Formulation and Evaluation of Celecoxib Emulgel

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Abstract

The purpose of present study was to formulate and evaluate emulgel system of celecoxib using two gelling agents: Carbapol 934 and Carbapol 940. Two different emulsions were prepared by varying the concentration of oil, surfactant and co-surfactant. Solubility studies of celecoxib in various oils and surfactants was performed among which Liquid paraffin, Span 20 and Tween 80 have shown higher solubility were selected as oil, surfactant and co-surfactant. Compatibility studies showed that there were no physical or chemical interaction between drug and excipients. All prepared formulations were evaluated. In terms of physical properties (like colour, homogeneity, consistency) all the prepared formulations were white in colour, smooth consistency and homogenous. pH of all the formulations were in the range 5.8-6.40. Swelling ability of F4 formulation was more compared to other formulations when performed for 30min. Rheological study (viscosity) of prepared emulgels were determined using Brookfield viscometer, F4 formulation exhibited greater viscosity. Drug content determination studies were performed for all prepared formulations among which F4 exhibited greater drug content. Ex-vivo diffusion study was carried out using Franz diffusion cell and chicken skin as the semi permeable membrane. Among all the prepared formulations optimized formulation was found to be F4 with 90% diffusion rate and follows first order release kinetics (with r^2=0.9691).

Keywords

Celecoxib, Emulgel, Brookfield viscometer, Franz diffusion cell.

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INTRODUCTION:

Emulgel

When gels and emulsions are used in combined form that type of dosage forms are referred as emulgels. In earlier years, there has been huge attention in the use of novel polymers with complex functions as thickeners & emulsifiers because the gelling capacity of these compounds allows the formulation of study emulsions and creams by reducing surface and interfacial tension and at the same time increasing the viscosity of the aqueous phase. In fact, the presence of a gelling agent in the water phase converts a classical emulsion into an emulgel. Both O/W, W/O emulsions are used as vehicles for the delivery of drugs to skin. Emulsions possess a particular degree of elegance and are easily washed off whenever desired. They also contain a more ability to penetrate the skin. [1]

Rationale of Emulgel as a TDDS

Verities of medicated products are applied to the skin or mucous membrane that either enhance or restore a fundamental function of skin or pharmacologically alter an action in the underlined tissues. Such products are known as topical / dermatological. Widely used topical agents like ointments, creams, lotions these are have many disadvantages. They have very sticky nature causing difficult to the patient when applied on the skin. Moreover, they also have lesser distribution coefficient and need to apply with rubbing. And they have the major problem of stability also. Due to all these reasons within the major group of semisolid preparations, the use of transparent gels has extended both in the preparation of cosmetics and in pharmaceuticals. Gel, a colloid typically with 99% wt liquid immobilized by surface tension between it and a macromolecular network of fibers built from a small amount of a gelatin substance. Hydrophobic drugs delivery is a major advantage of gels. So to overcome this limitation an emulsion based advance is being used so that even a hydrophobic therapeutic moiety can be effectively incorporated and delivered through gels. [2]

Advantages of Emulgel as a drug delivery System

1. Hydrophobic drugs can be simply included into gels using emulsions of d/o/w
2. Better stability
3. Better loading capacity
4. Production feasibility and low preparation cost
5. No intensive sonication
6. Controlled release [3]

Important Constituents of Emulgel Preparation

1. Aqueous Material

This forms the aqueous phase of the emulsion. Usually used agents are alcohols, purified water.

2. Oils

This agent forms the oily phase of the emulsion. For on the surface applying mineral oils, emulsions either alone/combined with soft or hard paraffin's, are broadly used both as the vehicle for the drug and for their occlusive and sensory characteristics.

3. Emulsifiers

These are used to enhance emulsification at the time of manufacture and to control stability of emulsion during a shelf life that can vary from days for extemporaneously prepared emulsions to months or years for commercial preparations. eg Polyethylene glycol 40 stearates, Sorbitan mono-oleate (Span 80), Polyoxyethylene sorbitan mono-oleate (Tween 80), Stearic acid and Sodium stearate.

4. Gelling Agent

These are the agents used to increase the consistency of any dosage form and can also be used as thickening agent. Some of the examples are HPMC, HPMC K-100, carbopol 940, carbopol 934, sodium carboxy methyl cellulose, Xanthun gum etc. [4]

METHODOLOGY:

UV Spectrophotometric analysis of Celecoxib in methanol:

Stock solution of celecoxib was prepared using methanol. Absorbance of Celecoxib was scanned by UV-Visible spectrophotometer from wavelength of 400-200nm. From the standard stock solution, all the required concentrations were prepared using methanol. The spectrum shows maximum absorbance at 252nm, was selected as the wavelength (λ_{max}) and utilized for analysis, in the present investigation. Standard plot was drawn using the data obtained.

UV Spectrophotometric analysis of Celecoxib in 6.8pH Phosphate Buffer:

Stock solution of celecoxib was prepared using 6.8pH Phosphate Buffer (after dissolving undissolved drug in methanol). Absorbance of Celecoxib was scanned by UV-Visible spectrophotometer from wavelength of 400-200nm. From the standard stock solution, all the required concentrations were prepared using 6.8pH Phosphate Buffer. The spectrum shows maximum absorbance at 252nm, was selected as the wavelength (λ_{max}) utilized for further analysis. Standard plot drawn by using the data obtained.

