IJMPR 2022, 6(2), 74-77

International Journal of Modern Pharmaceutical Research
www.ijmpronline.com

ISSN: 2319-5878
IJMPR
Review Article
SJIF Impact Factor: 5.273

# A REVIEW ON "CIPROFLOXACIN (CF) AS A QUINOLONE ANTIBIOTIC"

**Sagar Navanath More*, Rohit Jaysing Bhor, Mayur S. Bhosle and Mahesh Kolhe**

Department of Pharmaceutical Chemistry, Pravara Rural College of Pharmacy Pravaranagar, Tal-Rahata, District-Ahmednagar, Maharashtra, India.

**Received on: 15/01/2022**
**Revised on: 05/02/2022**
**Accepted on: 25/02/2022**

***Corresponding Author**
**Sagar Navanath More**
Department of Pharmaceutical Chemistry, Pravara Rural College of Pharmacy Pravaranagar, Tal-Rahata, District-Ahmednagar, Maharashtra, India.

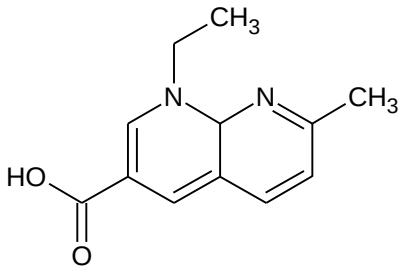
**ABSTRACT**

Ciprofloxacin (CF) is antibiotics and it sold as topmost selling drug. This drug is available at a cheap cost. This drug is used to treat many bacterial infections. Many researcher and scientists are working on Ciprofloxacin (CF) drug for various applications. This drug gives effect on different drug delivery systems. The main objective of review paper is to highlight the details of pure drug Ciprofloxacin (CF) and its delivery systems along with current research on Ciprofloxacin (CF) drug. In this review; we focused on history of CF, pharmacokinetics, mechanism of action for CF, types of dosage of Ciprofloxacin available in the market with their cost. It also highlighted drug to drug interactions with their adverse drug reactions of CF. The few drug delivery systems (DDS) of Ciprofloxacin (CF) were developed in the second decade.

**KEYWORDS:** Ciprofloxacin, Drug to Dug interactions; Pharmacokinetics.

## INTRODUCTION

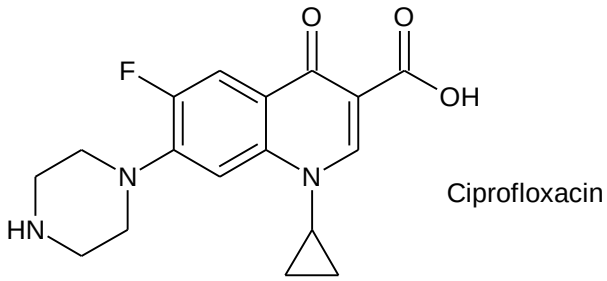
Quinolone antibiotic is an example of large group of broad spectrum bactericidal drug. These drugs are bicyclic in nature. Quinolone antibiotic are used in human and veterinary medicine to treat bacterial infection, as well as in animal. Mostly all quinolone antibiotics in use are flouro quinolones. It contains fluorine atom in their chemical structure.[1-3] They are effective against all gram positive and Gram negative bacteria. Fluoroquinolones are synthetic antibacterial agents structurally related to nalidixic acid4. See the below structure of nalidixic acid with IUPAC name.




