e-ISSN: 2320-4230, p-ISSN: 2961-6085

Journal of Drug Discovery and Therapeutics

Available Online at www.jddt.in

CODEN: - JDDTBP (Source: - American Chemical Society)

Volume 12, Issue 05; 2024, 33-36

Formulation and Evaluation of Solid Lipid Nanoparticles Containing Fenoprofen

Sanjay Kumar Tiwari, Rishab Shukla, Supyar Singh

RKDF College of Pharmacy Bhopal
Sarvepalli Radhakrishnan University, Bhopal

Received: 12-08-2024 / Revised: 05-09-2024 / Accepted: 17-09-2024

Corresponding author: Sanjay Kumar Tiwari (tiwarisk2569@gmail.com)

Conflict of interest: No conflict of interest.

Abstract:

The biggest challenge up to date is to control the delivery rate of the medicaments by various modern technologies met by extensive research. However, TDS is not practical for delivery of materials whose final target is the skin itself. The oral administration of fenoprofen causes gastrointestinal ulcers and bleeding in chronic use. Due to gastrointestinal bleeding, it may cause anaemia. Also, use of fenoprofen is limited by its poor solubility and low bioavailability. Thus, the present study aimed at design and development of a drug delivery system which could enhance the solubility of fenoprofen.

Keywords: Gastrointestinal, Bioavailability, Fenoprofen

INTRODUCTION

The drug delivery technology landscape has become highly competitive and rapidly evolving. More and more developments in delivery systems are being integrated to optimize the efficacy and cost- effectiveness of the therapy. New classes of pharmaceuticals, biopharmaceuticals (peptides, proteins and DNA-based therapeutics) are fuelling the rapid evolution of drug delivery technology [1]. These new drugs typically cannot be effectively delivered by conventional mean. Drug delivery systems (DDS) that can precisely control the release rates or target drugs to a specific body site have had an enormous impact on the health care system. In the current years the development of new drugs is not sufficient for the drug treatment. But it also involves the development of suitable drug delivery system at site of action. The in-vivo fate of the drug is not only determined by the properties of the drug, but it is also determined by the carrier system, which permits a controlled and localized release of the active drug according to the specific need of the therapy [2]. The biggest challenge up to date is to control the delivery rate of the medicaments by various modern technologies met by extensive research. However, TDS is not practical for delivery of materials whose final target is the skin itself. The controlled release of drug from the formulation into the epidermis such that the drug remains primarily localized with only a restricted amount entering the systemic circulation, is a means of controlling side-effects.

Experimental Work

Preformulation Studies and Characterization of Fenoprofen

Preformulation studies are essential for the rational development of any dosage form of a drug substance. A detailed understanding of the properties of the drug along with excipients is essential to minimize formulation problems at the later stages of drug development. Preformulation studies are designed to identify those physiochemical properties of a drug that may influence the formulation design, method of manufacture and pharmacokinetics properties of the resultant product. The goals of preformulation studies include the selected or the correct form of the drug substance, evaluation of its physical properties, and a thorough understanding of its stability and compatibility profiles [3, 4].

Physicochemical Characterization

Appearance

Fenoprofen is a white, crystalline, odourless powder.

Melting Point

Melting point was determined by using Differential Scanning Calorimeter.

Solubility

Solubility of drug was determined in different solvents at room temperature by adding excess of drug to 10 ml volumetric flasks with different solvents. The containers were sealed and kept it for 24 hrs at ambient temperature with appropriate shaking. After 24 hrs, the solutions were filtered through 0.45 µm millipore filter, diluted suitably and analyzed spectrophotometrically at 260 nm.

Identification of Drug

Ultraviolet Spectral Analysis

Fenoprofen 50mg was dissolved in 50ml of phosphate buffer pH 7.4 and 0.1N HCl (pH 1.2) to prepare a stock solution of 1000µg/ml concentration, which was then further diluted to prepared 10µg/ml solution and was subjected to scanning in range of 200-300nm using UV-Visible Spectrophotometer. The wavelength at which maximum absorbance occurred was selected for the analysis of drug samples in subsequent studies.

Preparation of Standard Curve of Fenoprofen in 0.1N HCl (pH-1.2)

50mg of Fenoprofen was accurately weighed and dissolved in 50ml of ethanol to prepare a primary stock solution of concentration 1000µg/ml. 1ml from this stock solution was further diluted to 100 ml with 0.1N HCl to obtain a stock solution of concentration 10µg/ml. From this stock solution 0.5-4 ml of aliquot was pipetted out into a series of 25ml volumetric flask and volume was made upto 25ml with 0.1N HCl to obtain dilution in the concentration range of 2-16µg/ml. The absorbance of these solutions was measured at λ_{max} = 259nm using a UV-Visible Double beam Spectrophotometer against a suitable blank and Linear regression of the curve was obtained [5,6].

Formulation of Enteric Coated Capsules Containing Fenoprofen

Preparation of Coating solution

A 10% w/v Cellulose Acetate Phthalate (CAP) coating solution was prepared using acetone as solvent and 0.8% polyethylene glycol 600 as plasticizer. 10g of CAP was dissolved in 100 ml of acetone and 0.75 ml of polyethylene glycol 600 was added to the solution. The mixture was stirred properly on a magnetic stirrer to get a homogenous solution.

Coating of Capsules

The solid lipid nanoparticles of the optimized batch were lyophilized and the product equivalent to 5mg of drug was filled

in a hard gelatin capsule. The capsule was coated with the enteric coating polymer solution of CAP by dipping method. The filled capsule was dipped into the prepared enteric coating solution and then withdrawn from the solution at a controlled speed. The applied coating remained wet for several minutes until the solvent evaporated and coat become dry. Once a layer is cured, another layer was applied on the top of it by repeating the process. The above step was repeated 5-7 times to get a desired coating thickness. The thickness of the coat depends on the viscosity, density, and surface tension of coating solution [7].