Solubility studies:

The solubility of Celecoxib was estimated in various oils, surfactants and co-surfactants. Excess amount of drug was added to 1gram of each excipient in cap vials and were cyclo-mixed immediately using cyclo-mixer to increase drug solubilisation and then placed for heating at 40-50°C for five minutes. The resultant mixture was then left for equilibration at room temperature on a rotary shaker at a speed of 100rpm for 72hours. The supersaturated solutions were then centrifuged at a speed of 3000rpm for 15minutes to remove the undissolved drug. The supernatant was separated and adequately diluted with methanol and concentration of Celecoxib in each excipient was determined spectrophotometrically at 252nm.

Preformulation studies:

Pre-formulation testing is the first step in rational development of dosage forms of a drug substance. Pre-formulation studies are the process of optimizing the delivery of the drug through determination of physicochemical properties of new compound that could affect the drug performance and development of an efficacious, stable and safe dosage form. It gives the information needed to define the nature of the drug substance and provide a framework for the

drug combination with pharmaceutical excipients in the dosage form.

Drug and polymer interaction studies:

FTIR studies:

FTIR spectroscopy was carried out to check the compatibility of between drug and polymer. The IR spectra of Celecoxib along with excipients and physical mixture of drug and polymer (final formulation) was carried out by KBr disc method using FTIR (Alpha Bruker) with data acquisition

system OPUS. The wave numbers of characteristic peaks of drug and polymers in mixture were compared. [5]

Formulation design for Celecoxib emulgel preparation:

The formulation code was designed according to a 2^3 factorial design so total eight Celecoxib emulgel formulations were prepared. The optimization in the formulation batches were made mainly based on gelling agent and emulsifying agents.

Table 1: Composition of celecoxib emulgel

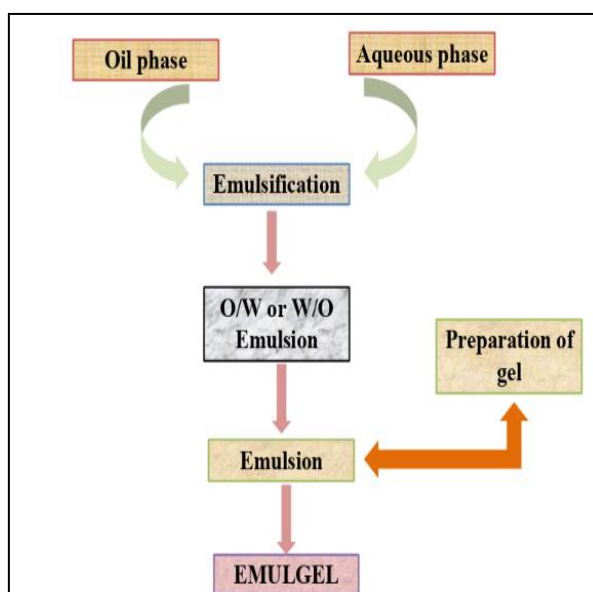| Ingredients (% w/v)	F1	F2	F3	F4	F5	F6	F7	F8
Celecoxib (mg)	100	100	100	100	100	100	100	100
Carbopol 934 (mg)	75	75	100	100	-	-	-	-
Carbapol 974 (mg)	-	-	-	-	75	75	100	100
liquid paraffin(ml)	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Propylene glycol (ml)	5	5	5	5	5	5	5	5
Tween 80	0.5	1	0.5	1	0.5	1	0.5	1
Span 20	1	1.5	1	1.5	1	1.5	1	1.5
Methyl paraben (mg)	40	40	40	40	40	40	40	40
Ethanol (ml)	4	4	4	4	4	4	4	4
Purified water (ml)	Q.S	Q.S	Q.S	Q.S	Q.S	Q.S	Q.S	Q.S

Figure 1: Emulgel preparation flow chart

Gel preparation:

Gel bases prepared by dispersing various concentrations of gelling agents in distilled water by constant stirring at moderate speed using mechanical shaker.

Emulsion preparation:

Oil phase: Span 20 dissolved in liquid paraffin.

Aqueous phase: Tween80 dissolved in water.

Methyl paraben dissolved in propylene glycol whereas drug dissolved in methanol and both solutions added to aqueous phase.

Oil and Aqueous phase heated separately to 70℃. Then oily phase added to aqueous phase with continuous stirring until cooled to room temperature.

Emulgel preparation:

Emulsion is mixed with gel in 1:1 ratio with gentle stirring. [6]

Evaluation parameters for celecoxib emulsion:

1. **Organoleptic characteristics:** Freshly prepared emulsions were investigated Organoleptically for colour, and phase separation.
2. **Globule size determination:**

Determined using optical microscope, fluorescent microscope.

3. **Dilution test:**
Based on solubility of external phase of emulsion O/W emulsion can be diluted with water whereas W/O emulsion diluted with oil.

4. **Dye test:** Emulsion mixed with water soluble dye (amaranth red) and observed under microscope if continuous phase appears red then emulsion O/W type or if scattered globules appear red and continuous phase is colourless then W/O type.

5. **Thermodynamic stability studies:**
Centrifugation test:
Emulsion subjected for centrifugation at 3500rpm for 30min.
Freeze-thaw test:
Emulsion subjected to Freeze-thaw cycles for 48hrs.

6. **Robustness to dilution:**
Emulsions were subjected to dilution with water and 7.4 pH phosphate buffer using magnetic stirrer.

Evaluation parameters for celecoxib emulgel:

1. **Physical appearance:**
Prepared emulgel formulations were examined visually for color, phase separation, consistency and homogeneity. [7]

2. **pH evaluation:**
pH evaluation is important criteria especially for topical formulations. The pH of emulgel should be in between 5-7 to mimic the skin conditions. If the pH of prepared emulgel is acidic or basic, it may cause irritation to the patient. pH of prepared emulgel was measured using digital pH meter by dipping the glass electrode into the emulgel. The measured pH of each formulation was done in triplicate and average values were recorded. [8]

3. **Rheological studies (Viscosity):**
The viscosity of gel during handling, transport and storage is an important criterion. The viscosity of different emulgel formulations was determined at 25^0C using Brook field viscometer. The emulgels were rotated at10 rpm and viscosities were measured.

