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SOLUBILITY ENHANCEMENT OF POORLY WATER SOLUBLE DRUG IRBESARTAN BY SELF EMULSIFYING DRUG DELIVERY SYSTEM

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ABSTRACT

The objectives of the present investigations were to optimize concentration of oil, surfactant and co-surfactant by psedoternary phase diagrams and to develop a stable formulation of self emulsifying lipid formulations (SELFs)in order to enhance the dissolution rate of poorly soluble Irbesartan (IRB) by SELFs. Pseudo ternary phase diagrams were constructed to identify the self emulsifying region. Self emulsifying formulations were prepared using PEG 600 as surfactant, capryol 90 as co-surfactant and rose oil/olive oil as oil in various proportions. SELFs were formulated and evaluated for drug content, infrared spectroscopy (FTIR), zeta potential analysis, particle size analysis, in vitro dissolution study and in vitro diffusion study. Optimal formulation of Irbesartan SELFs were successfully developed in this work. The study illustrated that potential use of SELFs dispense liquid soluble drug by oral route.

KEYWORDS: Irbesartan, PEG 600, Capryol 90, rose oil, FTIR studies, In vitro drug release studies.

1. INTRODUCTION

Oral bioavailability depends on several factors including aqueous solubility, drug permeability, dissolution rate, first-pass metabolism, pre systemic metabolism and suscepti bility to efflux mechanisms.[1] These drugs are classified as class II drugs by the Biopharmaceutical Classification System, drugs with poor aqueous solubility and high permeability.[2] Realization that the oral bioavailability of poor water-soluble drugs may be

enhanced when co-administered with meal rich in fat has led to increasing the recent interest in the formulation of poorly water-soluble drugs in lipids. Lipid suspension, solutions and emulsions have all been used to enhance the oral bioavailability but, more recently, there has been increasing focus on the utility of self emulsifying drug delivery systems (SEDDS). Being hydrophobic, i.e. more lipophilic, a lipid-based drug delivery system would ideally work for a poorly water-soluble drug. Lipid-based formulation approaches, predominantly the self-microemulsifying drug delivery system (SMEDDS), illustrate their potential as alternative approaches for the delivery of hydrophobic drugs. Dosing of drug substances that exhibit poor water solubility, but sufficient lipophilic properties in a pre dissolved state are advantageous in view of the fact that the energy input allied with a solid-liquid phase transition is circumvented, thus overcoming the slow dissolution process after oral intake.[5] Self-microemulsifying drug delivery system formulations are isotropic mixtures of an oil, a surfactant, a co-surfactant (or solubilizer) and a drug. Lipid-based formulation approaches, predominantly the self-microemulsifying drug delivery system (SMEDDS), illustrate their potential as alternative approaches for the delivery of hydrophobic drugs.[6] To develop self micro emulsifying drug delivery system which improves oral bioavailability of Irbesartan. Hence, objectives of present investigation are to optimize SEDDS by pseudoternary phase diagram, to formulate S-SEDDS, to Design, Development and In-vitro Characterization of Self Emulsifying Drug Delivery System, to investigate invitro release profile of SEDDS, and to investigate in vitro drug release studies of SEDDS.[7]

2. MATERIALS AND METHOD

2.1 MATERIALS

Irbesartan was collected as a gift sample from CPS, IST, JNTUH, Hyderabad, Capryol 90, capmul, labrafac, croda and Transcutol-HP were purchased from Gattefosse, Mumbai, Oilve, Rose, clove oils were purchased from Deoleo India Pvt, Ltd. And other excipients from CPS, IST, JNTUH, Hyderabad.

2.2 METHODODOLOGY[8,9,10]

Solubility studies

The dissolvability of Irbesartan was controlled by including excess measure of medication (500mg) to each screw topped glass vials containing 1 gram of excipient. The blend was cyclomixed instantly utilizing cyclo-blender to encourage active ingredient solubilisation. At that point the blends were warmed in thermostatic water shower at 40^{o}C for 5 minutes further

to build the solubilisation. Then, the blends were kept in revolving shaker at a speed of 100 rpm for 48 hours at 25°C and kept for equilibration for room temperature. The supersaturated solutions were then centrifuged at a speed of 2000 rpm for 15 minutes to isolate the undissolved medication from the supernatant fluid. Aliquots of supernatant fluid were pulled back utilizing a micropipette and diluted appropriately. The concentration of medication in solution was determined by UV spectrophotometer at 246 nm after dilution. Concentration of Irbesartan in each vehicle was determined from the calibration curve.

Drug-Excipient compatibility studies by FTIR spectroscopy

Drug-Excipient compatibility studies were performed by studying the Infra Red spectrums of various drug-excipient mixtures.

