

# Solubility Enhancement of Satranidazole Using Self Emulsified Drug Delivery Systems

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## ABSTRACT

**Background:** Satranidazole is an antiprotozoal and antibacterial drug which falls under class II drug as per biopharmaceutical classification systems having poor aqueous solubility. **Aim:** Therefore, present study was aimed at solubility enhancement of Satranidazole using self emulsified drug delivery system (SEDDS). **Methods:** SEDDS was prepared using Oleic acid as oil, Tween 20 and PEG400 as Surfactant and Co-surfactant respectively. For preparation of stable SEDDS, micro emulsion region was identified by constructing pseudo ternary phase diagram containing different proportion of surfactant: co-surfactant (1:1, 2:1 and 3:1), oil and water. **Physico-Chemical Evaluation:** Total nine SEDDS formulations were prepared (F-1 to F-9) and evaluated for self emulsification time & dispersibility, droplet size analysis, stability studies, turbidimetry, zeta potential, drug content and *in vitro* drug release. **Results:** Among all the formulations, three formulations (F-1, F-4 & F-7) showed a drug release of greater than 70% in 45 minutes whereas marketed preparation showed more than 70% of drug release in 90 minutes. Based on results of self emulsification time & dispersibility, droplet size analysis, drug content and *in vitro* drug release, F-7 formulation was selected as an optimized formulation which showed a maximum drug release of 94.89% in 45 minutes. **Conclusion:** Hence SEDDS formulations can be a potential alternative to traditional oral drug delivery systems of Satranidazole to improve its solubility.

**Key words:** Satranidazole, Surfactants, Lipid vehicles, Pseudo ternary phase diagrams, SEDDS.

## INTRODUCTION

Protozoal infections are common amongst the people in undeveloped tropical and subtropical countries, where sanitary conditions, hygienic practices and control of vectors of transmission are insufficient. As protozoans are unicellular eukaryotes, their cells have metabolic processes closer to those of human host than to prokaryotic bacterial pathogens. Therefore, protozoal diseases are less easily treated than bacterial infections.<sup>1,2</sup> Literature investigation reveals that amoebiasis is the second leading cause of death from parasitic disease worldwide.<sup>3</sup> Satranidazole is an antiprotozoal and antibacterial drug belonging to nitroimidazole derivatives and was selected as a drug of choice because it is very potent, well tolerated and clinically effective against common protozoa.<sup>1,4</sup> Satranidazole is a systemically acting drug which is twice as effective as other

nitroimidazoles. It is successfully used in the treatment of some parasitic diseases (intestinal and hepatic amoebiasis, giardiasis, trichomoniasis and anaerobic infections). But it exhibits a low bioavailability which is related to its poor aqueous solubility. Satranidazole falls under class II compounds as per biopharmaceutical classification system.<sup>5</sup> Several formulation approaches are employed such as co-solvency, inclusion complexation, micronization, use of nanosuspensions, micellar solubilization by surfactants and solid dispersions to tackle the formulation challenges of poorly water soluble drugs.<sup>6</sup> However their success ratio and utility have been faced by certain disadvantages. Among all such delivery systems, one of the most popular approach is the Self-emulsifying drug delivery system (SEDDS).<sup>7</sup>

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Self-emulsifying drug delivery systems (SEDDS) are comparatively newer lipid-based scientific innovations with massive promise in oral bioavailability enhancement of poorly water soluble drugs.<sup>8</sup> SEDDS are isotropic mixtures of drug, lipids and surfactants, usually with one or more hydrophilic co-surfactants or co-solvents. Upon dilution with aqueous media and gentle agitation provided by the gastrointestinal motility, they undergo spontaneous emulsification in gut lumen.<sup>9,10</sup> 'SEDDS' is a general term with droplet size below 250 nm. The small globule size of SEDDS coupled with its surface activity enables more efficient transport through intestinal membranes, resulting ultimately in more rapid onset of action.<sup>8</sup> Formulation of self-emulsifying drug delivery system requires less energy input and its stability is longer than that of conventional emulsions. Benefit of self-emulsifying formulations over solid dosage formulations is the avoidance of slow drug dissolution. Therefore, self-emulsifying drug delivery system can be competent vehicle for class II and IV molecules of the Biopharmaceutical Classification System (BCS) drugs.<sup>11</sup> The present study focuses on preparation of thermodynamically stable self-emulsifying drug delivery system having self-emulsification efficiency which results in increased solubility of poorly water soluble drugs.

