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FORMULATION AND EVALUATION OF PIROXICAM EMULGEL FOR TOPICAL DRUG DELIVERY SYSTEM

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ABSTRACT
The present work is concerned with the formulation and evaluation of Piroxicam emulgel employing carbopol 934 and xanthan gum as polymers. The emulgel is prepared by combining the gel and emulsion. The gel in formulations were prepared by dispersing Carbopol 934 and xanthan gum separately in purified water with constant stirring at a moderate speed and then the pH was adjusted to 6 to 6.5 using Tri-ethanol amine (TEA). The oil phase in the emulsion consists of liquid paraffin and span-80. The aqueous phase in the emulsion was prepared using Tween-80 and distilled water. The prepared emulgel formulations were subjected to evaluation studies like Physical appearance, ph determination, estimation of drug content and invitro drug release. The appearance of prepared emulgel was white. The emulgel were prepared using various concentration of Carbopol-934 and penetration enhancers (Clove oil and Eucalyptus oil) from batch F1 to F8. The results shown that all prepared formulations having good homogeneity, uniform consistency with smooth texture, good spreadability, extrudability, swelling index, and constant drug content.

KEYWORDS: Piroxicam, Emulgel, Carbopol 934, Xanthan gum.

INTRODUCTION

Topical drug delivery system (tdds)

Topical drug delivery system (TDDS) is defined as "The application of drug containing formulation to the skin or mucous membrane for direct treatment of cutaneous disorder or the cutaneous manifestation of the general disease, with the intent of confining the pharmacological or other effect of the drug to the surface or within the layers of skin or mucous membrane". With the beginning of new epoch of pharmaceutical dosage forms, topical drug delivery systems have established themselves as integral part of novel drug delivery products. Topical drug delivery systems are attaining increase in popularity and several drugs have been successfully delivered by topical route for both local and systemic action. Topical drug delivery systems deal the non- invasive delivery of medication from the surface of skin, the largest and most accessible organ of human body through its layers to the circulatory system.[1-2]

Emulgels having lead of both gels and emulsion act as a controlled drug delivery system for topically applied drugs. They are emulsion of either oil in water type or water in oil type which are gelled by mixing with a gelling agent. Gels have mucoadhesive property that lengthens the contact period of medication over the skin. Both o/w and w/o type of emulsion are used in topical preparation as water washable preparation and emollients used for dry skin respectively. However if the emulsion becomes less thixotropic in nature i.e. less viscous on shearing, the process of penetration becomes easy. In order to increase emulsion stability and ability to penetrate stratum corneum it is jellified in a gel base and the resulting formulation is known as Emulgels. Gels in dermatological formulation have advantage of ease of application and removal and provide better stability as compare to cream and ointments. From the four classes of BCS classification of drugs class II drugs show poor solubility and high permeability.[3-4]

Piroxicam is an NSAID with pain relieving and antipyretic impacts, utilized for the treatment of rheumatoid joint inflammation, osteoarthritis and horrendous wounds. It is very much retained after oral absorption anyway its utilization has been related with various bothersome reactions on the stomach and kidneys.[5] Dermal conveyance is an elective route however requires a suitable dosage form which guarantees profound skin penetration, permitting helpful impact at particular site. Despite the fact that piroxicam is not effortlessly consumed after topical application, a few investigations have been completed to foresee the percutaneous retention of piroxicam utilizing distinctive substances as penetration enhancers. Numerous broadly

utilized topical preparations like ointments, creams, have various disadvantages.[6] Semisolid preparations like ointments are normally sticky, making uneasiness to the patient when used topically. Additionally they likewise have less spreading coefficient and need to apply with rubbing. They additionally display the issue of stability. Because of every one of these variables, inside the real gathering of semisolid dosage forms, the utilization of transparent gels has expanded both in beauty care products and in pharmaceutical products. A gel is colloid that is normally 99% by weight fluid, which is immobilized by surface tension amongst it and a macromolecular system of strands worked from a little measure of a gelating substance. Despite numerous favourable circumstances of gels a noteworthy constraint is the incapability of transporting hydrophobic medications. To defeat this restriction an emulsion based approach is being utilized so a hydrophobic moiety can be effectively fused and conveyed through gels. Whenever gels and emulsions are consolidated together the dosage forms are specified as emulgels. [6-7]

MATERIALS AND METHODS

Materials

Piroxicam was received as a gift sample from Apex Healthcare Ltd, Ankleshwar. Carbopol 934 and Xanthan gum were purchased from Research Lab Fine Chem Industries, Mumbai. Tween 80, Span 80, Propyl paraben, methyl paraben, Tri-ethanol amine (TEA) Clove oil, Eucalyptus oil, Sodium hydrogen phosphate, Sodium dihydrogen phosphate ,Sodium hydroxide also purchased from Research Lab Fine Chem Industries, Mumbai. All chemicals used were of analytical grade.

Methods

Experimental work was divided into three parts.

1. Preformulation study.
2. Formulation of Piroxicam Emulgel
3. Evaluation of formulated Piroxicam Emulgel

Preformulation Studies[8-11]

Identification and characterization of Piroxicam

Organoleptic properties the drug such as description, color, odor, taste and appearance of the drug were studied.

Determination of Melting Point

The melting point of the drug was determined using capillary tube. One end of the capillary tube was sealed. The sample was filled and placed in the melting point apparatus. The melting point of the drug was noted. Melting point of the drug was found to be 200 0C and the normal range is 198-202 0C. Hence, drug was suitable for formulation.

Calibration curve in Phosphate buffer pH 7.4[12-16]

Preparation of Phosphate buffer pH 7.4

Weigh accurately 17.5 gm of Sodium hydrogen Phosphate and dissolve in 500 ml of distilled water in volumetric flask. Labeled it as solution “A”.

Weigh accurately 13.8 gm of Sodium dihydrogen phosphate and dissolve in 500 ml of distilled water in volumetric flask. Labeled it as solution “B”.