Construction of pseudo-ternary phase diagram

The pseudo-ternary stage charts were developed for oil, surfactant/co-surfactant, and water bat room temperature by water titration method. The surfactant was mixed with a co-surfactant in a settled volume proportion 4:1, 3:1, 2:1, 1:1 separately. Aliquots of surfactant/co-surfactant blend were then blended with the oil at proportions of 9:1, 8:2, 7:3, 6:4, 5:5, 4:6, 3:7, 2:8, 1:9 in various vials and afterward titrated with water at room T°C.

Formulation and development

Preparation of SELFs

Varying proportion of oil, surfactant and co-surfactant were chosen for preparation systems.

Irbesartan was kept consistent (50mg) for all preparations. Surfactant/co-surfactant mixture(Smix) was set up by blending reasonable extents of surfactant, co-surfactants and they were cyclo-blended. Irbesartan was precisely weighed and dissolved in appropriate extents of oil/Smix blend. The preparations were cyclomixed for 1 min to facilitate uniform blending and after that heated in thermostatic water bath at 40°C to encourage active ingredient solubilization. At that point all preparations were cyclomixed until transperant formulations were acquired. At long last formulated SELFs of Irbesartan were kept aside at room temperature for 48 hours and analyzed for indications of turbidity (or) stage partition and the preparation is described for different parameters.

Characterization of self-emulsifying lipid formulation[11,12,13,14,15]

Self emulsification time and visual assessment

The prepared formulations were added drop wise to 250ml of water. Self emulsifying mixtures should quickly disperse in water with mild shaking.

Dispersibility test

Self emulsification property of SELFs was assessed by visual appraisal. Time taken for the arrangement of miniaturized micro emulsion was controlled by drop wise addition of detailing to 250ml of distilled water, simulated gastric liquid and phosphate buffer of pH 6.8 in isolated glass measuring glasses at 37°C. The substance were tenderly blended utilizing magnetic stirrer at 100rpm. The inclination to form an emulsion was surveyed as "great" when emulsification happens quickly in less then 1 minute with clear (or) straightforward appearance.

Phase separation and stability study of emulsion

Each SEDDS preparation (50µL) was added to vials containing 5ml of multiplied distilled water, simulated gastric liquid at room temperature and cyclomixed for 1 minute then every blend was put away and watched for phase separation and precipitation of drug at interims 2, 4, 6, 8, 12, and 24 hours period of time.

Effect of Dilution

Prepared Selected preparations were subjected to dilution in various proportions of 1:100 and 1:1000 folds with distilled water, 0.1 N HCL and phosphate buffer (pH 6.8). The dilutions emulsions were put away for 24 hr and visually watched for any indications of stage partition (or) precipitation of medication.

Percentage Transmittance

Each SEDDS preparation (100µL) was added to a vial contains10mL of double distilled water, 0.1N HCL and phosphate buffer of pH 6.8 at room temperature and cyclo-mixed for 1minute. Each sample was observed for % transmittance at 246 nm.

Drug loading efficiency

Drug content in preparation was determined UV-Spectrophotometrically. 50mg of every detailing was precisely weighed and diluted to 100ml with methanol.

$$\text{Drug loading efficiency} = \frac{\text{Amount of drug in known amount of formulation}}{\text{Initial drug load}} * 100$$

Thermodynamic Stability Studies

The formulated SSELFs were subjected to thermodynamic stability studies to study the effect of centrifugation and temperature on stability of micro emulsions.

Centrifugation study

The preparations were added to deionized water (1:20) and centrifuged at 3500 rpm for 30 minutes, and observe for phase separation or prepicitation.

Freeze thaw cycle

Preparation which are stable under centrifugation were subjected to freeze thaw cycle. In this investigation, SELFs were diluted with deionized water (1:20) and subjected to two freeze thaw cycle somewhere in the range of −20°C and +25°C by putting away at every temperature for 48 hours.

Droplet size and zeta potential determination:

SELFs formulations were diluted to 100 times with distilled water in beaker with consistent magnetic stirrer. The droplet size distribution and Zeta potential of resultant smaller micro emulsion were resolved after 1 hr by powerful light scattering (DLS) spectroscopy utilizing a Zetasizer Nano ZS Version 6.20(Malvern Instruments, UK).

In vitro drug release studies

The in vitro dissolution investigation of SELFs which were filled into appropriate size capsule were carried utilizing USP Type II dissolution test apparatus (DS 8000 LabIndia) in 500ml buffer of pH 1.2 at 37+-0.5°C with 100rpm turning speed.