## MATERIALS AND METHODS

Satranidazole was obtained as gift sample from Alkem Laboratories, Mumbai. Oleic acid and Castor oil were obtained from Merck specialist Pvt. Ltd. Mumbai, Isopropyl myristate, Sunflower oil, Tween 20, Tween 60, Tween 80, Span 20, Span 80, PEG 400, PEG 600 and Propylene glycol were obtained from Himedia Laboratories Pvt. Ltd. Mumbai.

### Saturation solubility study

Equilibrium solubility of Satranidazole was measured in various oils (viz. Oleic acid, Isopropyl myristate, castor oil, sunflower oil), Surfactants (viz. Tween 20, Tween 60, Tween 80, Span 20, Span 80) and Co-surfactant (viz. PEG 400, PEG 600 and Propylene glycol). An excess amount of Satranidazole (100 mg) was added to each of selected vehicles (10 ml) and the mixture was stirred continuously for 72 hours at  $37 \pm 1^\circ\text{C}$ . After equilibrium was attained, the mixture was centrifuged at 3000 rpm for 10 min, and the obtained supernatant was filtered through a membrane filter having pore size of  $0.45 \mu$  and diluted with appropriate solvent (Methanol/Chloroform). Absorbance of the filtrate was measured using a double beam UV/VIS spectrophotometer at  $\lambda_{\text{max}}$  of 318

nm. The content of Satranidazole was determined using a previously constructed standard calibration curve.<sup>12,13</sup>

### Construction of pseudo ternary phase diagram

Based on the observations of solubility studies, components of emulsion viz. oil phases, surfactants and co surfactants indicating highest solubility of Satranidazole were selected. The surfactants and co-surfactants were blended together in 1:1, 2:1, 3:1 proportions respectively. These blends of surfactants: co surfactants (S-cos mix) were mixed with oily phase by adding small amounts with constant stirring. The proportions of oil: S-cos mix were varied as 9:1, 8:2, 7:1, 6:4, 5:5, 4:6, 3:7, 2:8 and 1:9. The resultant blends were titrated with distilled water and visually observed for clarity. The amount of water at which gel formation or transparency to turbidity transitions occurred was noted and was considered as the end point of titration. The points before the end point of titration were considered to be within the microemulsion region. The values of titration were then used to determine the boundaries of microemulsion region corresponding to chosen values of Oils as well as S-Cos mixing ratio. Phase diagrams were then constructed using CHEMIX School™ 3.60 (Trial version) software.<sup>14</sup>

### Preparation of SEDDS formulation of Satranidazole

A series of SEDDS were prepared using Oleic acid as oil, Tween 20 as a surfactant and PE400 as the Co-surfactant (Table 1). In all the formulations, the concentration of Satranidazole was kept constant (i.e., 60 mg/10 ml). The quantities of oil phase, surfactant and co-surfactant in appropriate portions were selected based on the result of solubility study and observing phase data of ternary diagram. Accurately weighed Satranidazole was placed in a glass vial and oil, surfactant and co-surfactant were added. Then the components were mixed by vortex mixing, until Satranidazole was perfectly dissolved. The mixture was stored at room temperature until further use.<sup>12</sup>

### Formulation characterization

#### Self emulsification time and Dispersibility test

Evaluation of self-emulsifying properties of SEDDS formulations was performed by visual assessment. The efficiency of self-emulsification of oral nano or micro emulsion is assessed by using a standard USP XXII dissolution apparatus 2 for dispersibility test. 1 ml of each formulation was added in 500 ml of water at  $37 \pm 1^\circ\text{C}$ . A standard stainless steel dissolution paddle is used with rotating speed of 100 rpm provided gentle agitation

and the time required for the formation of emulsion is noted.