Take 202.5 ml of solution “A” in volumetric flask of 500 ml. add 97.5 ml of solution“B” and finally make up the volume up to 500 ml

Standard Calibration Curve of Piroxicam

Weigh accurately 100mg of pure drug and transfer it in to 100ml volumetric flask and make up volume upto 100ml with 7.4 Phosphate buffer labelled it as stock solution-I. (1000 µg /ml) Pipette out 10ml from stock solution-I and transfer it to another 100ml volumetric flask and make up volume upto 100ml mark and labelled it as stock solution-II. (100 µg /ml) Then pipette out 2 ml, 4 ml, 6 ml, 8ml and 10ml from stock solution 2 and make upvolume upto 10ml. to make the resultant concentration in the range of 2, 4, 6, 8 &10 µg /ml respectively. All dilutions are made with 7.4 Phosphate buffer. Take the absorbance of all dilution at 242 nm by using UV-Visible spectrophotometer.

Compatibility Study of Drug and Excipient

It is very important parameter to study compatibility of drug and polymers under the experimental condition before the formulation. It is therefore necessary to confirm that the drug does not react with the polymer and excipients under experimental condition and affected the shelf life of product. [17]

FTIR spectrum

FT-IR spectra for pure Piroxicam and polymer at room temperature using FT-IR spectrophotometer (FTIR-8400S, Shimadzu, Japan) in transmittance mode. The samples were ground in a mortar, mixed with Nujol and placed between two plates of KBr and compressed to form a thin film. The sandwiched plates were placed in the infrared spectrometer and the spectra were obtained. Scanning was performed between wave numbers 4000-400 cm-1 at a resolution of 2 cm-1. [18]

DSC (Differential Scanning Calorimetry)

The DSC, test involves heating up a milligram-sized sample of the material under investigation, and by detecting and measuring heat evolution or heat consumption by the sample, examining and quantifying the exothermic or endothermic reactions that occur while that sample is slowly heated up.[19]

Formulation of Piroxicam Emulgel[20-21]

Preparation of Gel base

Gel base was prepared by dispersing Carbopol 934 in preheated distilled water at with constant stirring at moderate speed using mechanical shaker. Prepared dispersion was cooled and left overnight.

Preparation of Emulsion

Preparation of Oil phase: Oil phase of emulsion prepared by dissolving Span 80 in light liquid paraffin.

Preparation of Aqueous phase: Aqueous phase of emulsion was prepared by dissolving Tween 80 in purified water Methyl paraben & Propyl paraben were dissolved in Glycerine whereas Piroxicam was dissolved in ethanol & both solution were mixed in aqueous phase. Clove oil & Eucalyptus oil were mixed in oil phase. Both oily & aqueous phase were separately heated to 70-80 ^{o}C then oily phase was added to the aqueous phase with constant stirring until it got cooled to room temperature, pH adjusted to 6-6.5 by using Triethanolamine (TEA).

Preparation of Emulgel

Obtained emulsion was mixed with gel in the ratio 1:1 with gentle stirring to obtained emulgel.

Table 1: Formulation Composition of Piroxicam Emulgel (%W/W).

Ingredients	F1	F2	F3	F4	F5	F6	F7	F8
Piroxicam	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Carbapol 934	0.6	0.8	1	1.25	1.5	1.25	1.25	1.5
Liquid paraffin	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Tween 80	1	1	1	1	1	1	1	1
Span 80	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Glycerine	5	5	5	5	5	5	5	5
Ethanol	3	3	3	3	3	3	3	3
Methyl paraben	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Propyl paraben	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Clove oil	1.5	2	2.5	-	-	-	1.8	1.5
Eucalyptus oil	-	-	-	1.5	2	2.5	1.8	1.5
Water	Q.S	Q.S	Q.S	Q.S	Q.S	Q.S	Q.S	Q.S

Evaluation of Formulated Piroxicam Emulgel

Physical Appearance

The prepared emulsion preparations were examined visually for their color, homogeneity, Consistency, phase separation & Texture.[22-23]

pH determination

The pH of prepared emulgel was determined by using a digital pH meter. 1gm of the emulgel was stirred in distilled water until a uniform dispersion was formed. It was kept a side for 2 hours. The volume was then made up to 100 ml i.e. 1% solution of prepared formulation. Then pH measurement was performed in triplicate using a digital pH meter and mean was calculated.[24-25]

Spreadability

Spreadability of the Emulgel was determined 48 hours after preparation of the Emulgel by using the wooden block and the glass slide apparatus. 1 g of the prepared Emulgel was placed between two 10 × 10 cm glass plates (125g each). A weight of 25g was placed it in a pan and the time required for the upper glass plate to completely separate from the fixed glass plate was recorded. The spreadability was then calculated from the following equation.[26-27]

S= M×L/T

Where,

S= Spreadability

M= Weight tied to upper slide (in gm) L= Length of glass slide (in cm)

T= Time taken to separate the slide (in sec) Spreadability was measured in terms of g.cm/sec.

Extrudability Study

The method adopted for evaluating emulgel formulation for extrudability was based upon the quantity in percentage of emulgel extruded from lacquered aluminum collapsible tube on application of weight in grams required to extrude at least 0.5 cm ribbon of gel in 10 seconds. More quantity extruded better was extrudability. The measurement of extrudability of each formulation was in triplicate and the average values were presented.The extrudability was than calculated by using the following formula.[28-29]

Extrudability = Applied weight to extrude gel from tube (in gm) / Area (in cm2)

Swelling Index

To determine the swelling index of prepared topical emulgel, 1gm of emulgel is taken on porous aluminum foil and then placed separately in a 50 ml beaker containing 10ml 0.1N NaOH. Then samples were removed from beakers at different time intervals and put it on dry place for some time after it reweighed. Swelling index is calculated as follows. [30-31]

SW = [(Wt– Wo) / Wo] × 100

Where,

Swelling index (SW) %= Equilibrium percent swelling

Wo= Original weight of emulgel at zero time

Wt= Weight of swollen emulgel after time t.