Accelerated stability studies

Accelerated stability studies of SELFs was carried out by storing the preparation at 40°C and 75%RH for 1 month in stability chamber. Later the preparation was characterized for parameters such as effect of dilution, droplet size, PDI and in vitro drug release.

3. RESULTS AND DISCUSSION

Drug-excipient compatibility studies by FT-IR spectroscopy

The spectrums of drug-excipient mixtures and the formulations so obtained were compared with spectrum of pure drug for any interactions. Characteristics peaks were observed at 1732.5 cm^{-1}, 2395.0 cm^{-1}, 1616.8 cm^{-1}, 1177.9$cm^{-1,}$ 722.8cm^{-1} for NH stretching vibration, OH stretching, C=N stretching, C=C stretching and bending of C-CL groups respectively.

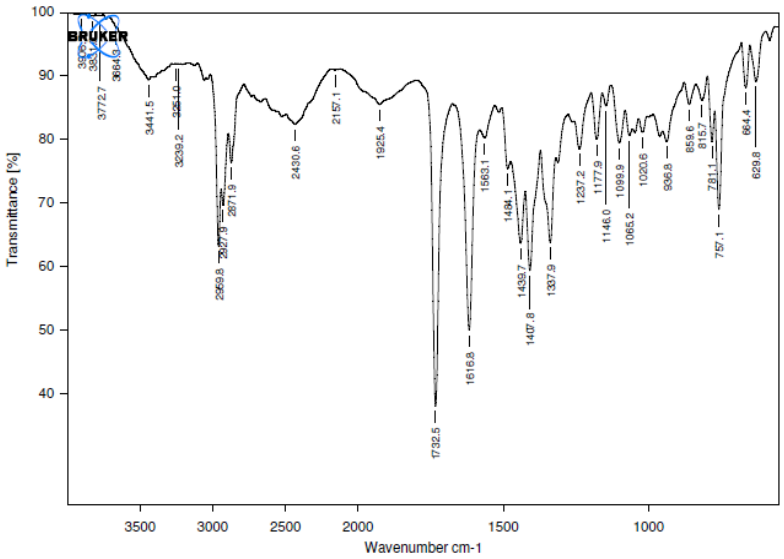

Fig-1: FT-IR Spectrum of pure drug (Irbesartan).

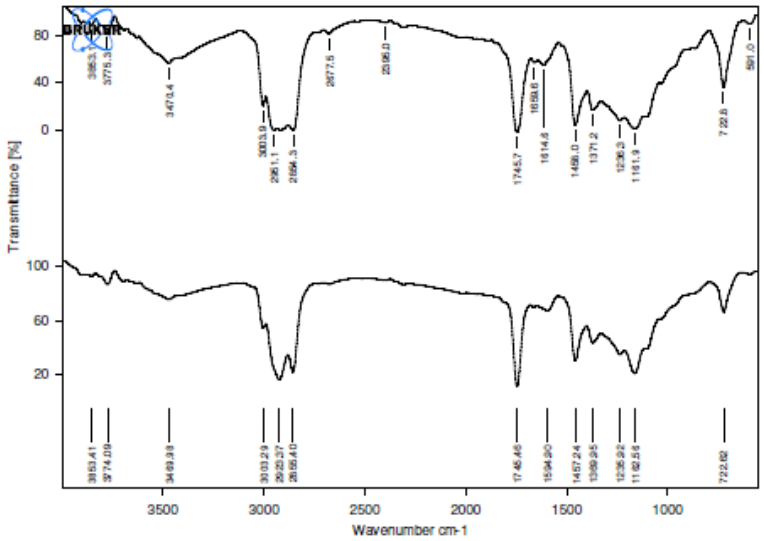

Fig-2: Function group analysis of pure drug and liquid Irbesartan SELFs by FTIR

Solubility studies of Irbesartan.

Solubility of irbesartan in various oils

Solubility of irbesartan in various oils were determined by UV spectrophotometer.

Table-1: Solubility of irbesartan in various oils./

OILS	SOLUBILITY
Olive oil	20.608
Rose oil	15.232
Almond oil	5.752
Clove oil	10.614

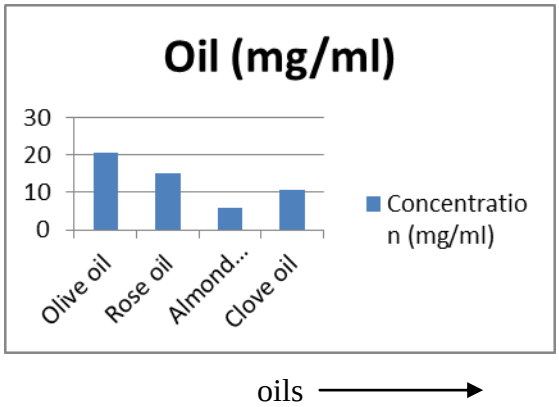

Fig 3: Solubility of Irbesartan in various oils.