The resulting mixture was evaluated for precipitation and phase separation at various time intervals (2, 4, 6, 8, 12, 24 hours). The *in vitro* performance of the formulations is visually assessed using the following grading system:<sup>9,12</sup>

Grade A: Rapidly forming (within 1 min), nanoemulsion, having a clear or bluish appearance.

Grade B: Rapidly forming, slightly less clear emulsion, having a bluish white appearance.

Grade C: Fine milky emulsion that formed within 2 min

Grade D: Dull, grayish white emulsion having slightly oily appearance that is slow to emulsify (longer than 2 min).

Grade E: Formulation, exhibiting either poor or minimal emulsification with large oil globules present on the surface.

#### **Droplet size analysis**

From each formulation, 0.1 ml of SEDDS was diluted in 250 ml of water and stirred gently at 100 rpm using magnetic stirrer. The resulting solution was subjected to size analysis using Nanotrack with a particle size measurement range of 1 to 6000 nm.<sup>9,12</sup>

#### **Stability studies**

**Effect of Dilution:** Formulations were diluted with excess of water, 0.1 N HCl and phosphate buffer (pH 6.8) and was stored for 24 hours. Later they were checked for precipitation or phase separation.

**Thermodynamic Stability Studies:** Thermodynamic stability studies were carried in three main steps;

**Heating cooling cycle:** Six cycles of cooling and heating between refrigerator temperature (4°C) and elevated temperature (45°C) with exposure at each temperature for not less than 48 hours are carried. Those formulations, which are stable, are then subjected to centrifugation test.

**Centrifugation:** Formulations which pass the heating cooling cycle are centrifuged at 3500 rpm for 30 min. Those formulations that doesn't show any phase separation, are taken for the freeze thaw stress test.

**Freeze thaw stress cycle:** Three freeze thaw cycles between -21°C and 25°C with storage at each temperature for not less than 48 hours. Then, formulations were observed for phase separation, cracking or creaming.<sup>10,15</sup>

#### **Turbidimetric Evaluation**

From each formulation, 0.1 ml of SEDDS was added to 10 ml of 0.1N HCl under continuous stirring at 100 rpm on magnetic stirrer at optimum temperature and the turbidity is measured using a Colorimeter at 510 nm.<sup>9</sup>

#### **Zeta potential Determination**

From each formulation, 0.1 ml of SEDDS was diluted in 10 ml of distilled water and it was employed to determine zeta potential. Zeta potential was determined by Zeta meter.<sup>13</sup>

#### **Drug content**

SEDDS formulation equivalent to 10 mg of Satranidazole, was dissolved in 0.1N HCl. Resultant solution was diluted appropriately and drug content was analyzed by UV-spectrophotometer.<sup>9</sup>

#### **In vitro Dissolution Studies**

The *in vitro* dissolution test was performed in 900 ml of 0.1N HCl media at pH 1.2 using US Pharmacopeia dissolution apparatus II (Paddle type). The bath temperature was maintained at  $37 \pm 0.5^\circ\text{C}$ ; the paddle speed was maintained at 100 rpm. 2 ml of the SEDDS formulation along with 2 ml of dialyzing medium (0.1 N HCl) were filled in the dialysis membrane (0.45  $\mu$ ) and used for drug release studies; results were compared with those of Marketed product (Satrogyl Tablet). At regular intervals of time, a 5 ml sample of medium was taken out and subjected to drug analysis using UV spectroscopy. The removed volume was replaced each time with 5 ml of fresh medium.<sup>12</sup>

#### **Short term Stability study**

Stability study was performed on the optimized formulation; the formulation was subjected to different temperature and humidity conditions i.e. Accelerated Conditions ( $40 \pm 2^\circ\text{C}$ ) and  $75 \pm 5\%$  RH and Room Temperature ( $25 \pm 2^\circ\text{C}$ ) and  $60 \pm 5\%$  RH of 2 months. Sample was withdrawn at the interval of 1 month and was evaluated for drug content, droplet size and self emulsification.<sup>16</sup>

## **RESULTS**

#### **Saturation solubility study**

Selection of oils, surfactant and co-surfactant was done on the basis of solubility. The oils, surfactant and co-surfactants which were able to solubilize the maximum amount of drug were selected. From the results it was clear that the Oleic acid, Tween 20 and PEG 400 solubilised maximum amount of drug (Figure 1, 2, 3). Therefore, they were selected for further studies.