Drug Content

Weigh accurately 1 gm of emulgel and it was dissolved in 100 ml of phosphate buffer 7.4.The volumetric flask was kept for 2 h and shaken well in a shaker to mix it properly. The solution was passed through the filter paper and filtered. The absorbance was measured Spectro photometrically after appropriate dilution against corresponding emulgel concentration as blank. The drug content was then determined after appropriate dilution at 242 nm using a UV spectrophotometer. [32-33]

Invitro Drug Release Study

The Invitro drug release studies of the emulgel were carried out in modified diffusion cell using dialysis membrane. The membrane was soaked in phosphate buffer solution(PBS) pH 7.4 for 9- 12 hour was to clamped carefully to one end of the hallow glass tube of dialysis cell. Then emulgel (300mg) was spread uniformly on the dialysis membrane. 200 ml of phosphate buffer solution pH7.4 used as dissolution media was added to receptor compartment. This whole assembly was kept on a magnetic stirrer and the solution on the receptor side was stirred continuously using a magnetic bead and temperature of the cell was maintained at 37±0.5^{o}c.

Sample (10ml) was withdrawn at suitable time intervals

and replaced with equal amounts of fresh dissolution media. Samples were analyzed spectrometrically at 242 nm and the cumulative percentage drug release was calculated.[34]

Stability Studies

Stability of a pharmaceutical preparation can be defined as "the capability of a particular formulation in a specific container/closure system to remain within its physical, chemical, microbiological, therapeutic and toxicological specifications throughout its shelf life. "Formulated emulgel were kept in on 45 oC with humidity 75% for the period of one month and evaluated after one month. Samples were withdrawn and evaluated for Physical Appearance, pH, Spreadability, Extrudability, Swelling index, Drug content and In vitro drug release.[35]

RESULTS

Identification & characterization of Piroxicam

Melting point

Melting point of the drug was found to be 200 oC and the normal range is 198-202 ^{o}C as reported in pharmacopoeia.

Standard Calibration Curve of Piroxicam

The standard calibration curve of Piroxicam were taken in pH 7.4 phosphate buffer at wavelength of 242 nm

Table 2: Standard Calibration Curve of Piroxicam in phosphate buffer pH 7.4 at 242 nm

Sr. No	Concentration (mcg/ml)	Absorbance
1	2	0.109
2	4	0.215
3	6	0.361
4	8	0.426
5	10	0.516
6	12	0.606

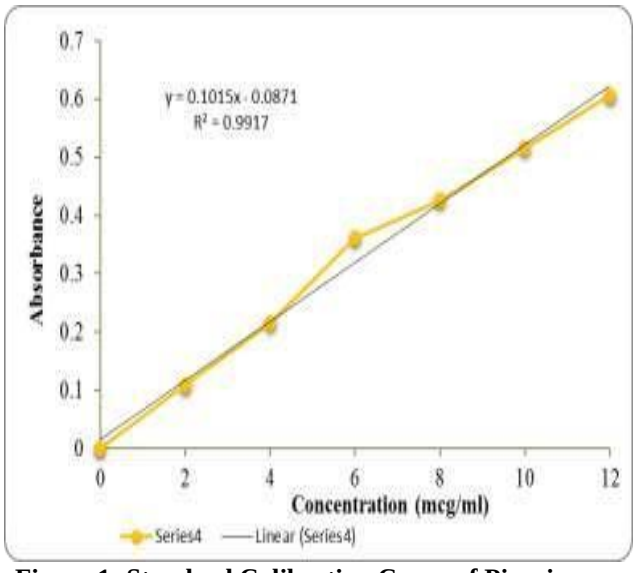

Figure 1: Standard Calibration Curve of Piroxicam.

FTIR Analysis

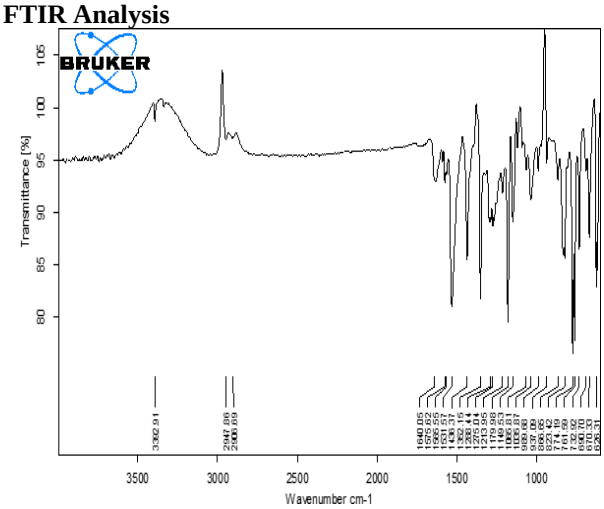

Figure 2: FTIR spectrum of Piroxicam.

The spectrum of Piroxicam shows the following groups at their frequencies.

Table 3: FTIR interpretation of Piroxicam.

Sr. No.	Functional groups	Frequency (cm^{-1})
1	C=C	1630-1635
2	C=O	1800-1810
3	N-H	3392-3400
4	C-H(Aromatic)	3050-3065
5	C-N	1149-1155

FTIR Spectrum of Carbopol 934

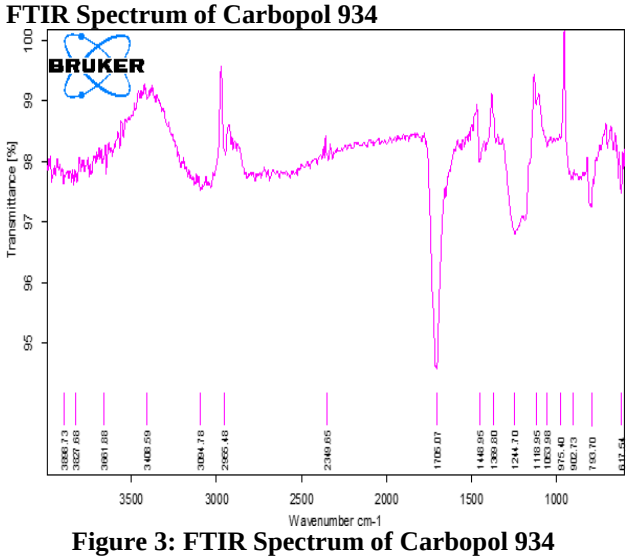

Figure 3: FTIR Spectrum of Carbopol 934

Table 4: FTIR Interpretation of Carbopol 934.