1-ethyl-7-methyl-1,8a-dihydro-1,8-naphthyridine-3-carboxylic acid

Nalidixic acid

They give various physical and chemical favorable properties such as excellent bioavailability, good tissue penetrability, and low adverse and toxic effects. Fluoroquinolones drugs are potentially used in the treatment of urinary tract infection and prostatitis. Fluoroquinolones are also employed against bacterial enteric infections, biliary tract infections, sexually transmitted diseases.[5-7] There are many derivatives of Fluoroquinolone like Ciprofloxacin. In this review we focus on ciprofloxacin drug; this drug is available in the market in cheap cost. It is used in the treatment of bacterial infection. This drug is an example of fluoroquinolones category or fluoroquinolones derivatives.[8] This drug is an example of broad spectrum second generation antibacterial agent. Ciprofloxacin is used in the treatment of mostly gram negative bacteria; urinary tract infections, skin, ophthalmic, respiratory, bone and joint, intra abdominal infections bacterial diarrheal infections and periodontal pathogens.[9-10] See the below structure of Ciprofloxacin with IUPAC name.




Ciprofloxacin

1-cyclopropyl-6-fluoro-4-oxo-7-(piperazin-1-yl)-1,4-dihydroquinoline-3-carboxylic acid

Ciprofloxacin (CF) is not used for the treatment of viral disease; it is a nucleic acid synthesis inhibitors. Ciprofloxacin is most popular drug and most selling antibiotic drug.[11-13] There are number of researcher and scientists are working on this Ciprofloxacin (CF) drug. Many researcher and scientists are work on the development of novel drug delivery systems of CF in the last 3 decades (1985-2017).[14] It includes the patents and different marketed products of Ciprofloxacin (CF) with their price along with the properties. The Ciprofloxacin properties are shown in table 1.

**Table 1: Ciprofloxacin properties.**

| Sr. no. | Name of Ciprofloxacin properties | Description |
|---|---|---|
| 1 | Molecular formula | $C_{17}H_{18}FN_2O_3$ |
| 2 | Melting point ( °C) | 581.8°C |
| 3 | Biological half-life | 3.5 h |
| 4 | pKa (Strongly Acidic) | -0.57 |
| 5 | pKa (Strongest Basic) | 5.76 |
| 6 | Water solubility | 1.35 mg/ml |

Ciprofloxacin (CF) drug was store in the temperature like in between 5-25 °C. Quinolones were first discovered or developed in 1960's. Quinolones are classified as per generation. It is based on the antimicrobial activity. In the 1st generation; there is a nalidixic acid was developed in 1962 to treat urinary tract infections.[15-16] After Nalidixic acid; introduction of fluorine group in quinolone ring; then it gives a 2nd generation like Ciprofloxacin. This drug was developed to treat a number of infections. Ciprofloxacin parameter i.e. CF are given below;

**Table 2: Pharmacokinetic parameters.**

| Sr. no. | Parameter | Values |
|---|---|---|
| 1 | Renal excretion | 70 % |
| 2 | Volume of distribution | 3.5 Liter /kg |
| 3 | Hepatic metabolism | 5% |
| 4 | Half life | 3 to 4 hours |
| 5 | Plasma protein binding | 30-40 % |
| 6 | Bioavailability (Oral) | 69-71% |

About 60-80% CF is rapidly absorbed within 1 to 1.5 hours, when given by oral route and it has no significant effect when administered with food. This drug penetrates well into the most of the body fluids and tissues. It gives exceed serum concentrations in both men and women. This drug metabolized into oxo-Ciprofloxacin, sulfo-Ciprofloxacin. With oral administration, this drug approximately 15% of the dose is converted into four metabolites which are identified in human urine. About 50% of Ciprofloxacin are eliminated by kidney, 15% by feces, and 45% of liver. This drug is used for the treatment of acute sinusitis, lower respiratory tract infection, chronic bronchitis, hospital acquired pneumonia, kidney, urinary tract, diarrheal and abdominal infections, skin and soft tissue, bone and joint infections.[18] The all fluoroquinolones gives mechanism of action by inhibiting type 2 bacterial DNA *topoisomerases*, DNA gyrase and topoisomerase IV. This drug binds and traps the enzyme-DNA complex. This drug binds to blocks DNA synthesis and cell growth. Ciprofloxacin (CF) is available in the market as tablet, infusion, eye drops, suspensions, ointments with various costs.[19] See the below table 3 gives number of dosage forms of CF available with their cost range.