#### **Construction of pseudo ternary phase diagram**

Based on the observations of solubility studies, components of emulsion viz. oil phases, surfactants and co surfactants indicating highest solubility of Satranidazole

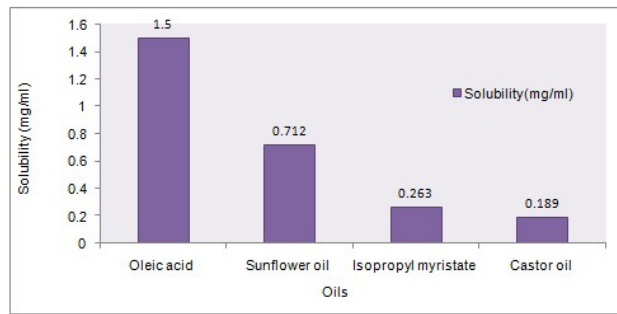


Figure. 1: Solubility of Satranidazole in various Oils

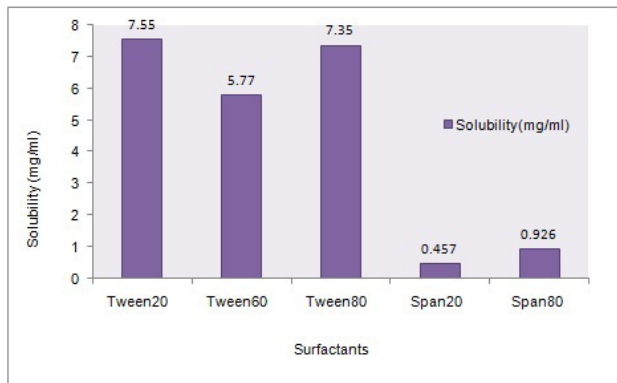


Figure. 2: Solubility of Satranidazole in various Surfactants

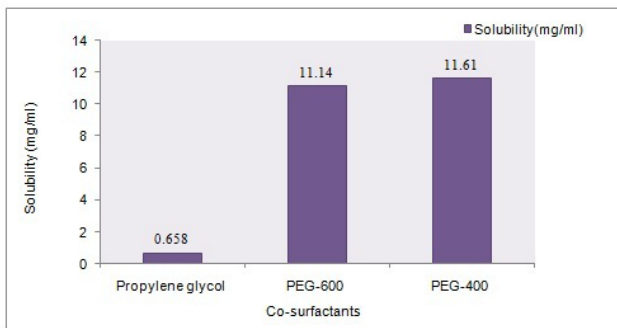


Figure. 3: Solubility of Satranidazole in various Co-surfactants

were selected. Pseudo ternary phase diagram was constructed to find out micro emulsion area. In the results of Pseudo ternary phase diagram where, surfactant: co-surfactant (3:1) showed larger micro emulsion area than for surfactant: co-surfactant (1:1 and 2:1). In the (Figure 4), Golden yellow colour indicates microemulsion area.

The size of micro emulsion area in the (Figure 4) depends upon the amount of water consumed in the titration. Larger micro emulsion area indicates maximum