Sr. No.	Functional groups	Frequency (cm^{-1})
1	C=O	3300-3310
2	C-H (Aliphatic)	2966-2970
3	CH2	1485-1489

FTIR Spectrum of Piroxicam + Carbopol 934

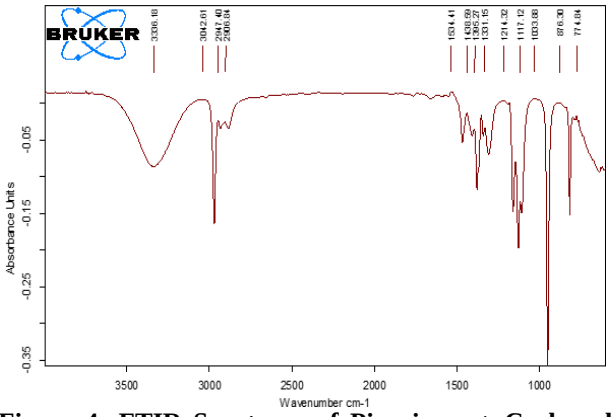

Figure 4: FTIR Spectrum of Piroxicam + Carbopol 934.DSC Analysis (Analysis Of Differential Scanning Calorimetry)

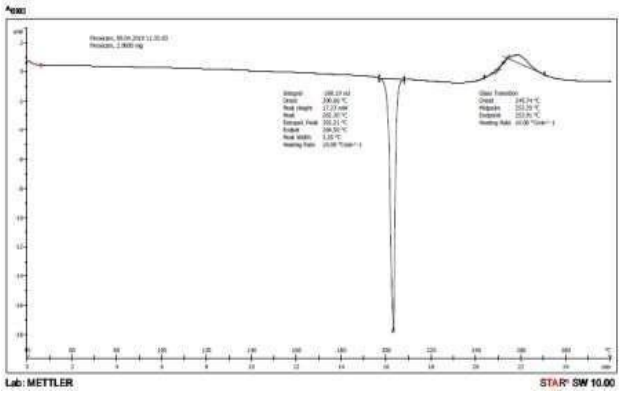

Figure 5: Differential Scanning Calorimetry (DSC) of Piroxicam.

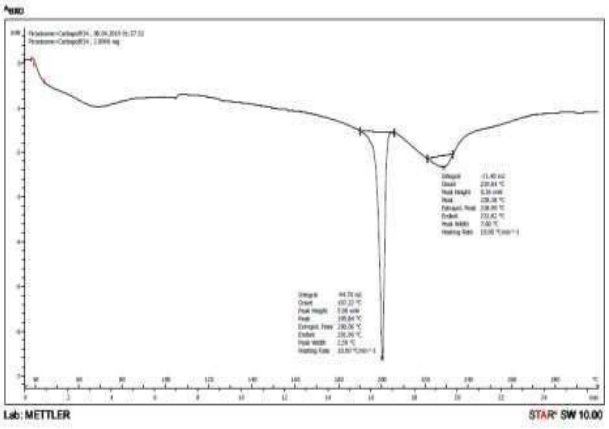

Figure 6: DSC of Piroxicam + Carbopol 934.

Evaluation Parameter of Formed Piroxicam Emulgel

Physical Appearance

All formulated final batch of Piroxicam Emulgel examined visually for their color, homogeneity, Consistency, phase separation & texture. The results of final batches are shown in Table 5 respectively.

Table 5: Physical Appearance of Final batches (F1-F8).

Sr. no	Formulation codes	Colour	Consistency	Homogenicity	Phase separation	Texture
1	**F1**	White fluid	Uniform	Good	None	Smooth
2	**F2**	White fluid	Uniform	Good	None	Smooth
3	**F3**	White creamy	Uniform	Good	None	Smooth
4	**F4**	White creamy	Uniform	Good	None	Smooth
5	**F5**	Thick white	Uniform	Excellent	None	Smooth
6	**F6**	White creamy	Uniform	Excellent	None	Smooth
7	**F7**	White creamy	Uniform	Excellent	None	Smooth
8	**F8**	Thick white	Uniform	Good	None	Smooth

pH Determination

pH of different formulations of Emulgel as a final batches were measured by digital pH meter, the readings were noted in triplicate and average values were calculated and results are shown in Table 6 respectively.

Table 6: pH of Final batches (F1-F8).

Sr no.	Formulation codes	pH
1	**F1**	5.9±0.3
2	**F2**	5.8±0.5
3	**F3**	5.6±0.2
4	**F4**	6.2±0.1
5	**F5**	6.3±0.3
6	**F6**	6.8±0.3
7	**F7**	6.5±0.2
8	**F8**	6.1±0.2

Spreadability

Spreadability was measured as discussed in methodology the readings were noted in triplicate and average values were calculated and results are shown in Table7 for final batches respectively.

Table 7: Spreadability values of Final batches (F1-F8)

Sr no.	Formulation codes	Spreadability (g.cm/sec)
1	F1	38.81±0.5
2	F2	33.68±0.4
3	F3	32.03±0.54
4	F4	30.79±0.2
5	F5	18.14±0.36
6	F6	26.41±0.51
7	F7	30.44±0.6
8	F8	20.30±0.34

Extrudability

Extrudability was performed according to the method discussed in methodology readings were noted in triplicate and average values were calculated and results are shown in Table 8 for final batches respectively.

Table 8: Extrudability values of Final batches (F1-F8)

Sr no.	Formulation codes	Extrudability (gm/cm^2)
1	F1	39.52±0.4
2	F2	33.43±0.2
3	F3	30.47±0.52
4	F4	27.39±0.6
5	F5	17.32±0.5
6	F6	29.49±0.56
7	F7	26.90±0.6
8	F8	20.39±0.58

Swelling index

Swelling index was performed by using the specified method it was based on amount of liquid material that can be absorbed readings were noted in triplicate and average values were calculated and results are shown in Table 9 as final batches respectively.