**Table 3: Dosage form of CF.**

| Sr. no. | Dosage form of CF | Cost range of CF |
|---|---|---|
| 1 | Tablets | 8-125/10 tablets |
| 2 | Infusion | 17.86-/100 ml |
| 3 | Eye drops | 6-24.80/10 ml |
| 4 | Suspensions | 27.76-48.50/60 ml |
| 5 | Ointments | 4.31-10/5 ml |

There are several or various analytical methods for the quantitative determination of Ciprofloxacin (CF) in pharmaceutical formulations. These methods are electrophoresis, UV spectrophotometer, titration, and High Performance Liquid Chromatography (HPLC); High Performance Thin Layer Chromatography (HPTLC).[20-21] This is necessary to determine the quality of medicine, which are available in the market. These methods are necessary to check quality of medicine. Methods developed for estimation of CF in different samples are given in table 4.

**Table 4: Analytical methods for the quantitative determination of Ciprofloxacin (CF).**

| Sr. no. | Sample | Method | Application |
|---|---|---|---|
| 1 | Body fluids | HPLC | This method is ideal for clinical trials and PK studies of CF |
| 2 | Biological fluids | HPLC/ HPTLC | To study the pharmacokinetics of CF |
| 3 | Pharmaceutical preparations and biological fluids | HPLC | Separation of compounds and to determine the pharmacokinetics of CF |
| 4 | Serum and urine | HPLC | To study the pharmacokinetics of CF in patients receiving multiple drug therapy |
| 5 | Plasma and urine | HPLC/ HPTLC | Used to measure only the parent drug in human serum and urine but not metabolites |

Ciprofloxacin (CF) drug gives around 275 drug interactions listed in drug bank. But some drug interactions with Ciprofloxacin (CF) based on drugs category and its effects are shown in table 5.

**Table 5: Drug interactions with ciprofloxacin (CF).**

| Sr. no. | Drug interaction with CF | Effect |
|---|---|---|
| 1 | Caffeine and xanthine derivative | Reduced clearance of caffeine and a prolongation of its serum half-life |
| 2 | Class IA or III Antiarrhythmic drug | It gives Additive effect at different interval |
| 3 | Histamine H2-receptor Antagonists | No significant effect on the bioavailability of CF. |
| 4 | Nonsteroidal Anti-Inflammatory Drugs (NSAIDs) drug | Increase the risk of central nervous system stimulation and convulsive seizures |
| 5 | Oral Anticoagulants drug | Increase in oral anticoagulant activity |

## CONCLUSION

The present review revealed that analytical methods to determine Ciprofloxacin (CF) were developed for its pharmacokinetic studies in the first decade; i.e. (1985-1995). In the second decade, the researcher or scientist work on the development of drug delivery systems of Ciprofloxacin (CF) was found in the many literature. There are many research papers found in the development of novel drug delivery systems of Ciprofloxacin (CF) in third decade compared to the last 2 decades. This review on Ciprofloxacin (CF) will be useful for development of drug delivery systems which helps in the understanding of available applications.

## REFERENCES

1. Pichler H, Diridl G, Wolf D. Ciprofloxacin in the treatment of acute bacterial diarrhea: a double-blind study. Eur J Clin Microbiol, 1986; 5: 241-3.
2. Umadevi S, Rohini B, Nithyapriya, Sasidharan. Formulation and evaluation of ciprofloxacin dental films for periodontitis. J Chem Pharm Res, 2012; 4: 2964-71.
3. Committee on Antimicrobial Agents, Canadian Infectious Disease Society, Thomas JL. Ciprofloxacin: an oral quinolone for the treatment of infections with gram-negative pathogens. Can Med Assoc J, 1994; 150: 669-76.
4. Wishart DS, Knox C, Guo AC, Shrivastava S, Hassanali M, Stothard P, *et al*. Drugbank: a comprehensive resource for *in silico* drug discovery and exploration. Nucleic Acids Res, 2006; 34: 668-