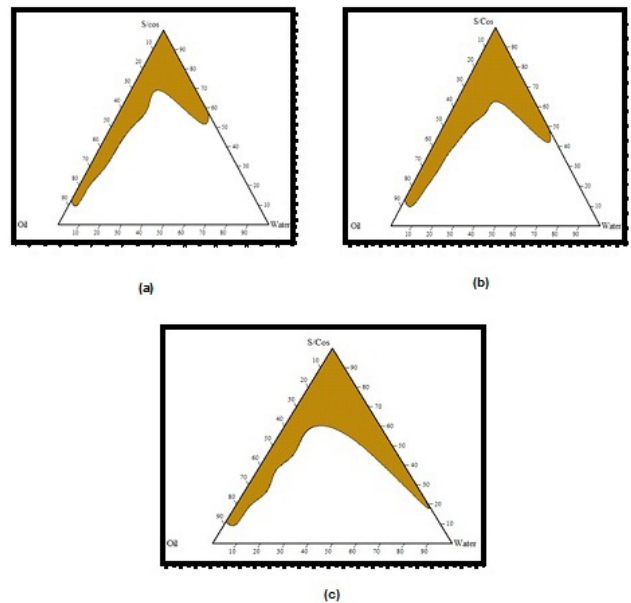


Figure. 4: Pseudo ternary phase diagrams of (a) S-Cos mix 1:1, (b) S-Cos mix 2:1 and (c) S-Cos mix 3:1

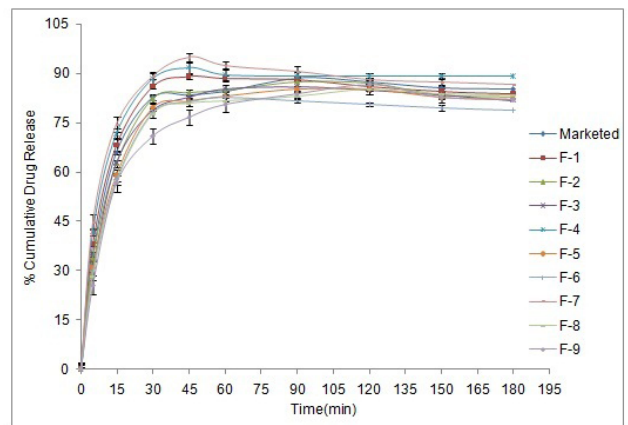


Figure. 5: *In vitro* drug release from various Satranidazole SEDDS

amount of water required for formation of emulsion. Therefore, for the preparation of SEDDS formulation, Oil: S-Cos mix 1:9, 2:8 and 3:7 were selected from all the three ratios of surfactant: co-surfactant (1:1, 2:1 and 3:1).

### Formulation characterization

#### Self emulsification time and Dispersibility test

*In vitro* performance of SEDDS formulation can be assessed by this test. The results of Self emulsification time and Dispersibility test are as shown in the (Table 2). Self emulsification time was observed within the range of 34.6 to 308.3 sec. From the results it was observed that, increase in oil composition will lead to increase in self emulsification time.

**Table 1: Formulation table**

Formulation Ingredients	Formulation Code								
	F-1	F-2	F-3	F-4	F-5	F-6	F-7	F-8	F-9
Oil : S-Cos mix (Oleic Acid : Twee	1:9	2:8	3:7	1:9	2:8	3:7	1:9	2:8	3:7
S : Cos mix	1:1			2:1			3:1		
Total volume (ml)	10	10	10	10	10	10	10	10	10
Amount of drug(mg)	60	60	60	60	60	60	60	60	60

**Table 2: Formulation characterization**

Formulations	Self emulsification time* (Sec)	Grade*	Droplet size*(nm)	Turbidimetry* (Absorbance)	Zeta potential* (mV)	Drug content* (%)
F-1	74.6 ± 2.08	C	122.5 ± 21.9	0.03 ± 0.005	-41.2 ± 3.3	98.1 ± 0.9
F-2	168.6 ± 2.08	D	575.3 ± 173	0.13 ± 0.010	-53.7 ± 1.7	91.8 ± 1.3
F-3	209.3 ± 2.08	D	660.3 ± 43.4	0.35 ± 0.184	-34.5 ± 3.2	90.3 ± 1.1
F-4	44.3 ± 3.213	B	85.4 ± 5.42	0.03 ± 0.010	-38.3 ± 2.3	97.5 ± 1.3
F-5	308.3 ± 1.52	D	1,174 ± 60	0.12 ± 0.010	-65.3 ± 7.6	92.7 ± 1.3
F-6	184.3 ± 2.08	D	600.3 ± 22	0.26 ± 0.011	-27.6 ± 2.3	89.6 ± 0.4
F-7	34.6 ± 1.52	A	18.4 ± 9.5	0.01 ± 0.005	-36.7 ± 0.8	99.2 ± 0.2
F-8	317.6 ± 3.05	D	851 ± 245	0.12 ± 0.005	-36.7 ± 2.6	94.1 ± 4.6
F-9	173.3 ± 3.05	D	712.3 ± 12	0.27 ± 0.005	-43.2 ± 1.8	88.8 ± 1.1

\*Data are expressed as Mean ± SD (n=3).