Table 9: Swelling index values of Final batches (F1-F8)

Sr no.	Formulation codes	Swelling index (%)
1	F1	10.03
2	F2	14.05
3	F3	17.28
4	F4	28.25
5	F5	44.24
6	F6	27.35
7	F7	31.98
8	F8	46.38

Drug Content

The drug content of the formulated Piroxicam Emulgel was estimated spectrophotometrically at 242 nm. The results were in the limits as shown in Table1 0 as final batches respectively.

Table 10: Drug content of Final batches (F1-F8).

Sr no.	Formulation codes	Drug content (%)
1	F1	89.20
2	F2	90.30
3	F3	87.12
4	F4	88.90
5	F5	83.39
6	F6	96.24
7	F7	95.60
8	F8	90.80

Invitro Drug Release

The invitro release profile of Piroxicam from its various formulated emulgel was determined by Franz diffusion cell and results are being depicted in Table 11 and graph is plotted in Figure 7 for Final batches.

Table 11: % Drug release of Final batches (F1-F8).

Time (hrs)	% Drug Release							
	F1	F2	F3	F4	F5	F6	F7	F8
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	15.25	21.88	21.28	25.00	17.87	29.29	25.05	13.89
2	20.69	29.94	32.13	34.53	21.37	36.52	40.25	25.30
3	29.32	32.96	38.12	38.52	28.20	48.63	56.59	38.90
4	34.52	45.23	49.97	42.47	32.01	57.07	60.58	58.30
5	42.52	53.05	57.96	53.44	38.33	66.60	65.85	63.09
6	53.26	56.49	63.92	74.29	39.69	72.32	85.21	71.80
7	60.25	68.64	67.86	85.30	52.32	89.43	91.96	83.06
8	63.25	71.57	69.64	88.06	58.43	94.58	98.45	90.05

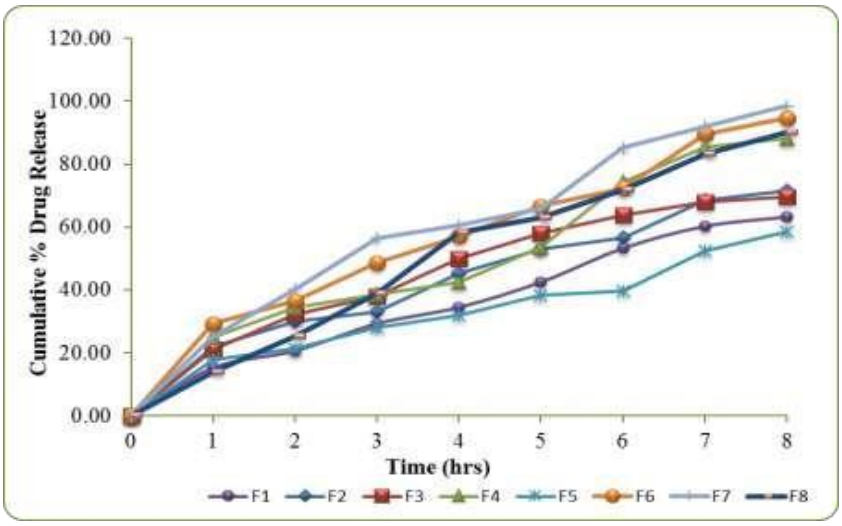

Figure 7: In Vitro % Drug Release Profile of Final batches (F1-F8).

Kinetics of Drug Release

Table 12: Release kinetic of Optimized batch F7

Formulation code	Higuchi	Zero Order	First Order	Hixon Crow	Korsmeyer Peppas	
	r^2	r^2	r^2	r^2	r^2	N
F7	0.98	0.95	0.86	0.95	0.98	0.57

Figure 8: Higuchi Plot.

Figure 9: Zero Order Plot.

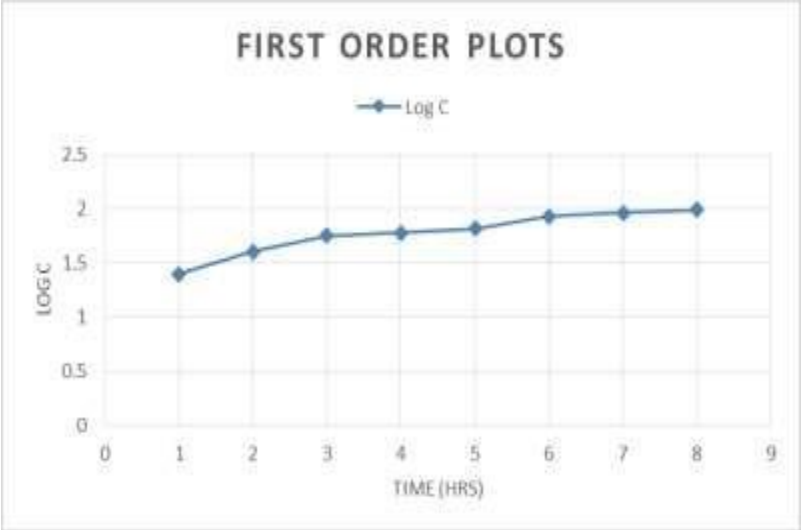

Figure 10: First Order Plot.

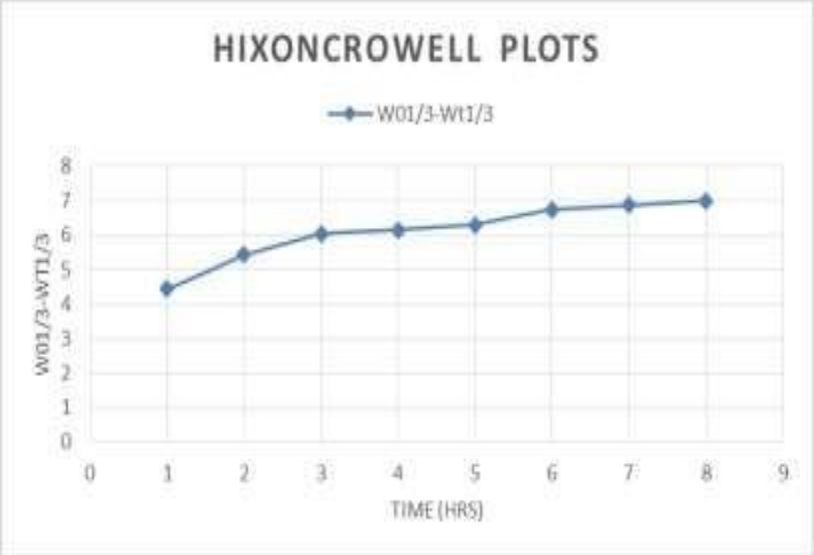

Figure 11: Hixoncrowell Plot.

