Original Research Article

# Ciprofloxacin hydrochloride mediated enhanced solubilization and stability by UV-spectroscopy


## Abstract

In the case of solubility limited absorption, creating super saturation in the GI fluid is very critical assuper saturation may provide great improvement of oral absorption. The techniques to create the so-called super saturation in the GI fluid include microemulsions, emulsions, liposomes, complexations, polymeric micelles, and conventional micelles. Ciprofloxacin was chosen because it is practically insoluble in water; hence its salt form is used commercially, which is soluble in water. The objective of the present investigation was to enhance the solubility of Ciprofloxacin by formulating Solid dispersions in water soluble carriers have attracted considerable interests as a mean of improving the dissolution rate & hence possibly bioavailability range of hydrophobic drugs. The poor solubility of ciprofloxacin leads to poor dissolution & hence variation in bioavailability. The purpose of present investigation was formulation & evaluation of controlled release floating capsule of ciprofloxacin with improved solubility & dissolution rate. In present study solid dispersion using various carriers like mannitol & lactose in different ratios were prepared by solvent evaporation method. The prepared solid dispersions were characterized for drug content, solubility & dissolution rate. The dissolution rate substantially improved for ciprofloxacin from its solid dispersions compared with pure drug. Dissolution rate increased with increase in carrier content.



**Keywords:** Ciprofloxacin, Spectroscopy, Solubilization, dissolution

## Introduction

The poor solubility and low dissolution rate of poorly water soluble drugs in the aqueous gastro-intestinal fluids often cause in sufficient bioavailability ratherthan the limited permeation through the epithelia and the formulation of poorly soluble drugs for oral delivery now presents one of the major challenges tom formulation scientists. Hence, novel technologies for drug solubilisation are required which can increase drug solubilisation and overcome the issues of traditional excipients(1). Ciprofloxacin is an antibiotic used to treat a number of bacterial infections. This includes bone and joint infections, intra abdominal infections, certain type of infectious diarrhea, respiratory tract infections, skin infections, typhoid fever, and urinary tract infections, among others. Product development scientists often encounter significant difficulties in solving the problem of poor water solubility of drug candidates in the development ofpharmaceutical dosage forms(2). As a matter of fact, more than one-third of the drugs listed in the U.S.Pharmacopeia fall into the poorly water-soluble or water-insoluble categories. It was reported a couple of decades ago that more than 41% of the failures in new drugdevelopmentbiopharmaceuticalhavebeenproperties,attributedincludingtopoorwaterinsolubility, while it was still indicated recently that about 50% failure of drug candidates was due to poor“drug-like” properties. It is commonly recognized in thepharmaceutical industry that on an average more than40% of newly discovered drug candidates are poorlywater soluble. Poor “drug like” properties of leadcompounds led to ineffective absorption from the site ofadministration, which has been designated as animportant part of the high clinical failure due to poorpharmacokinetics(3-5). (ciprofloxacin) is a synthetic broad-spectrum antimicrobial agent for intravenous (I.V.) administration. Ciprofloxacin, a fluoroquinolone, is 1-cyclopropyl-6-fluoro-1,4-dihydro-4-oxo-7-(1piperazinyl)-3-quinolinecarboxylic acid. Its empirical formula is C17H18FN3O3 and its chemical structure is in figure 1:

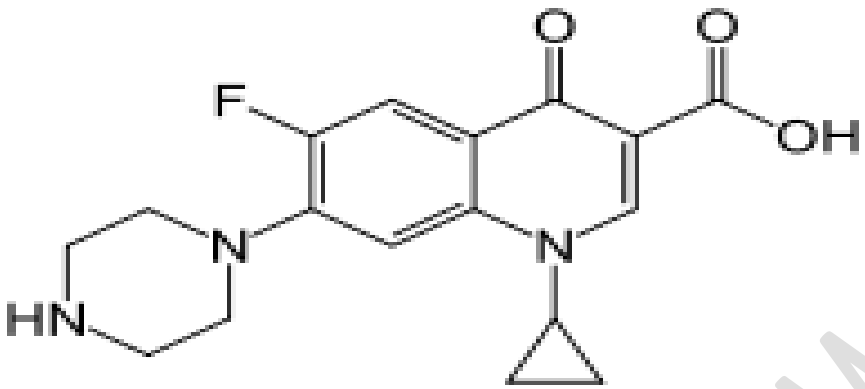


Fig. 1: Structure of ciprofloxacin

Surfactant micelles are found to facilitate drug absorption along with shielding of the active drug molecules from adverse environmental conditions. The study on molecular-level interactions between the drug and micelles can be used to predict several pharmacokinetic and pharmacological properties of drugs, viz., transport, biodistribution, accumulations, and therefore their efficacy. When a sufficient amount of a surfactant is dissolved in water, the surfactant molecules form colloidal clusters (micelles) of various shapes in which the polar head groups point outward and the hydrophobic ends point toward the coreof the micelle. The threshold concentration at which the formation of micelle begins is known as critical micelle concentration (cmc). Micellar core is capable of incorporating hydrophobic substances present in the system. In past, various ionic surfactants such as cetyl trimethyl ammonium bromide (CTAB), dodecyl trimethyl ammonium bromide (DTAB), tetradecyl trimethyl ammonium bromide, sodium dodecyl sulfate (SDS), sodium lauryl sulfate, alpha olefin sulfonate, alkylbenzene sulfonate alone, and their mixtures have been studied in association with various poorly water-soluble drugs, viz., ibuprofen,1,2 naringenin,3 danazol,4 gliclazide,5 and so forth. Nonionic surfactants, viz., Brij 351 and Tween 80,5 have also been studied in association with poorly soluble drugs for enhancing their solubility(6-7).

**Material and Method**

Ciprofloxacin (Pellets Pharma Ltd), Croscarmellose Sodium (Diocon Pharma Ltd), Distilled Water, Methanol, Di - Chloro methane, Potassium Di-hydrogen Phosphate, Sodium Hydroxide.

**Identification of the Drug**

**Melting Point Determination**

The Thiel'stube method of melting point determination in liquid paraffin was use in present study.

**UV Spectrum**

UV Scanning was done for pure drug between 200 and 400 nm using 0.1N HCL as dilution medium the λmax was found at 277 nm(8).

**Selection of surfactant and cosurfactant**

We studied different formulation in which Km ratio surfactant with different HLB values were screened such as tween 20, tween 80 cosurfactant such as polyethylene glycol400 and glycerol and oil such as castor oil (9).

**Estimation of Ciprofloxacin**

The standard solutions of Ciprofloxacin were subsequently diluted with pH 7.2 Phosphate buffer to obtain series of dilutions containing 5,10,15,20, and 30 μg of Ciprofloxacin solution 9. The absorbances of above dilutions were measured in Spectro 2080 plus Analytical technologies limited U-V Spectrophotometer at 288 nm using distilled water as blank (10).

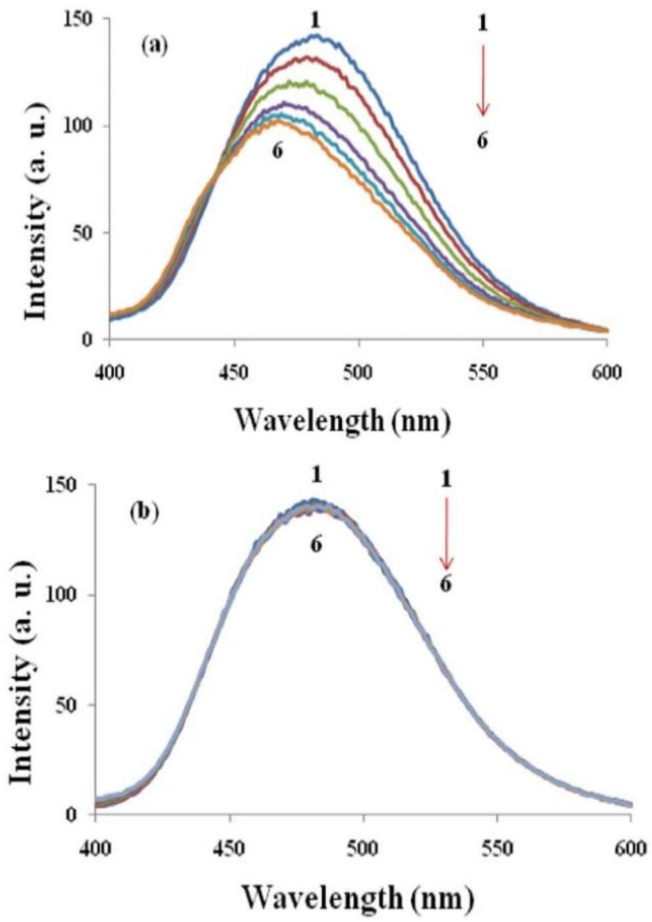


**Figure2. UV Spectra of ciprofloxacin**

**Drug solubility**

The amounts of drug present in the taken oven formulations were determined with the help of U-V Spectrophotometric method. For each batch 100 mg of sample was taken in to the volumetric flask and add methanol and the mixer was diluted with the pH 7.2 phosphate buffer(11).