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**Table 3: In vitro drug release from various Satranidazole SEDDS**

Time (min)	% Cumulative Drug Release*									
	F-1	F-2	F-3	F-4	F-5	F-6	F-7	F-8	F-9	Marketed
0	0	0	0	0	0	0	0	0	0	0
15	68.09±0.62	62.57±0.6	62.75±1.8	71.60±1.2	58.96±2.0	57.75±2.9	74.41±2.2	57.02±2.3	56.47±2.7	65.91±1.0
30	86.09±2.17	82.20±1.1	78.60±1.8	88.28±1.7	79.59±1.7	78.01±1.8	89.29±2.2	77.83±1.6	70.85±2.5	82.61±0.5
45	89.04±0.62	84.02±1.0	82.87±1.4	91.71±1.6	81.53±1.1	81.24±1.4	94.89±1.1	80.86±0.8	76.71±2.3	83.31±0.9
90	88.12±0.87	87.40±1.6	85.75±0.8	89.08±1.7	85.14±1.5	81.69±0.9	90.71±1.3	82.91±1.2	83.63±2.0	88.56±0.2
180	83.93±0.75	82.76±0.6	81.71±0.4	86.35±0.9	81.99±1.4	78.68±0.8	86.68±1.2	83.32±1.0	81.98±0.4	85.20±0.9

\*Data are expressed as Mean± SD (n=3).

**Table 4: Short term stability study of an optimized formulation F-7**

Evaluation Parameters	Optimized Formulation F-7				
	Initial (Zero days)	Accelerated Conditions (40±2°C) and 75 ± 5% RH		Room Temperature (25 ± 2°C) and 60 ± 5% RH	
		30 Days	60 Days	30 Days	60 Days
Drug content (%)	99.09	99.03	99.1	99.06	99.04
Droplet size(nm)	18.4	18.9	19.2	18.1	17.6
Self-emulsification time(sec)	34.6	34.9	35.2	35.3	35.9



### Droplet size analysis

The results obtained for Droplet size analysis of all the formulations were tabulated in (Table 2). From the result it was observed that, only three formulations (F-1, F-4, F-7) were within the range of droplet size of SEDDS i.e. below 250 nm. Variation in the droplet size is related to composition of SEDDS. Increase in surfactant: co-surfactant ratio and decrease in oil concentration will lead to decrease in droplet size of emulsion.<sup>17</sup>

### Stability studies

**Effect of Dilution:** On visual assessment, no precipitation or phase separation was found which indicate that all the formulations were stable on dilution.

**Thermodynamic Stability Studies:** On visual assessment, no precipitation or phase separation was found which indicate that all the formulations were stable on thermodynamic studies.

### Turbidimetric Evaluation

It is done to monitor the growth of emulsification. The results obtained for turbidimetry of all the formulations were tabulated in (Table 2). From the results it was observed that, there was decrease in turbidity upon increase in amount of S-Cos mix. Turbidity is also related to droplet size. Larger the droplet size, more turbid is emulsion.

### Zeta potential Determination

The magnitude of zeta potential gives an indication of the potential stability of the colloidal system. If all the particles have a large negative or positive zeta potential, they will repel each other and there is dispersion stability. The results obtained for zeta potential of all the formulations were tabulated in (Table 2).

### Drug content

Percentage drug content was evaluated for all the nine formulations. The results obtained for drug content of all the formulations were tabulated in (Table 2). Drug content was within the range of  $88.88 \pm 1.1$  to  $99.29 \pm 0.2\%$ . It was maximum for F-7 formulation.