Solubility of Irbesartan in various surfactants

Table-2: Solubility of irbesartan in various surfactants.

SURFACTANT	SOLUBILITY
PEG 400	27.527
Labrafac M19	7.260
Labrasol	20.439
Capmul PG 8	18.633

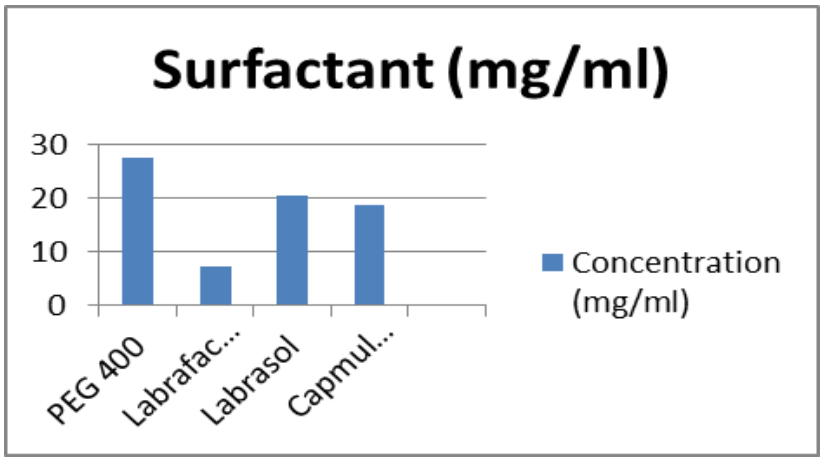

Fig-4: Solubility of irbesartan in various surfactants.

Solubility of Irbesartan in various co-surfactants

Table -3: Solubility of Irbesartan in various co-surfactants.

Co-surfactant	Solubility
Capryol 90	23.745
Transcutol HP	12.614

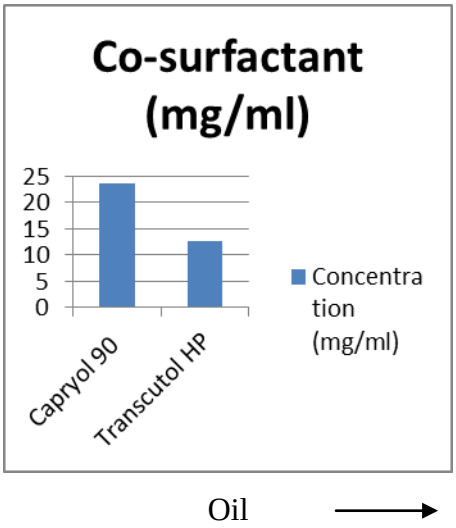

Fig-5: Solubility of Irbesartan in various co-surfactants.

Pseudo ternary phase diagram

Pseudo-ternary phase diagrams were constructed to identify the self-microemulsifying regions by water titration technique. It helps to identify suitable composition of oil,surfactant and co-surfactant for the preparations of SELFs. From the ternary phase diagram,it has been found that the systems containing olive oil, as oily phase PEG 400 as surfactant and capryol 90 as co-surfactant showed good nano emulsifying property. For S_{mix} 3:1 ratio formulations OLPEGCL31 showed Bluish transparent emulsion (BTE) for Oil: S_{mix} 2:8, 1:9 and Clear transparent emulsion(CTE) for 9:1, 8:2, 7:3, 6:4, 5:5, 4:6, 3:7. For S_{mix} 4:1 ratio formulations OLPEGCL41 showed Milky white emulsion (MWE) for Oil: S_{mix} 9:1, 8:2,7:3, 6:4, 5:5,4:6 and Bluish white emulsion(BWE) for 3:7, 2:8, 1:9.

Formulation: Olive oil, PEG 400(3) - Capryol 90(1) (OLPEGCL3:1)

Table-4: Percentage composition of Olive oil and PEG 400 (3)– Capryol 90(1) upon titration with water.