72.
5. http://www.drugsupdate.com/generic/view/475/ciprofloxacin. [Last accessed on 10 Jan 2018]
6. Scherer R, Jessica P, Juliete F, Mariana L, Mayara L. Determination of ciprofloxacin in pharmaceutical formulations using HPLC method with UV detection. Indian J Pharm Sci, 2014; 76: 541-4.
7. http://www.medindia.net/drug-price/CIPROFLOXACIN.htm. [Last accessed on 10 Jan 2018]
8. https://www.fda.gov/downloads/Drugs/ResourcesForYou/Consumers/BuyingUsingMedicineSafely/GenericDrugs/UCM564 441.pdf. [Last accessed on 10 Jan 2018]
9. https://pubchem.ncbi.nlm.nih.gov/compound/ciprofloxacin. [Last accessed on 10 Jan 2018]
10. Madan MG, Maulesh MC, Madhulika G. Formulation development and evaluation of gastro retentive floating tablet of ciprofloxacin hydrochloride. Int J Pharm Pharm Sci, 2016; 8: 149-52.
11. SB Makwana, VA Patel, SJ Parmar. Development and characterization of in-situ gel for the ophthalmic formulation containing ciprofloxacin hydrochloride. Results Pharma Sci, 2016; 6: 1–6.
12. Daniel CR, Seth T, David MB, Nicole LW, Sandra CB, Luke RB, *et al.* Ciprofloxacin-loaded keratin hydrogels prevent pseudomonas aeruginosa infection and support healing in a porcine full-thickness excisional wound. Adv Wound Care, 2014; 4: 457-68.
13. Ashwin K, Ramesh S, Ramesh, Sudhakar B, Goverdhan Reddy P. Design and evaluation of biodegradable periodontal films containing ciprofloxacin and ornidazole. Sch Acad J Pharm, 2013; 2: 60-9.
14. Smriti M, Jitendra P, Sumeet D. Formulation and evaluation of floating microbeads of ciprofloxacin hcl by emulsion gelation method. Int J Pharm Life Sci, 2013; 4: 2876-84.
15. Raheem SA, Hussein AH, Abbashayder K, Matrood MK, Azeez OS. Effect of method of preparation on physical properties of ciprofloxacin hcl elastic liposomes intended to be utilized in the treatment of acne vulgaris. Int J Res Ayur Pharm, 2013; 4: 742-6.
16. Sathish Reddy E, Mohammed MI, Syed MK, Syed AB, Mohammed I. Formulation and evaluation of sustained release floating tablets of ciprofloxacin with hepato-protectant. Int J Pharm Appl, 2012; 3: 289-92.
17. Mudgul VK, Rajat K, Saraogi GK, Singhai AK, Sharma D. Formulation and evaluation of sustained release floating tablets of ciprofloxacin. Int Res J Pharm, 2012; 3: 120-2.
18. Mohamed AA, Mohamed AA, Mohamed SH. Design and evaluation of ciprofloxacin hydrochloride ocular inserts. Int J PharmTech Res, 2011; 3: 1750-63.
19. Himabindu TVL, Vidyavathi M, Kavitha, Sastry TP, Suresh Kumar RV. Preparation and evaluation of ciprofloxacin loaded chitosan-gelatin composite film for wound healing activity. Int J Drug Delivery, 2010; 2: 173-82.
20. Mukhopadhyay S, Goswami L, Satheesh MNV, Upadhyaya K. Formulation and evaluation of floating bioadhesive tablets of ciprofloxacin hydrochloride by direct compression technique. Int J Pharm Pharm Sci, 2010; 2: 113-5.
21. Ramji AKA, Chandra Sekhara Rao G, Prabhakar Reddy V. Formulation and evaluation of swellable and floating gastroretentive ciprofloxacin hydrochloride tablets. AAPS Pharm Sci Tech, 2009; 10: 220-6.