4. **Swelling index:**
1g of prepared emulgel formulations was taken on porous aluminium foil and then placed in the Petri dish containing 10 ml 0.1N Hcl. The samples were taken from the Petri dish at a different time interval and left undisturbed in a dry place for some time so that the external liquid is removed and weighed. Swelling index is then calculated by using below formula,

Swelling Index (SW) % = [(Wt – Wo) / Wo] × 100
Where (SW) % = Equilibrium percent swelling,
Wt = Weight of swollen emulgel after time t,
Wo = Original weight of emulgel at zero time

5. **Drug content determination:**
Drug concentration in emulgel was measured by UV-Visible spectrophotometer. Celecoxib content in emulgel was measured by dissolving accurately weighed (1g) of emulgel in 6.8 pH phosphate buffer by sonication and diluted to 10 folds prior to absorbance. Absorbance was measured at 252nm using UV-Visible spectrophotometer (Shimadzu, Japan). Concentration and drug content were determined using same plot by putting value of absorbance in standard equation. The test was conducted in triplicate and the average % drug content was determined.

Drug content = (Concentration × Dilution factor × Volume taken) × Conversion factor.

6. **Ex-vivo diffusion study**:
Ex-vivo diffusion study was carried out using Franz Diffusion cell having capacity of 26ml volume. Chicken skin was isolated and used for the study. Pre weighed (1.5g) emulgel was spread evenly on to the skin membrane. The skin membrane was clamped between donor and receptor compartment. The receptor compartment was filled with 26ml of 6.8pH phosphate buffer maintained at 37ºC and stirred by using magnetic stirrer. The sample (2ml) was collected at suitable time intervals and analysed for drug content by UV-Visible Spectrophotometer (Shimadzu, Japan) at 252nm after appropriate dilutions. [7]

EX-VIVO DRUG RELEASE KINETICS [9]

- Zero Order Release
- First Order Release
- Higuchi Model
- Hixson-Crowell
- Korsmeyer-Peppas Model

Table 2: Diffusion exponent and release mechanism

Diffusion exponent (n)	Diffusion mechanism
0.5	Fickian diffusion (Higuchi matrix)
0.5 < n < 1	Anamolous (non fickian diffusion)
1	Case-II transport (zero order release)
N > 1	Super case-II transport

RESULTS AND DISCUSSION:

Physical appearance: Physical appearance of the drug was examined by organoleptic properties and results were obtained as follows:

Colour: White or almost white

Odour: Odourless

Taste: Bitter

State: Fine powder

Determination of λ_{max} and construction of calibration curve in methanol:

The standard stock solution of Celecoxib was prepared in methanol and scanned by UV-Visible spectrophotometer between 400-200nm. The UV absorption spectrum of Celecoxib showed λ_{max} at 252nm and same was used as analytical wavelength for further analysis. Calibration curve in methanol plotted using values in the table 3. This method was well validated and reproducible with R^2 value 0.99613 for methanol which was shown in the figure 2.

Table 3: Calibration Curve of Celecoxib in Methanol

S.No.	Concentration	Absorbance
1.	2	0.167
2.	4	0.293
3.	6	0.393
4.	8	0.485
5.	10	0.618

$y = 0.05467 x + 0.06319$
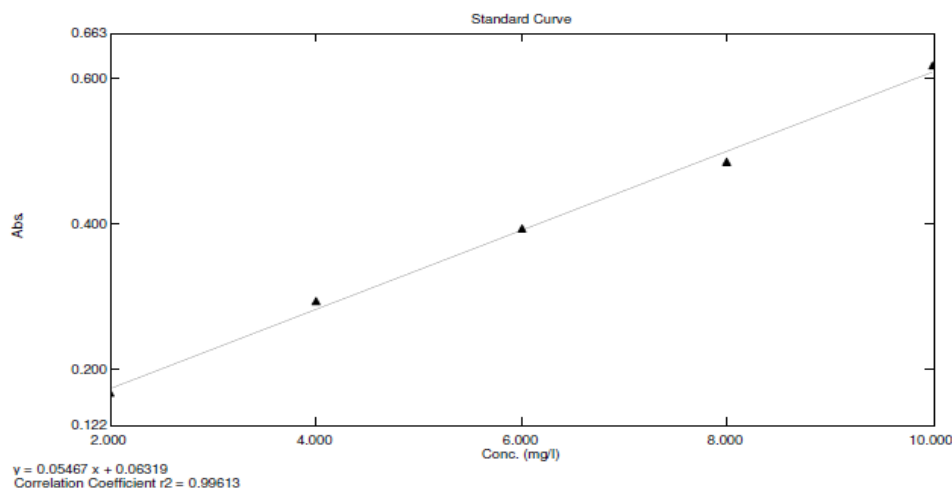Correlation Coefficient r2 = 0.99613

Figure 2: Standard graph of Celecoxib in methanol.

Determination of λ_{max} and construction of calibration curve in 6.8pH phosphate buffer:

The standard stock solution of Celecoxib was prepared in 6.8pH phosphate buffer and scanned by UV-Visible spectrophotometer between 400-200nm. The UV absorption spectrum of Celecoxib showed λ_{max} at 252nm and same was used as analytical wavelength for further analysis. Calibration curve in 6.8pH phosphate buffer plotted using values in the table 4. This method was well validated and reproducible with R^2 value 0.97084 for methanol which was shown in the figure 3.