Formulation name	Oil (mg)	S_{mix} (mg)	Water(mg)	Total(mg)	% S_{mix}	% Oil	%water	Remarks
OLPEGCL31 9:1	450	50	6986	7486	0.667	6.011	93.320	CTE
OLPEGCL31 8:2	400	100	7936	8436	1.185	4.741	94.073	CTE
OLPEGCL31 7:3	350	150	6186	6686	2.243	5.234	92.570	CTE
OLPEGCL31 6:4	300	200	6930	7430	2.691	4.037	93.270	CTE
OLPEGCL31 5:5	250	250	7131	7631	3.276	3.276	93.447	CTE
OLPEGCL31 4:6	200	300	7205	7705	3.893	2.595	93.510	CTE
OLPEGCL31 3:7	150	350	8261	8761	3.994	1.712	94.292	CTE
OLPEGCL312:8	100	400	8245	8745	4.574	1.143	94.282	BTE
OLPEGCL311:9	50	450	8399	8899	5.056	0.561	94.381	BTE

BTE=Bluish transparent emulsion ;CTE= Clear transparent emulsion

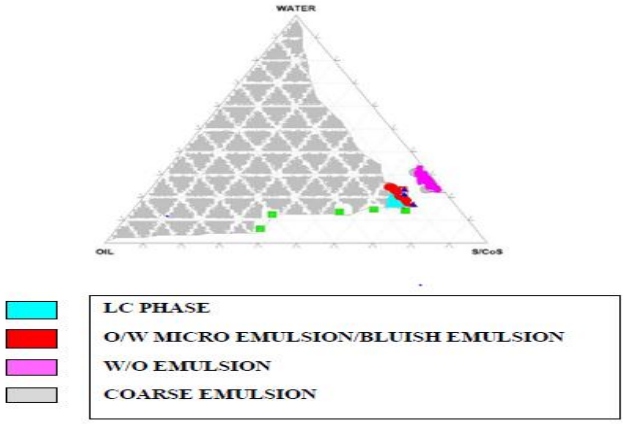

Fig-6: Pseudo ternary phase diagram of OLPEGCL3:1.

Formulation: Olive oil, PEG 400 (4) – Capryol(1)(OLPEGCL4:1)

Table-5: Percentage composition of Olive oil and PEG 400 (4)– Capryol 90(1) upon titration with water.

Formulation name	Oil (mg)	S_{mix} (mg)	Water (mg)	Total (mg)	% S_{mix}	%Oil	%Water	Remarks
OLPEGCL41 9:1	450	50	3072	3572	1.399	12.597	86.002	MWE
OLPEGCL41 8:2	400	100	3901	4401	2.272	9.088	88.638	MWE
OLPEGC41 7:3	350	150	3753	4253	3.526	8.229	88.243	MWE
OLPEGCL41 6:4	300	200	4125	4625	4.324	6.486	89.189	MWE
OLPEGCL41 5:5	250	250	5023	5523	4.526	4.526	90.946	MWE
OLPEGCL41 4:6	200	300	7038	7538	3.979	2.653	93.366	MWE
OLPEGCL41 3:7	150	350	8506	9006	3.886	1.665	94.446	BWE
OLPEGCL412:8	100	400	8800	9300	4.301	1.075	94.623	BWE
OLPEGCL41 1:9	50	450	9163	9663	4.656	0.517	94.825	BWE

BWE=Bluish white emulsion; MWE=Milky white emulsion;

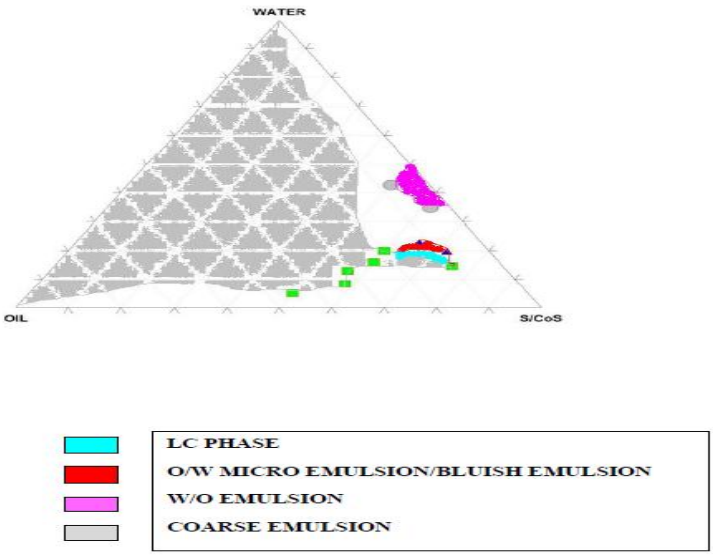

Fig 7: Pseudo ternary phase diagram of OLPEGCL4:1.

Table-6: Visual observations of OLPEGCL41 and OLPEGCL31 emulsions.

