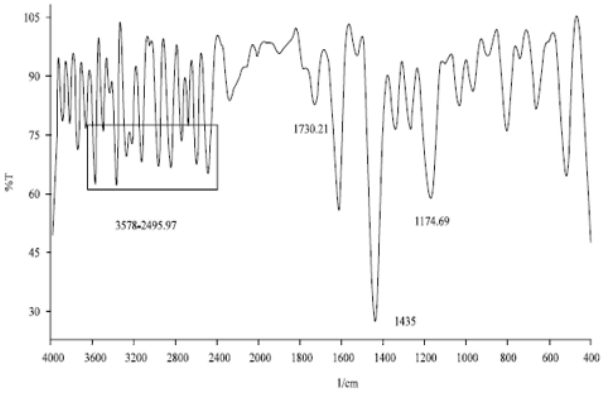

Figure 4: FTIR Spectra of Ketoprofen and Hibiscus

In-vitro Evaluation studies of Ketoprofen Emulgels

Physical Characteristics of Ketoprofen Formulations

The formulated emulgels (F1-F9) were characterized for clarity, color, Consistency and phase separation tests [Table 4].

Table 2: API Characteristics

S No	Characteristics	Results
1.	Description	White or almost white crystalline, odorless, bitter powder
2.	Melting Point	$98^{o}C \pm 0.56^{o}C$
3.	Bulk Density	0.434 ± 0.47 gm/mL
4.	Tapped Density	0.625 ± 0.11gm/mL
5.	Carr's Index	$30.56 \pm 0.29\%$
6.	Hausner's Ratio	1.44 ± 0.21
7.	Angle of Repose	39.63 ± 0.32

Table 3: Wave numbers obtained for drug along with excipients

Functional Group	Literature Value	Pure Drug	Drug & Sodium CMC	Drug & Sodium alginate	Drug & Hibiscus
N-H Stretching	3000-3700	3425.69	3211.29	3576.72	3578.88
C-H Stretching	1700-3300	1790.49	1787.96	1790.69	1730.21
C=N Stretching	1400-1700	1582.35	1584.81	1583.02	1435
O-H Stretching	1100-2400	1536.94	1514.68	1256.32	1147.69

Table 4: Physical Characteristics of Ketoprofen Emulgels

Formulation code	Color	Homogeneity	Consistency	Phase Separation
F1	Creamy white	Homogenous	Smooth	No
F2	Creamy white	Homogenous	Smooth	No
F3	Creamy white	Homogenous	Smooth	No
F4	Creamy white	Homogenous	Smooth	No
F5	Creamy white	Homogenous	Smooth	No
F6	Creamy white	Homogenous	Smooth	No
F7	Off Creamy white	Homogenous	Smooth	No
F8	Off Creamy white	Homogenous	Smooth	No
F9	Off Creamy white	Homogenous	Smooth	No
F10 (Marketed gel)	Creamy white	Homogenous	Smooth	No

Table 5: Evaluation Parameters of Ketoprofen Emulgels

Formulation code	Spreadability (cm/sec)*	Viscosity (cp)	Drug Content (%)	pH
F1	12.144±0.21	3695±2.34	98.41±0.55	6.6±0.26
F2	38.204±0.52	4115±3.21	99.15±0.54	6.7±0.60
F3	29.282±0.18	4130±4.87	98.02±0.65	6.7±0.15
F4	41.902±0.14	4120±3.46	98.83±0.18	6.4±0.42
F5	43.162±0.26	4150±2.57	97.54±0.46	6.5±0.15
F6	43.432±0.50	4560±3.46	99.47±0.48	6.5±0.25
F7	29.540±0.48	4475±6.13	98.74±0.75	6.3±0.12
F8	28.663±0.42	4286±4.32	99.90±0.58	6.2±0.23
F9	24.634±0.15	4395±4.13	98.35±0.67	6.3±0.21
F10 (Marketed gel)	33.32±0.19	4054±2.36	96.24±0.75	6.4±0.24

Table 6: *In-Vitro* Drug permeation Data of Ketoprofen Emulgels using Sodium CMC as Gelling agent (F1 – F3)

Time (hrs)	% Cumulative Drug Release			
	F1	F2	F3	F10 (Marketed gel)
0	0	0	0	0
1	19.22±0.02	37.31±0.01	30.61±0.0001	19.23±0.07
2	34.32±0.04	38.13±0.03	39.34±0.24	32.89±0.29
3	48.26±0.46	41.34±0.25	43.86±0.16	47.98±0.37
4	61±0.0.17	44.29±0.49	50.16±0.19	62.34±0.59
5	81.26±0.24	75.56±0.47	58.78±0.39	70.36±0.74
6	92.34±0.16	82.46±0.55	72.61±0.32	87.56±0.82
7	94.26±0.18	94.61±0.85	85.54±0.68	90.81±1.15
8	96.21±0.20	94.54±1.12	93.34±0.86	93.45±0.56