Figure 12: Korsemeyer- Peppas Plot.

Stability Studies

Stability study is carried out on formulation batch F7 formulated emulgel were kept in on 45 ^{o}C with humidity 75% for the period of one month and evaluated after one month. The results obtained after 1 month time period are shown in Table 13.

Table 13: Stability Studies.

Evaluation Parameters	Before	After
1. Physical appearance	White Creamy	White Creamy
• **Colour**	Uniform	Uniform
• **Consistency**	Excellent	Excellent
• **Homogenicity**	None	None
• **Phase separation**	Smooth	Smooth
• **Texture**		
2. pH	6.5	6.8
3. Spreadability	30.44 g.cm/sec	32.85 g.cm/sec
4. Extrudability	26.30 gm/cm^2	29.41 gm/cm^2
5. Swelling index	31.98 %	34.22 %
6. Drug content	95.60	96.25
7. Invitro drug release	98.45 %	96.93 %

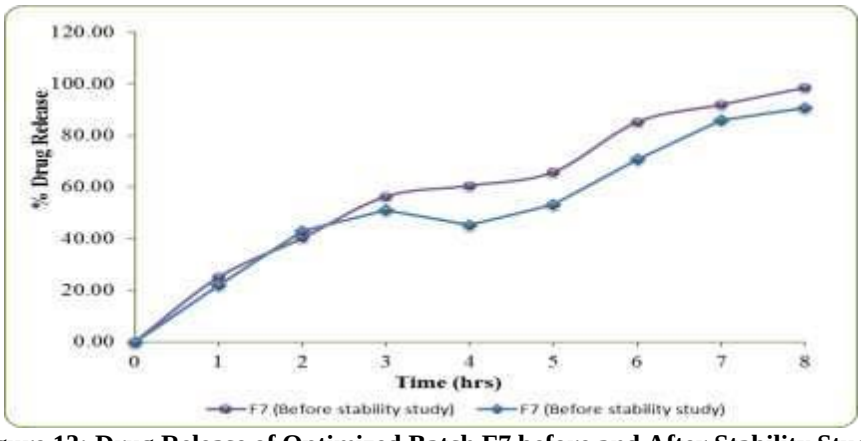

Figure 13: Drug Release of Optimized Batch F7 before and After Stability Study.

DISCUSSION

The objective of present study was to formulate and evaluate the Emulgel of Piroxicam for effective treatment of Arthritis and pain it's suitable for use as long-term anti- inflammatory drug in rheumatoid and osteo arthritis. Piroxicam inhibit the prostaglandin synthesis which is responsible for inflammation. According to literature survey even though the drug is well absorbed through oral route, gastric irritation is still the most serious adverse effect. Thus there is a need for another drug delivery system with improved GI tolerability. Topical route of drugs administration

provides a useful route for both systemic and local actions and bypasses first-pass effects and avoids GI side effects.

The melting point of the Piroxicam was found to be 200 ^{o}C by capillary tube method and their calibration curve was taken in phosphate buffer pH 7.4 at 242 nm by U.V Spectrophotometer. The standard calibration curve of Piroxicam was obtained by plotting absorbance v/s. Concentration. The standard calibration curve shows the slope of 0.101 and correlation coefficient of 0.991. The curve was found to be linear in concentration in range of 2- 12 µg/ml (beer's range) at 242 nm.

In the FTIR and DSC study of compatibility of Piroxicam with polymers Carbapol 934 shows that all above characteristic peaks of Piroxicam observed near about their respective values. There are no significant changes in drug peaks were observed in the mixture of drug and excipients so there is no incompatibility. The Emulgel of Piroxicam was formulated and evaluated for different parameter to confirm their therapeutic efficacy and accuracy. Pre- formulation study confirms the purity drug through above tests. Post formulation study was carried which includes Physical appearance, pH of Emulgel, Spreadability , Extrudability , Swelling index , Drug content , Invitro Drug Release.

All the formulated Emulgel of final batches were examined visually for their color, homogeneity, consistency, phase separation & Texture. Final batches formulations F1 and F2 were white fluid due to presence of low concentration of carbapol-934.

Formulation F3 were white creamy. Formulation F5 and F8 was thick white in colour due to higher concentration of carbapol-934 while Formulations F4, F6, F7 were white creamy in appearance as containing similar concentration of carbopol 934. All formulations were having uniform consistency with smooth homogeneous texture. No phase separation was observed inany of the formulated emulgels.

According to the results of pH analysis presented in Table 6 for final batches respectively the range of pH of formulations was 5.6±0.2 to 6.8±0.3 for final batches which is considered acceptable for avoiding the risk of skin irritation.

Spreading test was carried out for all the formulations. The spreadabilty indicates that the emulgel is easily spreadable by small amount of shear. The spreadability is very much important as it shows the behavior of emulgel when it comes out from the tube. Lesser the time taken to spread better the spreadability. Emulgel prepared with low concentration of carbopol Formulation F1 and F2 belonged to fluid gel category having more spreadability values i.e. 38.81±0.5 g.cm/sec and 33.68±0.4 g.cm/sec. Formulation F3, F4, F6 and F7 spreadability was 32.03±0.54 g.cm/sec, 30.79±0.2 g.cm/sec, 26.41±0.51 g.cm/sec and 30.44±0.6 g.cm/sec respectively. The Formulation F5 and F8 prepared with higher concentration of carbopol i.e. 1.5 g were stiff category spreadabilty value found to be 18.14±0.36 g.cm/sec and 20.30±0.34 respectively. With increase in concentration of polymer in formulations the spreadability of formulation decreases. Spreadability was in order of F1> F2> F3> F4> F7> F6> F8>F5.