PEG 400+Capryol 90:Olive oil	PEG 400+Capryol 90 4:1	PEG 400+Capryol 90 3:1
9:1	I	III
8:2	I	III
7:3	I	III
6:4	I	III
5:5	I	III
4:6	IV	III
3:7	IV	II
2:8	II	II
1:9	II	II

Formulation and Development

Preparation of selected Self emulsifying lipid formulation

Four different self emulsifying lipid formulatios were prepared with varying ratios of oil, surfactant, and co-surfactant. In all the formulations, the amount of Irbesartan was constant (i.e. 50 mg).Drug is dissolved in oil and then S_{mix} is added to the oil-drug mixture and the final mixture is cyclomixed using a cyclomixer until a transparent preparation is obtained.

Table-7: Composition of prepared self emulsifying lipid formulations

F. name	Drug(mg)	Olive oil(mg)	PEG 400(mg)	Capryol 90(mg)
OLPEGCL31(2:8)	50	100	750	250
OLPEGCL31(1:9)	50	50	750	250
OLPEGCL41(3:7)	50	150	800	200
OLPEGCL41(2:8)	50	100	800	200
OLPEGCL31(1:9)	50	50	800	200

Evaluation of Irbesartan Self emulsifying lipid formulations

Self Emulsification time and visual assessment

The prepared self-emulsifying lipid of Irbesartan were emulsified under 1min. The efficiency of all prepared emulsion was good.

Table 8: Self emulsification time.

Formulation name	Self emulsifying time(sec)	Remarks
OLPEGCL31(2:8)	28±1.25 sec	Good
OLPEGCL31(1:9)	30±1.75 sec	Good
OLPEGCL41(3:7)	24±1.25 sec	Good
OLPEGCL41(2:8)	27±1.50 sec	Good
OLPEGCL41(1:9)	29±1.25 sec	Good

Effect of dilution

Table 9: Effect of dilution.

Formulation name	Distilled water	0.1N HCL	Phosphate buffer
OLPEGCL31 (2:8)	Passed	Passed	Passed
OLPEGCL31 (1:9)	Passed	Passed	Passed
OLPEGCL41 (3:7)	Passed	Passed	Passed
OLPEGCL41 (2:8)	Passed	Passed	Passed
OLPEGCL41 (1:9)	Passed	Passed	Passed

Phase separation and stability study of emulsions

Table 10: Phase separation and precipitation of the drug.

S.NO	Formulation	Precipitation	Phase separation
1	OLPEGCL31 2:8	No	No
2	OLPEGCL31 2:8	No	No
3	OLPEGCL41 3:7	No	No
4	OLPEGCL41 2:8	No	No
5	OLPEGCL41 1:9	No	No

Percentage transmittance

Table 11: Percentage transmittance.

S.NO	Formulation	Distillied water	0.1NHCL	Phosphate buffer(pH 6.8)
1	OLPEGCL31 2:8	98.53±0.43	97.64±1.26	98.07±0.59
2	OLPEGCL31 1:9	95.10±0.57	98.79±0.76	97.63±0.63
3	OLPEGCL41 3:7	96.36±1.40	96.58±0.73	94.57±0.94
4	OLPEGCL41 2:8	94.95±0.26	95.57±0.91	98.25±0.97
5	OLPEGCL41 1:9	97.16±0.94	98.36±0.98	97.68±0.96

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

Drug loading efficiency

Table 12: Drug loading efficiency of formulations.

S.NO	Formulation	Drug loading efficiency
1	OLPEGCL31 2:8	96.84±0.72
2	OLPEGCL31 1:9	98.27±0.43
3	OLPEGCL41 3:7	96.49±0.94
4	OLPEGCL41 2:8	93.52±0.84
5	OLPEGCL41 1:9	98.96±0.79

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

Thermodynamic stability studies

Table-13: Thermodynamic stability studies

S.NO	Formulation	Centrifugation (3,500 rpm)	Freeze thaw cycle (-20^0C and $+25^0$C)
1	OLPEGCL31 2:8	Passed	Passed
2	OLPEGCL31 1:9	Passed	Passed
3	OLPEGCL41 3:7	Passed	Passed
4	OLPEGCL41 2:8	Passed	Passed
5	OLPEGCL41 1:9	Passed	Passed

Droplet size and Zeta potential determination

The droplet size of the micro emulsion is essential since it determines the rate and extent of medication discharge and absorption. The medication can diffuse quicker from smaller droplets into the aqueous stage, subsequently expanding the medication dissolution. Littler droplet size estimate exhibits huge surface zone for medication absorption. Enhance in surfactant concentration decreases the droplet size upto a specific size however from that point any longer increase in surfactant focus results in an expansion in droplet size. The decrease in drop size can be credited to the adjustment of oil drops because of limitation of surfactant monolayers at the oil-water interface. The bead size of the microemulsion was estimated utilizing dynamic light disseminating. The bead sizes of chosen SELFs were observed to be in the middle of 100-200 nm as appeared in table poly-dispersity file was well underneath 0.500 which demonstrates great size consistency.