Table 4: Calibration Curve of Celecoxib in 6.8pH phosphate buffer

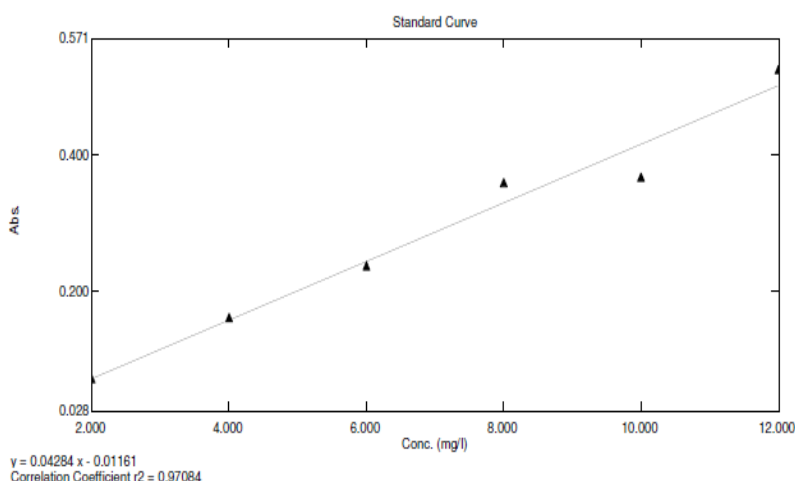| S.No.	Concentration (mg/ml)	Absorbance (nm)
1.	2	0.073
2.	4	0.164
3.	6	0.239
4.	8	0.360
5.	10	0.368
6.	12	0.526

Figure 3: Standard graph of Celecoxib in 6.8 pH Phosphate buffer.

Solubility of celecoxib in various solvents:

The solubility of Celecoxib was determined in various oils, surfactants and co-surfactants. Solubility of celecoxib in various oils follows the order Liquid paraffin > Campul PG-8 > Triacetin > Soybean oil > Clove oil > Cotton seed oil > Isopropyl myristate > Captex 355 > Olive oil > Arachis oil. Solubility of celecoxib in various surfactants and co-surfactants follows the order Tween -80 > Tween -40 > Tween -20 > Tween -60 > Tween -85 > Span 20 > Span 80 > Propylene glycol > Ethylene glycol > PEG-400.

Table 5: Celecoxib solubility in various oils

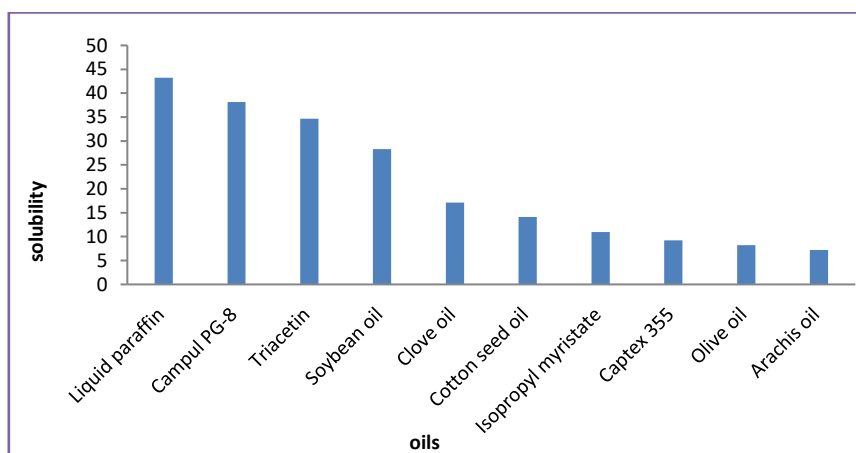| Oils	Solubility(mg/g)
Liquid paraffin	43.21
Campul PG-8	38.18
Triacetin	34.67
Soybean oil	28.34
Clove oil	17.14
Cotton seed oil	14.09
Isopropyl myristate	10.98
Captex 355	9.22
Olive oil	8.24
Arachis oil	7.23

Figure 4: Solubility of celecoxib in various oils

Table 6: Celecoxib solubility in various surfactants and co-surfactants

Surfactants and Cosurfactants	Solubility(mg/g)
Tween -85	35.41
Tween -80	39.24
Tween -60	36.08
Tween -40	38.68
Tween -20	37.11
Span-20	12.35
Span-80	10.85
Ethylene glycol	05.09
Propylene glycol	07.89
PEG 400	6.90
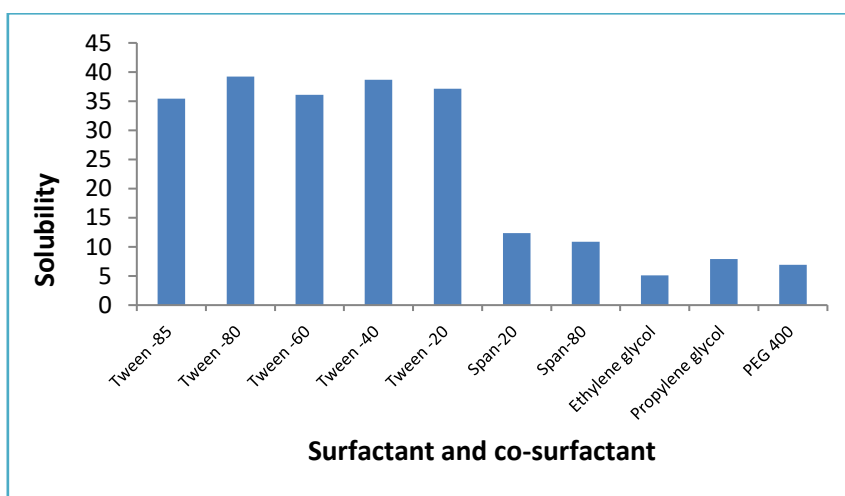
Figure 5: Celecoxib solubility in various surfactants and co-surfactants