### In vitro Dissolution Studies

The dissolution profiles of formulations F-1, F-4 and F-7 showed a drug release of greater than 70% in 45 minutes (Figure 5), whereas Marketed preparation showed more than 70% of drug release in 90 minutes. Among all the formulations, F-7 showed a maximum drug release of 94.89% in 45 minutes. The results of *in vitro* dissolution studies are depicted in Table 3.

From the results of dissolution profiles of formulations F-1, F-4 and F-7 it can be concluded that the maximum drug release may be due to their smaller droplet size.<sup>17</sup> As the dissolution study was carried out in  $0.45 \mu$  (450 nm) dialysis membrane, only F-1, F-4 and F-7 formulations can easily pass through this membrane because of their smaller size.

Based on results of self emulsification time and dispersibility, droplet size analysis, drug content and *in vitro* drug release, F-7 formulation was selected as an optimized formulation.

### Short term Stability study

During short term stability studies, optimized formulation F-7 was withdrawn at the interval of one month and evaluated for drug content, droplet size and self emulsification. The results of short term stability studies are depicted in Table 4. From the results, it was observed that there was no significant change in droplet size, drug content and self emulsification time. Hence the formulation was stable.

## DISCUSSION

The therapeutic efficacy and bioavailability of any drug depends upon the aqueous solubility of drug. Solubility of drug is one of the essential parameter to achieve the desired concentration of drug in systemic circulation for the pharmacological response.<sup>12</sup> The current study was performed to describe the function of self emulsifying formulations to enhance the solubility of Satranidazole. In case of sparingly soluble drugs that show dissolution rate limited absorption, the SEDDS offers an improved rate and extent of oral absorption.<sup>18</sup> They undergo spontaneous emulsification in gut lumen upon dilution with aqueous media and mild agitation provided by the gastrointestinal motility. The small emulsion droplets of SEDDS so formed are easily absorbed from the gastrointestinal tract through the villi. Hence with the help of SEDDS for delivery of Satranidazole could enhance its solubility.

Self emulsifying drug delivery system of Satranidazole was successfully prepared and evaluated for its solubility enhancement purpose. Marketed Tablet of Satranidazole in traditional form was used as a control in the present study. The excipients used in the SEDDS should show maximum solubility for the drug to ensure maximum solubilization of the drug and to prevent precipitation of the drug in gut lumen. Therefore, in the present study Oleic acid, Tween 20 and PEG 400 were taken into considerations and selected for construction of pseudo ternary phase diagrams as they solubilised

maximum amount of drug. Formulations were prepared based on the results of pseudo ternary phase diagrams and they were evaluated for self emulsification time & dispersibility, droplet size analysis, stability studies, turbidimetry, zeta potential, drug content and *in vitro* drug release. The result of self-emulsification time indicates that an increase in the proportion of Oleic acid in the composition resulted in decreasing self-emulsification time.<sup>17</sup> Droplet size of an optimized formulation was found to be  $18.4 \pm 9.5$  nm. A Mahapatra *et al* (2014) studied that 'SEDDS' is a general term, typically producing emulsions with a droplet size ranging from a few nanometers to several-microns. "Self-micro-emulsifying drug delivery systems" (SMEDDS) indicates the formulations forming oil droplets ranging between 100-250 nm and "Self-nano-emulsifying drug delivery systems" (SNEDDS) is a modern term with the globule size less than 100 nm.<sup>19</sup> In the present study, the results of droplet size of optimized formulation is below 100 nm, hence the optimized formulation is considered to be 'SNEDDS'. Decrease in oil concentration will lead to decrease in droplet size of SEDDS. Smaller the droplet size, larger the interfacial area will be provided for drug absorption.<sup>14</sup> Zeta potential of optimized formulation was found to be  $-36.7 \pm 0.8$  mV. K Sapra *et al* (2013) studied on Zeta potential of SEDDS. A high zeta potential above 25 (either positive or negative) indicates that the droplets generated after emulsification, shall repel each other and remain deflocculated and imparts physical stability to the system.<sup>13</sup> Therefore the optimized formulation appears to be physically stable. The dissolution profiles of formulations F-1, F-4 and F-7 resulted in spontaneous formation of emulsion with smaller droplet size showing a faster rate of drug release which was greater than 70% in 45 minutes whereas Marketed preparation showed more than 70% of drug release in 90 minutes. Among all the formulations, F-7 showed a maximum drug release of 94.89% in 45 minutes. Based on results of self emulsification time and dispersibility, droplet size analysis, drug content and *in vitro* drug release, F-7 formulation was selected as an optimized formulation. F-7 formulation consists of S-Cos mix (3:1) and Oil: S-Cos mix (1:9). Thus the study confirmed that SEDDS formulation can be used as possible alternative to traditional oral formulation of Satranidazole to improve its solubility.