Table 14: Droplet size and zeta potential and PDI of formulation OLPEGCL31.

Oil:Smix	Size of emulsion droplets(d-nm)	Region	Zeta potential	PDI
OLPEGCL31 9:1	130.5	Micro	-0.316	0.285
OLPEGCL31 8:2	129.9	Micro	-4.64	0.128
OLPEGCL31 7:3	155.6	Micro	-18.6	0.651
OLPEGCL31 6:4	147.8	Micro	-8.9	0.729
OLPEGCL31 5:5	143.7	Micro	-0.5	0.834
OLPEGCL31 4:6	138.2	Micro	-2.6	0.736
OLPEGCL31 3:7	130.9	Micro	-3.7	0.930
OLPEGCL31 2:8	193.1	Micro	4.74	0.137
OLPEGCL31 1:9	120.9	Micro	-9.46	0.894

Table: 15 Droplet size and zeta potential and PDI of formulation OLPEGCL41.

Oil:Smix	Size of emulsion droplets(d-nm)	Region	Zeta potential	PDI
OLPEGCL41 9:1	236.4	Micro	-0.316	0.285
OLPEGCL41 8:2	204.6	Micro	-4.64	0.128
OLPEGCL41 7:3	320.8	Micro	-18.6	0.651
OLPEGCL41 6:4	283.1	Micro	-8.9	0.729
OLPEGCL41 5:5	376.7	Micro	-0.5	0.834
OLPEGCL41 4:6	246.8	Micro	-2.6	0.736
OLPEGCL41 3:7	285.4	Micro	-3.7	0.930
OLPEGCL41 2:8	205.3	Micro	4.82	0.487
OLPEGCL41 1:9	56.16	Nano	-6.80	0.475

Table 16: Results of Droplet size, PDI and zeta potential of selected liquid SELFs.

Formulation name	Average droplet size (nm)	PDI	Zeta potential(mv)
OLPEGCL31 (2:8)	193.1	0.137	-4.74
OLPEGCL31 (1:9)	263.3	0.245	-5.19
OLPEGCL41 (3:7)	238.1	0.431	-4.54
OLPEGCL41 (2:8)	205.3	0.487	-4.82
OLPEGCL41 (1:9)	56.16	0.475	-6.80

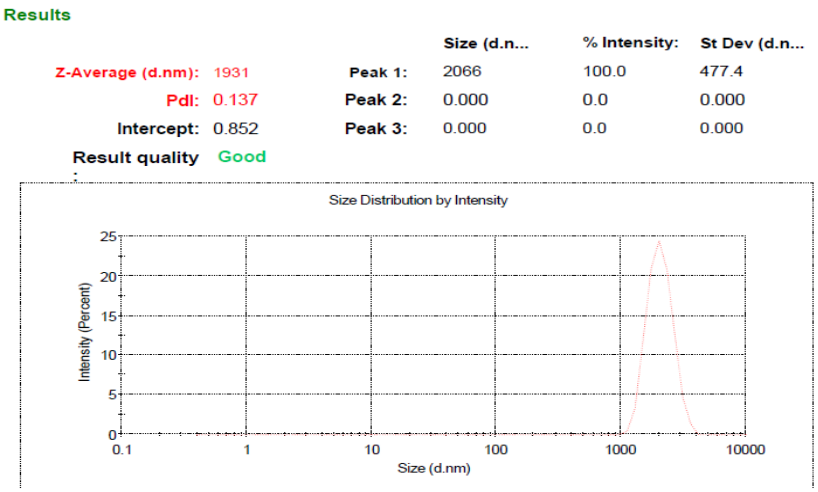

Fig. 8: Droplet size disturbution of OLPEGCL31 (1:9) formulation.

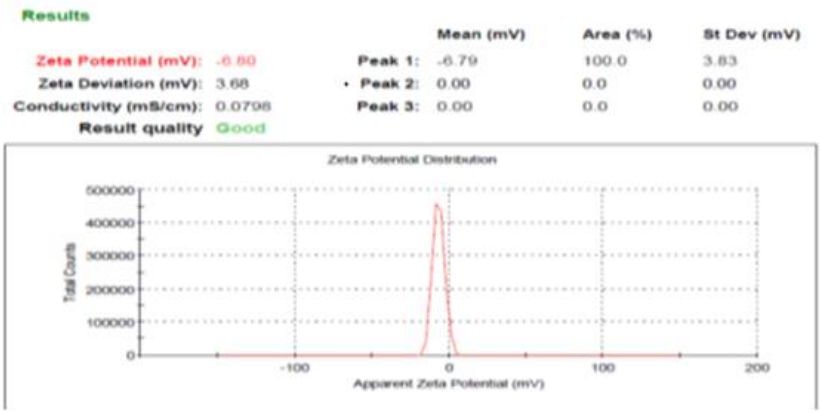

Fig-9: Zeta potential of OLPEGCL41 (1:9) formulation.