Pre-formulation studies:

FTIR spectroscopy: The IR spectrum of Celecoxib recorded by FTIR spectrophotometer and was shown in figure 6 this was compared with standard functional group of Celecoxib as shown in figure 7, it showed that functional group peak frequencies of Celecoxib were in resemblance to the reported range of standard Celecoxib which authenticated that the obtained sample of Celecoxib of pure drug.
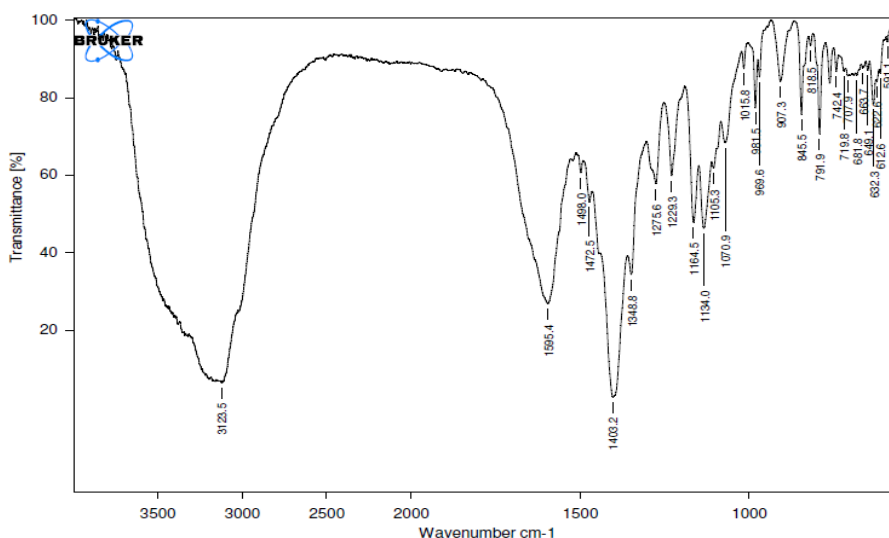
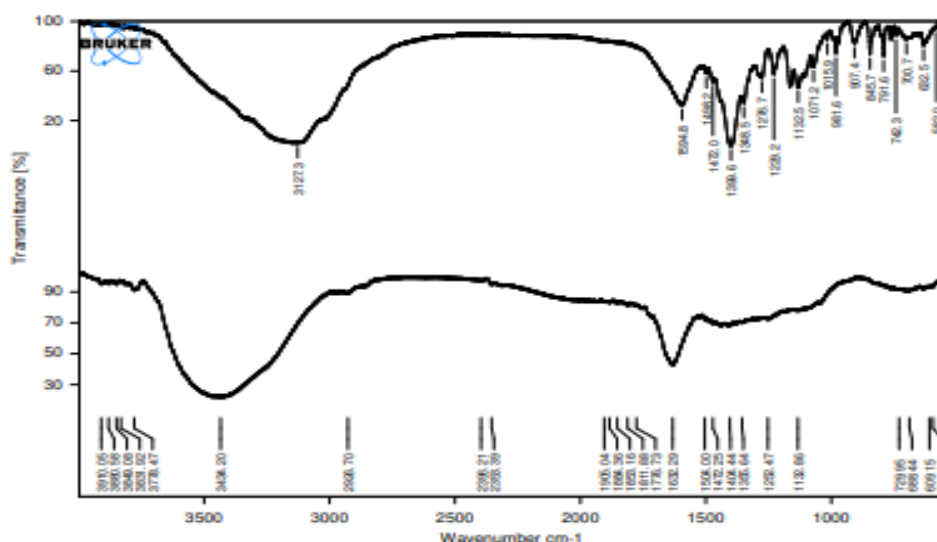**Figure 6: FTIR of Celecoxib pure drug**

Figure 7: FTIR of Celecoxib optimized formulation

EVALUATION PARAMETERS FOR CELECOXIB EMULSION

1. **Organoleptic characteristics and Globule size:** Freshly prepared emulsions were investigated. Organoleptically for homogeneity, colour, and phase separation. All the emulsions were found to be homogenous, creamy white; no phase separation was observed. Globule size for E_1 emulsion was up to 50 μ and E_2 emulsion was up to 80 μ.

Table 7: Physical appearance data

Emulsion	Homogenity	Color	Phase separation	Globule size
E1	Homogenous	White	None	Upto 50μ
E2	Homogenous	White	None	Upto 80μ

2. **Thermodynamic stability studies:** Emulsions when subjected for centrifugation and followed by freeze thaw were found to be stable

Table 8: Thermodynamic stability studies

Emulsion	Centrifugation test (3500rpm for 30min)	Freeze-thaw test (2cycles NLT 48hrs)
E1	Passed	Passed
E2	Passed	Passed

3. **Robustness to dilution:** Emulsions when subjected to dilution with water and 6.8pH phosphate buffer were found to be stable.

Table 9: Robustness to dilution

Emulsion	Distilled water		6.8 pH phosphate buffer	
	10ml	100ml	10ml	100ml
E1	Stable	Stable	Stable	Stable
E2	Stable	Stable	Stable	Stable

EVALUATION PARAMETERS FOR CELECOXIB EMULGEL

1. **Physical parameters:** All the formulations were evaluated for colour, homogeneity, phase separation and consistency. The formulations were found to be white in colour, homogenous, with no phase separation and smooth consistency.