Results and Discussion

Preformulation Studies

Physiochemical Characterization

Appearance

Fenoprofen is white, crystalline, odourless powder.

Solubility of Drug in different solvents

Fenoprofen is freely soluble in methanol, ethanol, isopropyl alcohol, acetone and soluble in strong alkali. It is practically insoluble in water.

Melting Point

The endothermic peak with a peak maximum at 98.07ºC was observed obtained in the thermogram, indicate the melting point and crystalline anhydrous nature of the drug. The onset melting of drug was at 93.54ºC.

Identification of Drug

Ultraviolet Spectral Analysis

To know the absorption maxima (λ_{max}) of Fenoprofen, spectral scan of Fenoprofen in Phosphate buffer pH. It was recorded which showed the maximum absorbance at 260 nm. This λ_{max} was further used to prepare calibration curve and estimation of Absorbance spectrum of drug in phosphate buffer pH 1.4.

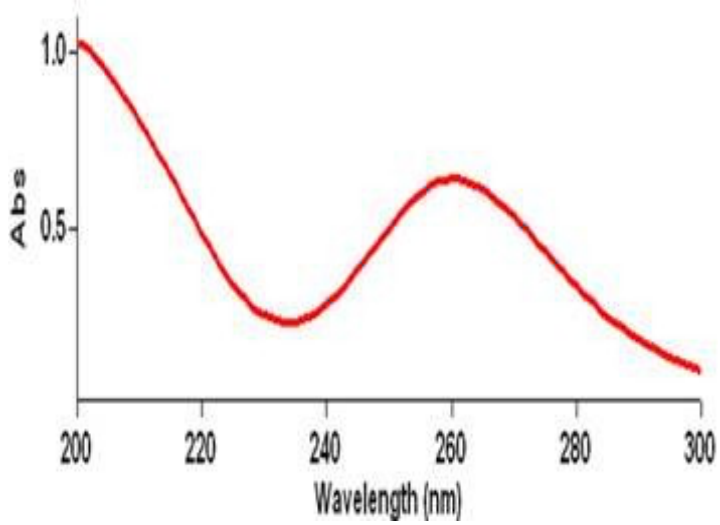

Fig. 1.1: UV Spectrum scans of Fenoprofen in Phosphate Buffer (pH 7.4)

Standard curve of Fenoprofen in 0.1N HCl (pH 1.2)

Different dilutions of Fenoprofen were prepared using 0.1N HCl pH 1.2 to produce solutions concentration of 2- 14 µg/ml. The absorbance of these concentrations was measured against 0.1N HCl as blank at 259 nm using UV-Visible double beam spectrophotometer. The data is shown in Table 1.2.

Table 1.2: Standard curve data of Fenoprofen in 0.1N HCl (pH 1.2)

Concentration (µg/ml)	Absorbance (Mean ± S.D)
2.0	0.1906 ± 0.008
4.0	0.3431 ± 0.017
6.0	0.4838 ±0.019
8.0	0.6229 ± 0.003
10.0	0.7409 ± 0.022
12.0	0.8882 ± 0.025
14.0	1.0347 ± 0.015

The coating capsules of containing lyophilized SLNs with cellulose acetate phthalate significantly reduced the release of drug in the simulated gastrointestinal fluid. The drug release from the prepared capsules was studied and it was found that about 4% of fenoprofen was released after 2 hrs, while more than 57% was released after 12 hrs followed the mechanism of sustained release of drug. Hence, prevent the excessive exposure of drug to stomach mucosal lining.

Conclusion

The oral administration of fenoprofen causes gastrointestinal ulcers and bleeding in chronic use. Due to gastrointestinal bleeding, it may cause anaemia. Also, use of fenoprofen is limited by its poor solubility and low bioavailability. Thus, the present study aimed at design and development of a drug delivery system which could enhance the solubility of fenoprofen.

References

1. Dixit M, Kulkarni PK and Vaghela RS. Effect of Different Crystallization Techniques on the Dissolution Behavior of Fenoprofen. Tropical Journal of Pharmaceutical Research 2021; 12 (3): 317-22.
2. Dhana Lakshmi. P, Nair R, Chakrapani. M, Venkatkrishnakiran. P. Solid lipid nanoparticle systems for delivery of drugs to the brain. International Journal of Biopharmaceutics. 2021; 3(2): 70-77.
3. Dodiya SS, Chavhan SS, Sawant KK, Korde AG. Solid lipid nanoparticles and nanosuspension formulation of Saquinavir: preparation, characterization, pharmacokinetics and biodistribution studies. J Microencapsul. 2020; 28(6):515-27.
4. Freitas C, Mullera RH. Spray-drying of Solid lipid nanoparticles. Eur J Pharm Biopharm 2021; 46:145-51.
5. Galal M. El-Mahrouk, Mona H. Aboul-Einien, Nermeen A. Elkasabgy. Formulation and Evaluation of Enteric Coated Capsules Containing Olanzapine-Loaded Solid Lipid Nanoparticles. IJPI's Journal of Pharmaceutics and Cosmetology 2022; 2(9):1-15.
6. Gaur PK, Mishra S, and Purohit S. Solid Lipid Nanoparticles of Guggul Lipid as Drug Carrier for Transdermal Drug Delivery. Biomed Res Int.2021:750690.
7. Heiati H, Tawashi R, Shivers RR, et al. Solid lipid nanoparticles as drug carriers I. Incorporation and retention of the lipophilic prodrug 3′-azido-3′-deoxythymidine palmitate. Int J Pharm. 2023; 146: 123–31.