Table 7: In-Vitro Drug permeation Data of Ketoprofen Emulgels using Sodium alginate as Gelling agent (F4 – F6)

Time (hrs)	% Cumulative Drug Release			
	F4	F5	F6	F10 (Marketed gel)
0	0	0	0	0
1	38.25±0.02	55.15±0.01	32.13±0.01	19.23±0.07
2	35.24±0.04	56.25±0.03	36.34±0.24	32.89±0.29
3	55.48±0.46	72.36±0.25	45.24±0.16	47.98±0.37
4	64.87±0.17	81.98±0.49	57.17±0.19	62.34±0.59
5	83.36±0.64	91.54±0.47	73.15±0.39	70.36±0.74
6	98.15±0.16	94.15±0.55	84.17±0.32	87.56±0.82
7	98.45±0.18	95.23±0.85	97.57±0.68	90.81±1.15
8	98.56±0.20	97.26±1.12	98.58±0.86	93.45±0.56

Table 8: *In-Vitro* Drug permeation Data of Ketoprofen Emulgels using Hibiscus as Gelling agent (F7 – F9)

Time (hrs)	% Cumulative Drug Release			
	F7	F8	F9	F10 (Marketed gel)
0	0	0	0	0
1	51.48±0.005	43.82±0.07	33.53±0.01	19.23±0.07
2	56.36±0.21	44.86±0.54	42.84±0.47	32.89±0.29
3	60.86±0.34	55.66±0.51	47.32±0.15	47.98±0.37
4	65.62±0.46	62.06±0.47	48.68±0.25	62.34±0.59
5	79.39±0.47	73.66±0.54	55.36±0.17	70.36±0.74
6	95.15±0.85	89.55±0.24	87.01±0.75	87.56±0.82
7	95.54±1.14	93.92±0.01	95.58±0.48	90.81±1.15
8	96.52±1.21	95.97±0.48	97.24±0.14	93.45±0.56

Table 9: *In-Vitro* Drug permeation kinetics Data of Ketoprofen Emulgels

Formulation Code	Zero order		First order		Order of release	Higuchi	Peppas	Mechanism of Diffusion
	r^2	ko	r^2	K1		r^2	n	
F1	0.963	12.86	0.952	0.403	Zero order	0.943	0.748	Non fickian diffusion
F2	0.920	11.18	0.901	0.345	Zero order	0.906	0.984	Case-II transport
F3	0.957	10.3	0.872	0.283	Zero order	0.951	0.728	Non fickian diffusion
F4	0.897	11.36	0.839	0.575	Zero order	0.967	0.654	Non fickian diffusion
F5	0.934	11.04	0.875	0.471	Zero order	0.977	0.862	Case-II transport
F6	0.967	11.88	0.847	0.492	Zero order	0.955	0.668	Non fickian diffusion
F7	0.933	10.17	0.908	0.365	Zero order	0.965	0.567	Non fickian diffusion
F8	0.906	10.18	0.86	0.423	Zero order	0.967	0.684	Non fickian diffusion
F9	0.951	11.43	0.89	0.462	Zero order	0.962	0.756	Non fickian diffusion
F10 (Marketed Gel)	0.944	11.99	0.922	0.345	Zero order	0.957	0.796	Non fickian diffusion

Table 10: f_1 and f_2 values for Ketoprofen Emulgel formulations

Formulation code	f1	f2
F1	3.71	60.53
F2	3.94	56.56
F3	4.76	57.32
F4	3.42	60.21
F5	4.01	57.54
F6	2.05	70.58
F7	3.56	58.52
F8	4.07	51.56
F9	3.57	59.23

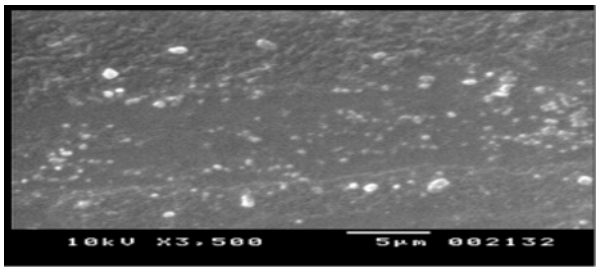

Figure 5: SEM of Best formulation (F6)

pH

All the formulations were evaluated for the pH and all the values were found [Table 5] well within the range of 6-7.

Spreadability studies

The formulated ketoprofen emulgels (F1-F9) were evaluated for determining spreadability by using spreadability apparatus and the results [Table 5].

Rheological parameters

The formulated ketoprofen emulgels (F1-F9) were evaluated for determining viscosity by using falling sphere viscometer apparatus [Table 5]. Amongst the formulations, formulations with Sodium alginate

showed increased viscosity that indicates Sodium alginate as the better gelling agent in low concentration compared to other batches.