Table 10: Physical parameters

Formulation Code	Color	Phase Separation	Homogenity	Consistency
F1	White	No	Homogenous	Smooth
F2	White	No	Homogenous	Smooth
F3	White	No	Homogenous	Smooth
F4	White	No	Homogenous	Smooth
F5	White	No	Homogenous	Smooth
F6	White	No	Homogenous	Smooth
F7	White	No	Homogenous	Smooth
F8	White	No	Homogenous	Smooth

2. **pH determination:** pH evaluation of the topical formulation is more important as it may cause irritation to the skin if varied from normal skin pH conditions. Furthermore, the polymer like carbopol gives consistency if the pH is in between 5.33-6.38. pH of all formulations was within the range of 5.86-6.40.

Table 11: pH determination data

S.No	Formulation code	pH
1	F1	6.06±0.12
2	F2	5.95±0.10
3	F3	6.26±0.11
4	F4	6.40±0.10
5	F5	6.17±0.12
6	F6	5.86±0.10
7	F7	6.02±0.11
8	F8	6.22±0.10

All values are expressed as Mean ±SD (n=3)

3. **Rheological studies (10rpm):** The viscosities of all the formulations were measured using Brookfield viscometer at 10rpm and values were represented in table 15 and fig 15. It was found that all the formulations were followed shear thinning effect with thixotropic property. It was observed that the viscosity of the formulation increases with increase in emulsion-gel ratio. Among all formulations F4 formulation exhibited highest viscosity.

Table 12: Rheological study data

| Formulation code	Viscosity (cp)
F1	3600±0.1
F2	3300±0.68
F3	3700±0.16
F4	3950±0.l1
F5	3800±0.18
F6	3100±0.24
F7	3400±0.51
F8	3200±0.16

All values are expressed as Mean ±SD (n=3)

4. **Swelling index:** Swelling index for all the formulations were determined at various time intervals i.e., 10, 20 and 30minutes. Swelling index for all the formulations were in between 90-114. Among all formulations F4 formulation exhibited highest swelling index value.

Table 13: Swelling index data

Formulation code	At 10min	At 20min	At 30min
F1	50±0.1	80±0.1	91±0.31
F2	48±0.1	78±0.1	97±0.12
F3	46±0.1	87±0.1	101±0.6
F4	57±0.1	91±0.1	114±0.24
F5	51±0.1	85±0.1	90±0.54
F6	48±0.1	81±0.1	94±0.17
F7	49±0.1	86±0.1	96±0.54
F8	53±0.1	88±0.1	105±0.45

All values are expressed as Mean ±SD (n=3)
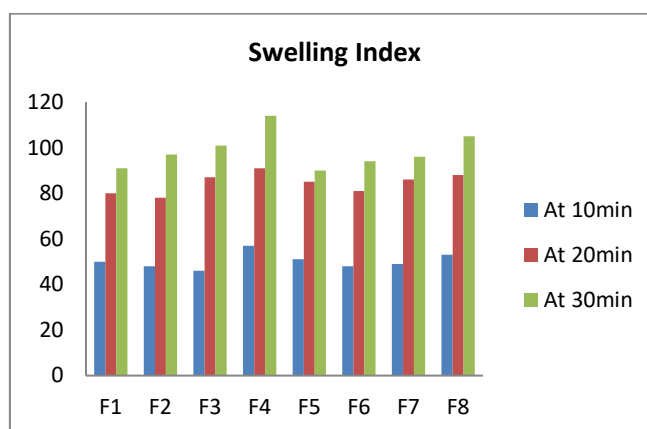
Figure 8: Graph for Swelling index data

5. **Drug content determination:** Drug content of all the formulations were carried out as per procedure stated in the methodology section. Drug content of all the formulations was found to be in the range 89.49%±3.2 - 93.02%±2.1 as indicates in the table 17

Table 14: Drug content data for F1 to F8

S.No	Formulation code	Drug content
1	F1	91.42±3.6
2	F2	90.24±2.1
3	F3	92.11±3.4
4	F4	93.02±1.8
5	F5	91.39±2.0
6	F6	92.18±1.6
7	F7	90.75 ±2.1
8	F8	89.49±3.2

All values are expressed as Mean ±SD (n=3)

6. **Ex-vivo Diffusion Studies:** The in-vitro permeation studies of all the formulations were carried out using Keishary chein as described in the methodology section using chicken skin membrane as a permeation membrane for the study. The comparative cumulative percentage drug permeation data of all the formulations F1 to F8 were shown in the table 18 and plots in the fig. 18 respectively.

The optimized formulation F4 containing maximum concentration of span 20 and tween 80 showed highest % drug permeation at the end of 240minutes and hence this formulation was selected as optimized formulation for further study. It was revealed that span 20 and tween 80 concentrations were having positive effect on the drug permeation through the membrane.

7. **Drug release kinetic study:**

The drug release kinetics was studied with in-vitro drug permeation data for all the formulations F1 to F8 and results were stated in the table 15, the best fit model for selected formulation F4 were found to be Zero order and

Higuchi with non-fickian diffusion with highest r^2 0.984 respectively.