In-vitro drug release study

Percentage drug release and cumulative % drug release were calculated from absorbance and concentration that were obtained with the help of standard graph of Irbesartan. After performing the drug release study for 60 min in 0.1N HCL, OLPEGCL31(2:8) formulation showed 70.14 % and the OLPEGCL41(1:9) formulation showed 83.42 % drug release and pure drug showed 71.55 % drug release.

Table 17: Cumulative % release of pure drug and liquid Irbesartan SELFs in 0.1N HCL.

Time (min)	Pure drug	OLPEGCL31 2:8	OLPEGCL41 1:9
0	0	0	0
5	25.47	55.6	33.8
10	35.80	59.36	44.6
15	48.16	64.68	58.78
30	59.19	69.92	62.80
45	63.15	73.52	65.29
60	71.55	83.42	68.14

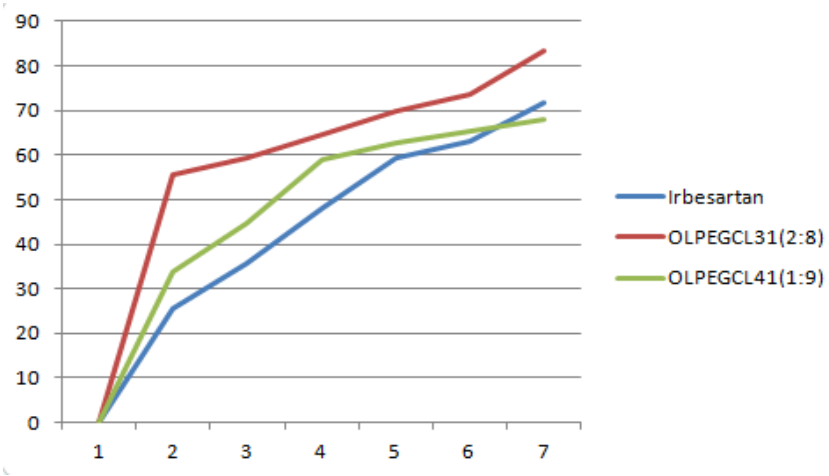

Fig-10: Comparison of percentage drug release of pure drug and their selected emulsions.

Accelerated Stability Studies

Stability studies as per ICH guidelines (40℃ and 75%RH) for SELFs of Irbesartan.

Table-18: Accelerated stability studies.

Formulation	Effect of dilution	Droplet size(d-nm)	Zeta potential	PDI	Drug release
OLPEGCL31 (2:8)	Passed	193.1	-4.74	0.137	83.42
OLPEGCL41 (1:9)	Passed	56.16	-6.80	0.475	68.14

4. CONCLUSION

The medication Irbesartan which was poorly soluble drug was chosen for SELFs because of its poor aqueous solubility and its oral bioavailability which is roughly under 60%. Self emulsifying lipid preparation was produced to enhance its solvency and dissolution rate. A series of Pseudoternary diagrams were constructed to identify by water the nanoemulsion region. Various compositions of oil and S_{mix} were titrated with water to idenify the nanoemulsion region. From pseudo ternary phase diagrams systems consisting of Olive oil, PEG 400 and Capryol 90 are prepared by selecting oil:S_{mix} ratio 1:9, ……,9:1 and S_{mix} ratio 3:1,4:1.The chose preparations were additionally assessed for self emulsification time, phase separation, rate transmittance, drug loading efficiency, effect of dilution, FT-IR studies, thermodynamic stability studies, dissolution studies, droplet size distribution and zeta potential. None of the formulations showed stage partition and medication precipitation. Thermodynamic security ponders had shown that they are steady after centrifugation and stop defrost cycle. No detailing showed stage partition and precipitation. All plans are emulsified in under 1 minute. All definitions demonstrated % transmittance over 95% showing clear emulsions. The definitions have drug entrapment efficiency over 95%. Drop estimate was observed to be 193.1 nm and zeta potential - 4.74 Mv and medication excipients studies about were finished by FTIR with chosenformulations. The SELFs obviously enhanced and increase the drug dissolution of poorly soluble drug. This keeps the medication in soluble state in GIT. So, the prepared SELFs have capability for delivering poorly water soluble drug Irbesartan in soluble state in GIT.

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