**Table 1: kinetic profile of ciprofloxacin f-3 (cogrinding) solid dispersion**

| **Amount of drug dissolved** | | | | **Log% Drug remained** | | |
|---|---|---|---|---|---|---|
| **S.NO** | **Time** | **OD** | | **%Drug dissolved** | | **%Drug remained** |
| 1 | 0 | 0 | 0 | 0 | 100 | 2 |
| 2 | 5 | 0.213 | 88.7 | 74.89 | 25.11 | 1.4 |
| 3 | 10 | 0.232 | 97.38 | 91.72 | 8.28 | 0.918 |
| 4 | 15 | 0.23 | 99.04 | 100 | 0 | - |

**Physical characterization of formulations**

***In-vitro* drug release studies**

Optimal formulation for each ciprofloxacin and drug were dialysed against water to harness their drug release profile. Briefly, 2 mL of formulation was pipetted inside a visking tube (12-14 kDa) (Medicell, UK) and dialysed against distilled water (200 mL) at room temperature(12-13).

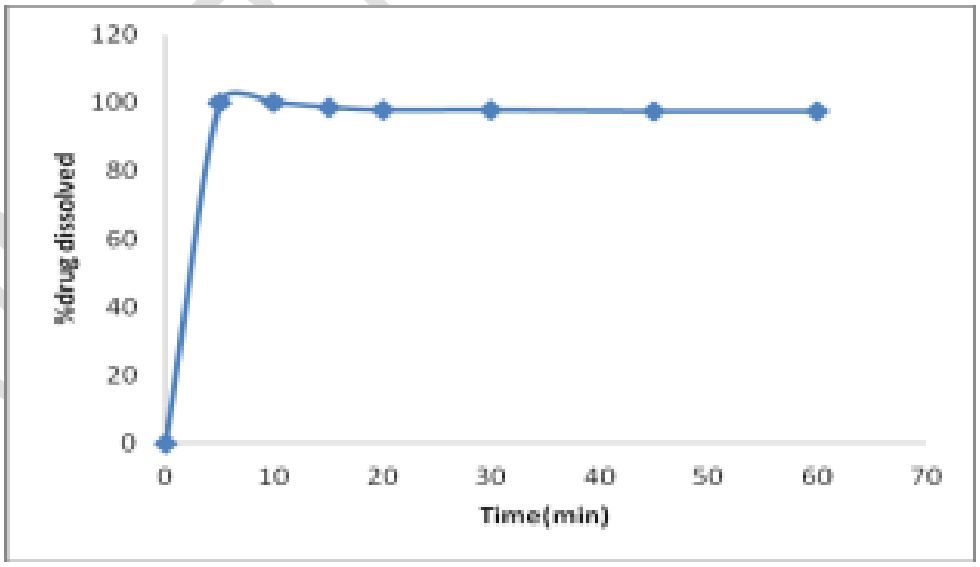


**Fig 3: zero order kinetic profile of ciprofloxacin**

## Results and Discussion

As pure drug has shown poor dissolution property, in order to enhance the dissolution rate we used different methods for preparing solid dispersions

### Melting point

The Melting point of ciprofloxacin was found at $255^0$ C which matched with reported data.

### UV Spectrum

The UV spectra of ciprofloxacin in 0.1 N HCl was scanned between 200 and 400 nm at medium scanning speed using 10 µg/ml solution in 1 cm quartz cell. λmax of 277 nm was found as earlier reported (Rajia et al., 2011). This was utilized for preparation of standard curve.

### Solubility studies

Solubility of the drug in microemulsion formulation and the individual ingredients of the microemulsion is shown in Fig. 3. The solubility of Ciprofloxacin in the optimized formulation is 81.18 mg/ml whereas in Tween80, PEG 400, Castor oil is 38.318, 41.486, 45.94 mg/mL respectively.

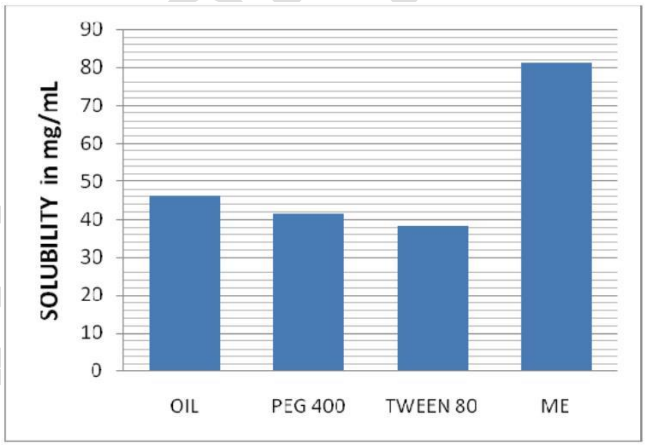


**Fig.4. Solubility study**

## Conclusion

This study was undertaken with an aim to formulate an Anti-Biotic drug in the form solid dispersion to overcome the poor solubility drawback of the drug. The selected Antibiotic agent was Ciprofloxacin. The drug Ciprofloxacin is having poor solubility in the water, under class 2 of BCS of classification of drug its solubility was tried to increase by formulating in the form of solid dispersion with polymer by using various techniques. Solid dispersions were prepared by using the Crosscarmelose sodium as a disintegrated in 1:1 ratio of different techniques.

**COMPETING INTERESTS DISCLAIMER:**

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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