Table 15: % Cumulative drug release data for F1 to F8

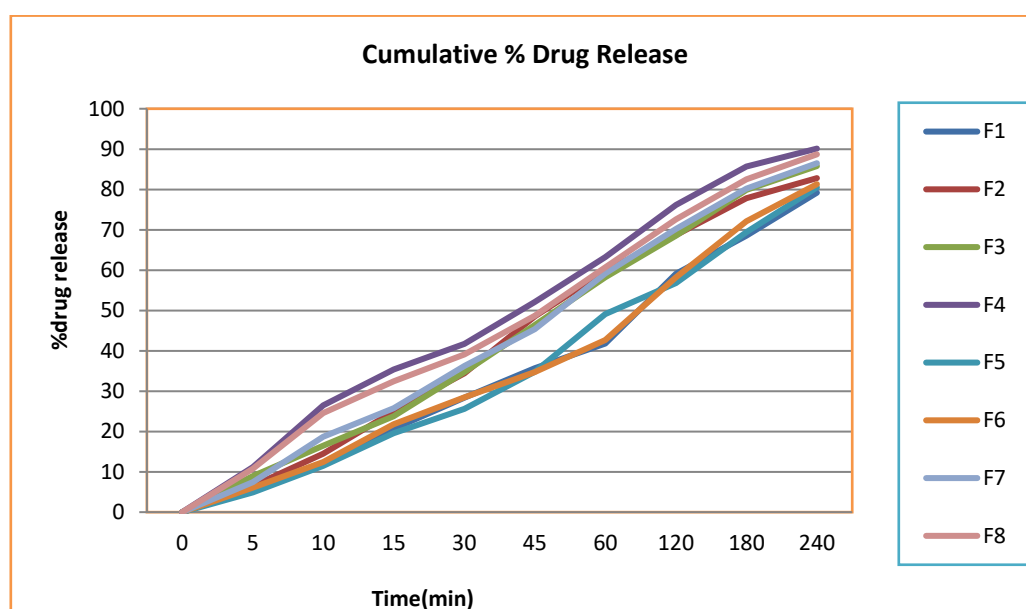| Time(min)	Cumulative % drug release							
	F1	F2	F3	F4	F5	F6	F7	F8
0	0	0	0	0	0	0	0	0
5	5.8±0.1	6.5±0.12	8.9±0.1	11.2±0.1	4.9±0.1	6.1±0.1	7.4±0.1	10.8±0.1
10	12.2±0.1	14.5±0.1	16.5±0.1	26.5±0.1	11.5±0.1	12.4±0.1	18.7±0.1	24.6±0.1
15	20.7±0.1	25±0.16	23.75±0.1	35.4±0.1	19.6±0.1	21.8±0.14	25.8±0.1	32.4±0.1
30	28.4±0.1	34.4±0.1	34.7±0.12	41.7±0.1	25.6±0.1	28.5±0.1	36.2±0.1	39.1±0.1
45	35.7±0.1	48.5±0.1	46.4±0.1	52.14±0.1	34.8±0.1	34.7±0.1	45.4±0.1	48.7±0.1
60	41.8±0.14	59.8±0.1	58.2±0.1	63.25±0.13	49.1±0.1	42.7±0.1	59.2±0.13	60.7±0.1
120	59.1±0.1	68.7±0.1	68.5±0.1	76.12±0.1	56.8±0.1	58.2±0.1	70.2±0.1	72.6±0.1
180	68.5±0.1	77.8±0.1	79.9±0.13	85.7±0.1	69.4±0.1	72.1±0.1	80.2±0.1	82.5±0.1
240	79.2±0.14	82.8±0.1	85.8±0.1	90.12±0.1	80.5±0.1	81.3±0.1	86.5±0.1	88.7±0.13

All values are expressed as Mean ±SD (n=3)

Figure 8: *In vitro* drug permeation graph

Drug release kinetics:

Table 16: *Ex-vivo* permeation profile of celecoxib from Formulation 4

| Time(min)	√t	Log t	% cummulative drug release	% cummulative drug remain	Log % cummulative drug release	Log % cummulative drug remain
0	0	-	0	100	-	2
5	2.23	0.698	11.2	88.8	1.05	1.95
10	3.16	1	26.5	73.5	1.42	1.86
15	3.88	1.176	35.4	64.6	1.54	1.81
30	5.47	1.477	41.7	58.3	1.62	1.76
45	6.71	1.653	52.14	47.8	1.72	1.68
60	7.74	1.778	63.25	36.75	1.80	1.56
120	10.95	2.079	76.12	23.88	1.88	1.38
180	13.42	2.255	85.7	14.3	1.93	1.15
240	15.49	2.380	90.12	9.88	1.95	0.99
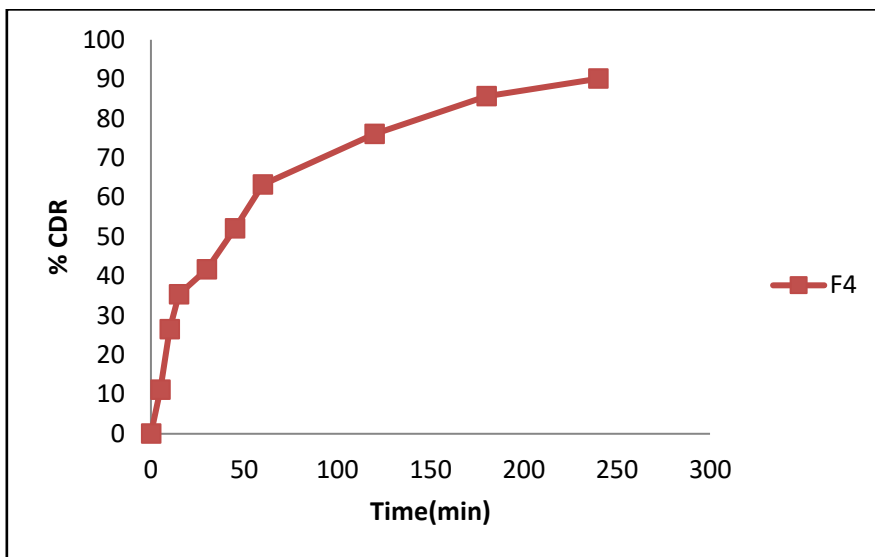
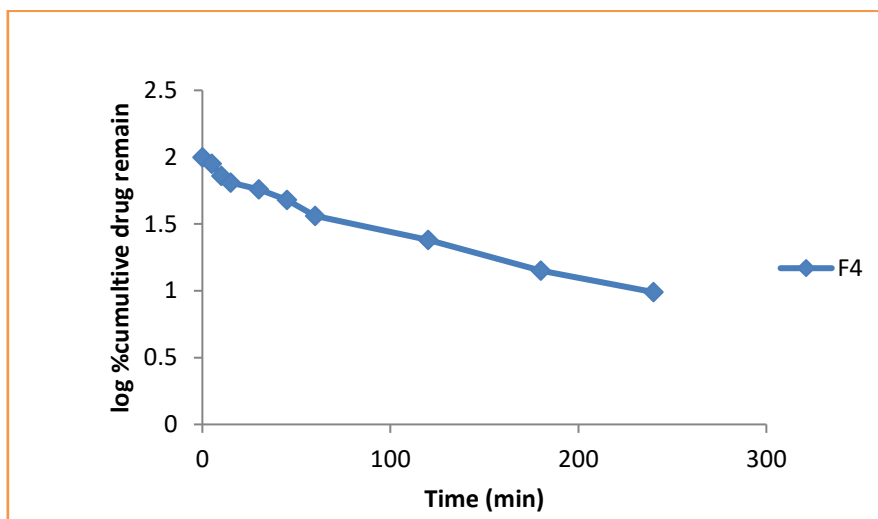**Figure 9: Zero order release model for F4 formulation**