Drug content

The formulated ketoprofen emulgels (F1-F9) were evaluated for determining Drug content was found to be in the range 96.24%-99.90% [Table 5].

***In-vitro* Drug Permeation Study**

The *in vitro* drug release studies were carried out for all the formulations and Figures represents the drug release from sodium CMC, Sodium alginate and Hibiscus. The study was carried out in order to examine the effect of gelling agent reaction (concentration & ratio) on the emulgels i.e. sodium CMC, Sodium alginate and Hibiscus were selected and formulations were prepared and their individual drug release parameters were evaluated. Based on the drug release comparison studies with the marketed gel, it was observed that maximum drug release from the emulgels from all formulations were higher when compared with that of the marketed gel. To give similar type of drug release in case of other gelling agents based emulgel preparations, they required high concentration of polymer than Sodium alginate [Tables 6, 7 and 8]. Thus the F6 formulation having Sodium alginate was considered as the better formulation when compared to others [Figures 6, 7 and 8].

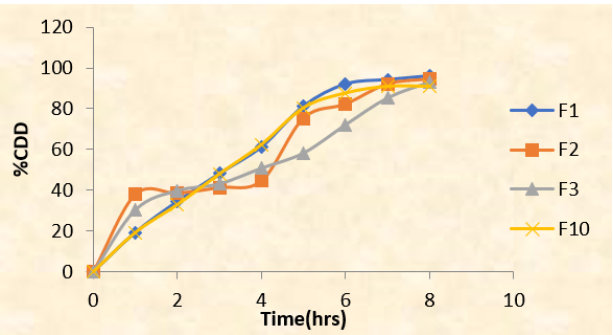

Figure 6: *In-Vitro* Drug permeation Data of Ketoprofen Emulgels using Sodium CMC as Gelling agent (F1 – F3)

Drug release mechanism and kinetics

It was determined by zero order and first order kinetics, Higuchi's model, and Peppas models. All the formulations followed zero order kinetics. Most of the emulgel formulations showed high r^2 values for Higuchi's model as their r^2 values were above 0.9. The high regression value of Higuchi model ensured that the release of drug from emulgels followed diffusion mechanism. From peppas studies, it was observed that all the formulations except F2 and F5 followed Non-fickian diffusion while they followed case - II transport mechanism [Table 9].

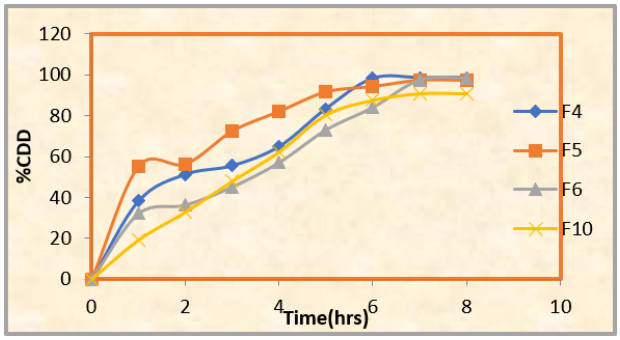

Figure 7: *In-Vitro* Drug permeation Data of Ketoprofen Emulgels using Sodium alginate as Gelling agent (F4 – F6)

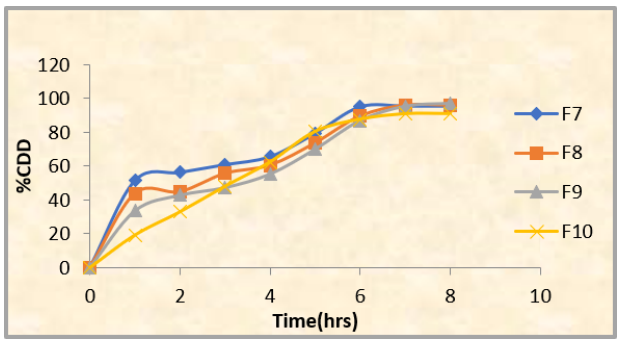

Figure 8: *In-Vitro* Drug permeation Data of Ketoprofen Emulgels using Hibiscus as Gelling agent (F7 – F9)

Calculation of similarity (f_2) and dissimilarity factors (f_1) for best formulations

Hence it was sure that the diffusion profile of F6 was similar to that of the marketed diffusion profile [Table 10].

CONCLUSION

From the current study of Ketoprofen Emulgels proved it as better topical administration and the release was comparable with that the marketed gel. It was observed that the release of the drugs from its emulsified Sodium alginate gel formulation can be ranked in the given descending order: F6 > F5 > F6 where, the F6 formulation showed highest drug release after 8h. It was confirmed from the results that Sodium alginate containing Ketoprofen emulgels followed zero order release and the optimized formulation F6 followed zero order kinetics with Non-fickian mechanism of diffusion. The calculated f_1 and f_2 values were within the limits. f_2 values of F6 formulation was higher when compared to the others.