The emulgels were filled into collapsible tubes after formulating them. The extrudability of the formulation has been checked. Extrudability was decreased with an increase in concentration of carbopol. Formulation F1 and F2 were fluid category extrudability was found to be 39.52± 0.4 gm/cm^2 and 33.43±0.2 gm/cm^2 respectively. Extrudability of Formulation F5 and F8 was less i.e. 17.32±0.5 gm/cm^2 and 20.39±0.58 gm/cm^2 respectively as containing higher concentration of polymer. Formulation F3, F4, F6, F7 having optimum concentration of polymer extrudability was good i.e. 30.47±0.52 gm/cm^2, 27.39±0.6 gm/cm^2, 29.49±0.56 gm/cm^2 and 26.90±0.6 gm/cm^2 respectively.

The swelling index was performed by using the specified method it is based on the amount of liquid material that can be absorbed. Swelling index is increased as the concentration of polymer increased and directly proportional to rate of hydration. The percentage swelling index of final batches like (F5, F6, F7 and F8) found to be 44.24%, 27.35%, 31.98% and 46.38% respectively, because these four formulation batches contain higher concentration of polymers. Percentage drug content estimation of various Emulgel Formulations was done by UV spectrophotometer. The absorbance was measured and percentage drug content of various Emulgel formulations of drug content of final batches ranged from 83.39 % to 96.24 %.

The In vitro drug release study was done by using modified diffusion cell using dialysis membrane in phosphate buffer pH 7.4 the study was done for 8 hrs with an optimum interval of sampling. Drug release was in following order F5< F1< F3< F2< F4< F8 < F6 < F7. Presence of two Penetration enhancer's Clove oil and Eucalyptus oil and optimum concentration of gelling agent has resulted in better performance as compared to other formulations. Hence F7 can be considered as the optimized formulation.

Eight formulations of Piroxicam emulgel were prepared it was found that carbopol used beyond 1.5 % the emulgel obtained was highly viscous making it unfavorable for use similarly at concentration 0.8 % was of fluid category. Hence Carbopol to be used in formulations from 0.8 to 1.5%.

The pattern of drug release was evaluated in pH 7.4 phosphate buffer of batch F7 formulation. The mechanism and Kinetics of drug release from batch F7 formulation was evaluated based on the Higuchi

equation, Zero order, First order, Hixoncrowell equation and Peppas model. The diffusion exponent 'n' values of Korsemeyer-Peppas model was found to be in the range of 0.57 for the Emulgel prepared by using Carbopol-934 as gelling agent, clove oil and Eucalyptus oil as penetration enhancer. The study was shows that the buccal patches of Piroxicam follows the korsmeyer-peppas release order kinetic.

The Emulgel shows very minor or little changes on physical appearance, pH, Spreadability, Extrudability, Swelling index, Drug content during the study period. The percentage drug release of Piroxicam Emulgel kept in stability condition were found to be 96.93% respectively after the end of 1 month.

CONCLUSION

The aim of this work is to formulate and evaluate an emulgel containing Piroxicam for treatment of Arthritis. As Emulgel have emerged as a promising drug delivery system for the delivery of hydrophobic drugs. The drug polymer interaction study was done by FTIR, and DSC analysis of physical mixtures of drug and polymer. The compatibility of Piroxicam with polymers Carbopol-934 the studies of FTIR and DSC shows that all above functional groups characteristic peaks of Piroxicam observed near about their respective values so it has been concluded that there is no incompatibility between polymer and pure drug.

The Emulgel were prepared using various concentration of Carbopol-934 and penetration enhancers from batch F1 to F8. The results shown that all prepared formulations having good homogeneity, uniform consistency with smooth texture, good spreadability, extrudability, swelling index, and constant drug content.

The drug release data revealed that formulation F7 exhibited 98.45% drug release after 8 hrs. Stability studies were performed on selected formulations for a period of 1 month wherein no significant variations were observed in parameter measured it could be concluded on the basis of result of evaluations that formulation containing clove oil and eucalyptus oil in combination as penetration enhancers had cumulative drug release of 98.45% after 8 hrs and there is no significance change in other parameters after stability study. Thus prepared emulgel exhibited a good potential and alternative to conventional delivery of Piroxicam for management of Arthritis.

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REFERENCES

1. Tadwee IK, Gore S, Giradkar P. Advances in Topical Drug Delivery System: A Review. International Journal of Pharmaceutical Research & Allied Sciences, 2011; 1(1): 14-23.
2. Thomas J, Kuppuswamy S, Sahib AA, Benedict A, George E. A Review on Emulgel as a Current Trend in Topical Drug Delivery System. International Journal of Pharmacy & Pharmaceutical Research, 2017; 9(3): 273-28.
3. Dev A, Chodankar R, Shelke. Emulgels: a novel topical drug delivery system Pharmaceutical and Biological Evaluations, 2015; 2(4): 64-75.
4. Singh P, Bala R, Seth N, Kalia S. Emulgel: a novel approach to bioavailability enhancement. International Journal of Recent Advances in Pharmaceutical Research, 2014; 4(2): 35-47.
5. Klaus Florey; Analytical Profile of Drug Substance: Elsevier, 15: 511-30.
6. Pant S, Badola A, Baluni S, Pant W. A review on emulgel novel approach for topical drug delivery system. World journal of pharmacy and pharmaceutical sciences, 2015; 4(10): 1728-1743.
7. Marks R, Dykes P. Plasma and cutaneous drug levels after topical application of piroxicam gel: a study in healthy volunteers. Skin Pharmacol, 1994; 7: 340–424.
8. Vani YB, Haranath C, Reddy CS, Bhargava E. Formulation and in vitro Evaluation of Piroxicam Emulgel. International Journal of Pharmaceutical Sciences and Drug Research, 2018; 10(4): 227-232.
9. Swetha M, Mohan B, Rao N, Kumar JN, Satyavathi, Sushma P. Formulation and Evaluation of Flubiprofen Emulgel by Using Different Concentration CARBOPOL 974P. Saudi Journal of Medical and Pharmaceutical Sciences, 2018; 4(2): 215-225.
10. Shankar D, Gajanan S, Suresh J, Dushyant G. Formulation and Evaluation of Luliconazole Emulgel for Topical Drug Delivery. Int. Res. J. of Science & Engineering, 2018; A3: 85-90.
11. Thanushree HR, Kumar GB, Acharya A. Formulation and development of Diclofenac sodium emulgel using Aloe vera gel for transdermal drug delivery system. International journal of pharmaceutical science and technology, 2017; 10(5): 3858-3865.
12. Rao V, Vijaya SP, Padmalatha. Formulation and Evaluation of Oxiconazole Emulgel for Topical Drug Delivery. International Journal of Current Research, 2017; 9(10): 58876- 58878.
13. Kausar R, Akhtar N. Formulation of an Emulgel