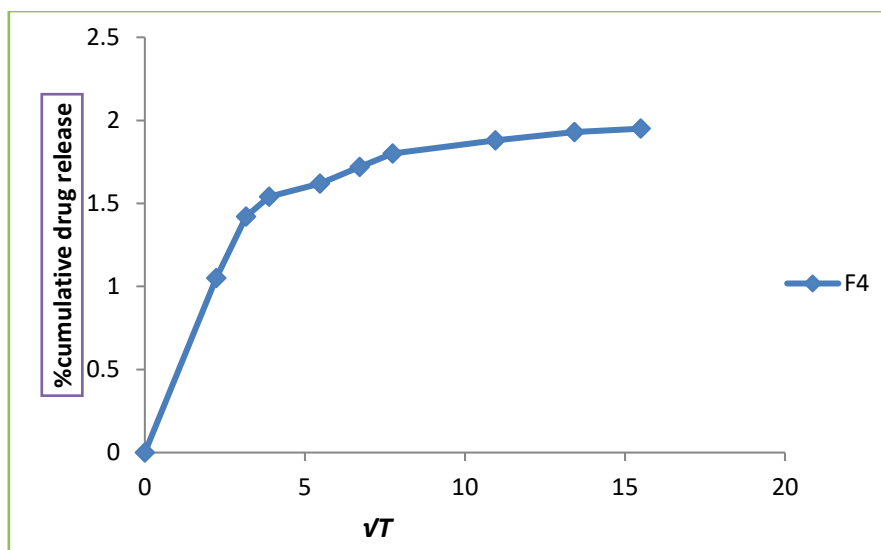**Figure 10: First order release model for F4 formulation**
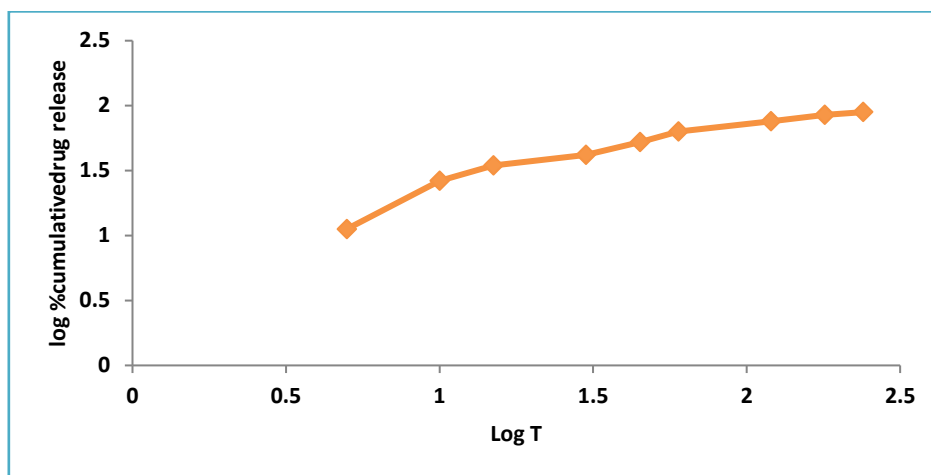

Figure 11: Higuchi model for F4 formulation

Figure 12: Kosmeyr-peppas model for F4 formulation

Table 17: Model fitting release profile of Formulation F4

Formulation Code	Zero Order r^2	First Order r^2	Higuchi r^2	Peppas r^2
F4	0.984	0.954	0.953	0.838

CONCLUSION:

Emulgel formulations are considered as recent approach in which either hydrophobic or hydrophilic drug can be formulated and quantified with desired pharmaceutical effects. Based on the solubility values screening of oil, surfactant and co-surfactant is done for emulsion formulation and selection of polymers for emulgel formulation.

Based on evaluation parameters F4 is considered to be the optimized formulation as its exhibits enhanced penetration of hydrophobic celecoxib drug.

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