## CONCLUSION

Self emulsifying drug delivery system of Satranidazole was successfully prepared and evaluated for its solubility

enhancement purpose. Based on solubility study data, Oleic acid, Tween 20 and PEG 400 were selected for construction of pseudo ternary phase diagram. From the results of pseudo ternary phase diagram, nine formulations were prepared and evaluated for self emulsification time and dispersibility, droplet size analysis, stability studies, turbidimetry, zeta potential, drug content and *in vitro* drug release. Optimized formulation of SEDDS showed a significant increase in dissolution rate as compared with marketed preparation. Hence, it can be concluded that the SEDDS formulations can be potentially used as an alternative to the traditional oral formulations for the poorly water soluble drugs like Satranidazole to improve its solubility and dissolution.

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## CONFLICT OF INTEREST

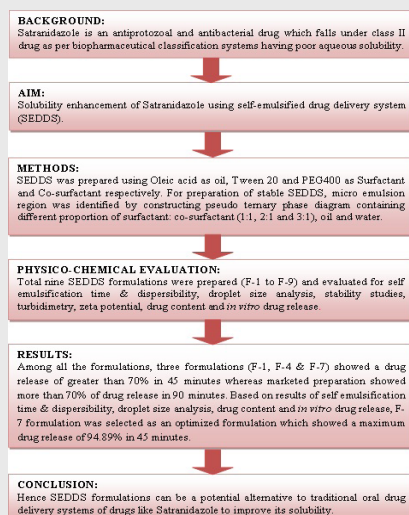
The author declare no conflict of interest.

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## PICTORIAL ABSTRACT



## SUMMARY

- Satranidazole is systemically acting, an antiprotozoal and antibacterial drug which is twice as active as other nitroimidazoles.
- For the preparation of SEDDS formulation, Pseudo ternary phase diagram was carried out and based on pseudo ternary phase diagram; nine formulations (F-1 to F-9) were prepared in different concentrations of oil, surfactant and co-surfactant.
- The prepared formulations were characterized for physicochemical properties and *in vitro* drug release. Based on *in vitro* % drug release, Drug content, Self emulsification time, Dispersibility test and Droplet size analysis, formulation F-7 (Oil: S-Cos mix in 1:9) was selected as the best formulation.
- Optimized formulation of SEDDS showed a significant increase in dissolution rate as compared with marketed preparation. Hence it can be potentially used as an alternative to the traditional oral formulations for the poorly water soluble drugs like Satranidazole to improve its solubility and dissolution.

## ABBREVIATIONS USED

°C: Degree Centigrade; mg: Milligram; µg: Microgram; ml: Milliliter; rpm: Rotations per minute; µm: Micrometer; cm: Centimeters; %: Percentage; min: Minutes; sec: Seconds; SEDDS: Self emulsifying drug delivery system; hr: Hour; FT-IR: Fourier Transform Infrared Spectroscopy; UV: Ultraviolet; λ<sub>max</sub>: Maximum Absorbance; RH: Relative humidity; e.g.: Example; % CDR: Percentage Cumulative Drug Release; nm: Nanometers; cps: Centipoises; R<sup>2</sup>: Regression coefficients; S-Cos mix: Surfactant-Cosurfactant mixture.

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