Containing Strawberry Fruit Extract and in-vivo Evaluation for Different Skin Parameter. Indian Journal of Pharmaceutical Education and Research, 2017; 51(4): 679-683.
14. Pakhare A.V., Deshmane S.V., Deshmane S.S., Biyani K.R. Design and development of Emulgel preparation containing Diclofenac Potassium. Asian Journal of Pharmaceutics, 2017; 11(4): 712-716.
15. Berdey I.I., Voyt O.I. Rheological properties of emulgel formulations based on different gelling agent. The Pharma Innovation Journal, 2016; 5(4): 76-79.
16. Chemate S.Z., Anbhule R. Formulation and Evaluation of Terbinafine Hydrochloride Film Forming Emulgel. International Journal of Drug Research and Technology, 2016; 6(3): 164-174.
17. Kumari A, Singh A, Saurabh A, Rathore KS, Issarani. Formulation and Evaluation of Lycopene Emulgel. IAJPS, 2015; 2(6): 1013-1027.
18. Panwar S, Mukhopadhyay S, Kothiyal P. Formulation and Evaluation of Tioconazole Emulgel for Topical Drug Delivery System. Am. J. PharmTech Res, 2015; 5(6): 479- 491.
19. Asija R, Nama N, Sharma D. Development and evaluation of novel Fluticasone Propionate Emulgel for topical drug delivery. Journal of Chemical and Pharmaceutical Research, 2015; 7(2):772-780.
20. Pottalaswathi, Vema K. Formulation and Evaluation of Aceclofenac Topical Emulgel. Journal of Advanced Pharmaceutical Technology & Research, 2015; 3(1): 52-57.
21. Kapoor D, Vyas RB, Lad R, Patel M, Lal B, Parmar R. Formulation, Development and Characterization of Emulgel of a NSAID'S. The Pharmaceutical and Chemical Journal, 2014; 1(3): 9-16
22. Yassin G.E, Formulation and Evaluation of Optimized Clotrimazole Emulgel Formulations. British Journal of Pharmaceutical Research, 2014; 4(9): 1014-1030.
23. Sundari PP, Mullapudi P, Srinivas P. Formulation and Evaluation of Anti-Arthritic Poly Herbal Emulgel. International Journal of Pharmacy & Technology, 2014; 6(2): 6608-6621.
24. Patel J, Trivedi J, Chaudhary S. Formulation and Evaluation of Diacerein Emulgel for Psoriatic Arthrities. IJPRBS, 2014; 3(2): 625-638.
25. Varma VN, Maheshwari PV, Navya M, Reddy SC, Shivakumar HG, Gowda DV. Calcipotriol delivery into the skin as emulgel for effective permeation. Saudi Pharmaceutical Journal, 2014; 22: 591-599.
26. Anwar E, Ramadon D, Harmita. Formulation And Evaluation Of Gel And Emulgel Of Chili Extract (*Capsicum Frutescens* L.) As Topical Dosage Forms. International Journal of Pharmacy and Pharmaceutical Sciences, 2014; 6(3): 13-16.
27. Khalid SA, Kumar BP, Abhinov T. Formulation and in-vitro evaluation of Aceclofenac loaded topical Emulgel. Indian Journal of Research in Pharmacy and Biotechnology, 2014; 2(6): 1487-1489.
28. Haneefa K.P, Abid, Hanan S, Mohanta GP ,Nayar C. Formulation and Evaluation of Herbal Emulgel of Pothos scandens Linn for Burn Wound Healing Activity. J. Pharm. Sci. & Res., 2014; 6(2): 63-67.
29. Hosny KM, Rambo SM, Al-Zahrani M, Al-Subhi SM, Fahmy UA. Ketoprofen Emulgel: Preparation, Characterization, and Pharmacodynamic Evaluation. Int. J. Pharm. Sci. Rev. Res., 2013; 20(2): 306-310.
30. Yapar E. Design and in vivo evaluation of emulgel formulations including green tea extract and rose oil. Acta Pharm, 2013; 63: 531–543.
31. Marwaha TK. Formulation design and evaluation of herbal Anti Psoriatic Emulgel. Journal of pharmaceutical and scientific innovation 2013; 2(3): 30-42.
32. Mulye SP, Wadkar KA, Kondawar MS. Formulation development and evaluation of Indomethacin emulgel. Der Pharmacia Sinica, 2013; 4(5): 31-45.
33. Thakur NK, Bharti P, Mahant S, Rao R. Formulation and Characterization of Benzoyl Peroxide Gellified Emulsions. Sci Pharm, 2012; 80: 1045–1060.
34. Khullar R, Kumar D, Seth N, Saini S. Formulation and evaluation of Mefenamic acid emulgel for topical delivery. Saudi Pharmaceutical Journal, 2012; 20:63-67.
35. Shivhare UD, Jain KB, Mathur VB, Bhusari KP, Roy AA. Formulation Development and Evaluation Of Diclofenac Sodium Gel Using Water Soluble Polyacrylamide Polymer. Digest Journal of Nanomaterials and Biostructures, 2009; 4(9): 285 – 290.