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Conflict of interest

The authors attest that they have no conflict of interest in this study.

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REFERENCES

[1] K P Mohammed Haneefa1, Sherry Easo, P V Hafsa, Guru, Prasad Mohanta, and Chandini Nayar. Emulgel: An Advanced Review. *Journal of Pharmaceutical Sciences & Research*, 5(12):254–258, 2013.

[2] R Bhavesh and S Chainesh. Nanoemulgel: A Comprehensive Review On The Recent Advances In Topical Drug Delivery. *International Journal of Pharmaceutical Sciences*, 7(2):346–55, 2016.

[3] Rachit Khullar, Deepinder Kumar, Nimrata Seth, and Seema Saini. Formulation and evaluation of mefenamic acid emulgel for topical delivery. *Saudi Pharmaceutical Journal*, 20(1):63–67, 2012.

[4] M Wang and L Fang. Percutaneous absorption of diclofenac acid and its salts from emulgel. *Asian Journal of Pharmaceutical Sciences*, 3(3):131–141, 2018.

[5] Ramakanth Ambala and Sateesh Vemula. Formulation and Characterization of Ketoprofen Emulgels. *Journal of Applied Pharmaceutical Science*, 5(07):112–117, 2015.

[6] Yerikala Ramesh, B Abhirami, Sri K Gnana, S Kaveri, S K Neha Sulthana, A. S. L. S. M. Sravya, and K Sujatha. Formulation and evaluation of oxymetazoline hydrochloride nasal gels. *Journal of Drug Delivery and Therapeutics*, 8(6):49–57, 2018.

[7] Jaya Raja Kumar, Selvadurai Muralidharan, and Sanggetha Ramasamy. Microsponges Enriched Gel (MEGs): A Novel Strategy for Opthalmic Drug Delivery System Containing Ketotifen. *Journal of Pharmaceutical Sciences and Research*, 5(4):97–102, 2013.

[8] Amrita Madhumadan and Netalamrutiya Bajaj. Formulation and in-vitro evaluation of topical emulgel containing combination of a local anaesthetic and anti-inflammatory drug. *International Journal of Pharmaceutical Education and Research*, 43(3):351–359, 2009.

[9] A Nagia, El-Megrab, Hasan, Gehan El-Nahas, and F Balata. Formulation and evaluation of Meloxicam gels for topical application. *Saudi Pharmaceutical Journal*, 3(14):3–4, 2006.

[10] M H Khaled, S M Rambo, M M Al-Zahrani, Al-Subhi Sm, and U A Fahmy. Ketoprofen emulgel: Preparation, characterization, and pharmacodynamic evaluation. *International Journal of Pharmaceutical Sciences Review and Research*, 20:306–316, 2013.

[11] V S Rao, V P Sri, and K Padmalatha. Formulation and evaluation of Oxiconazole emulgel for topical drug delivery. *International Journal of Current Research*, 9(10):58876–58878, 2017.

[12] Rahul Nair, M Sevukarajan, Badivaddin Mohammed, and Jayraj Kumar. Formulation of microemulsion based vaginal gel in-vitro and in-vivo evaluation. *Der Pharmacia letter*, 2(6):99–105, 2010.

[13] K M Hosny, S M Rambo, M M Al-Zahrani, S M Al-Subhi, and U A Fahmy. Ketoprofen emulgel: preparation, characterization, and pharmacodynamic evaluation. *International Journal of Pharmaceutical Sciences Review and Research*, 20(2):306–310, 2013.

[14] G E Yassin. Formulation and evaluation of optimized clotrimazole emulgel formulations. *British Journal of Pharmaceutical Research*, 4(9):1014, 2014.

[15] Weiwei Zhu, Aihua Chenyuguo, Yan Yu, and Gao. Fengliang Cao, GuangxiiZhai. Microemulsion based hydrogel formulation of Penciclovir for topical delivery. *International Journal of Pharmaceutics*, 378(1-2):152–158, 2009.

[16] P Kusuma and C Sushmitha. Design, Formulation And Optimization Of Rutin Trihydrate Emulgel By Response Surface Methodology. *International Journal of Pharmaceutical Sciences and Research*, 11(11):5799–5804, 2021.

[17] Bhautik Kapadiya, Dipti Gohil, Dinal Patel, Snehal Patel, Chintan Aundhia, Nirmal Shah, Kartik Pandya, and Chainesh Shah. Formulation and Evaluation of Spironolactone Loaded Emulgel for Topical Application. *Journal of Pharmaceutical Science and Bioscientific Research*,

6(5):740–752, 2016.

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