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Using UV-visible spectroscopy to quantitatively estimate the amount of ciprofloxacin in marketed dosage form

Dr. Dhanraj Patidar*, Dr. Shailesh Jain, Mr. Ajay Kumar, Mr. Ritesh Raj, Miss Pooja Yadav, Mr. Dipak Sariya
SAM College of Pharmacy, SAM Global University, Raisen, Madhya Pradesh, India.

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ABSTRACT
A common therapy for a range of bacterial illnesses is ciprofloxacin, a second-generation fluoroquinolone antibiotic. ciprofloxacin is used to treat bacterial infections, including pneumonia and urinary tract infections. The FDA has approved ciprofloxacin for the treatment of gastrointestinal infections, lower respiratory tract infections, anthrax, plague, salmonellosis, typhoid fever, skin, bone, joint infections, prostatitis, urinary tract infections, and sexually transmitted diseases (gonorrhea and chancroid). The determination of ciprofloxacin highlighted UV-Visible spectroscopy as one of the most reliable and accessible techniques. They reviewed many studies that used UV-visible spectroscopy to analyze ciprofloxacin, describing the best wavelengths, solvent combinations, and the method's suitability for use in the pharmaceutical sector. The study also underlined how crucial technique validation is to guaranteeing the precision and correctness of the findings. According to the authors, UV-visible spectroscopy is very appropriate for both industrial and research contexts since it yields fast and accurate findings.

Keywords: ciprofloxacin, UV-spectroscopy, fluoroquinolone, antibiotic, urinary tract infections, pneumonia.

I. INTRODUCTION

A common therapy for a range of bacterial illnesses is ciprofloxacin, a second-generation fluoroquinolone antibiotic. Both inpatient and outpatient settings frequently prescribe it due to its demonstrated effectiveness against a wide range of Gram-positive and Gram-negative bacteria. To guarantee both safety and effectiveness, precise measurement of ciprofloxacin in approved dosage forms is crucial, just like with any pharmaceutical medication. It is impossible to overestimate how crucial it is to maintain exact concentrations of active pharmaceutical ingredients (APIs) in medicinal products since variations may result in toxicity or therapeutic failure. Because of its ease of use, dependability, and affordability, UV-Visible Spectroscopy is one of the most used analytical techniques for measuring ciprofloxacin in pharmaceutical formulations.

The UV-visible spectroscopy technique relies on a compound's ability to absorb light at particular wavelengths. Because of its non-destructive nature, simplicity of usage, and capacity to handle a variety of sample types, such as tablets, liquids, and powders, this technology is very helpful for the examination of pharmaceutical compounds. According to Beer-Lambert's rule, UV-visible spectroscopy measures a sample's absorbance at certain wavelengths, which is exactly proportional to the compound's concentration. When the API in issue exhibits a significant absorbance at a certain wavelength, making it easily observable even at low concentrations, this approach is very beneficial. Since ciprofloxacin has a recognized peak at around 278 nm, UV-visible spectroscopy is a perfect method for estimating it in different dose forms. (Patil et al., 2017).

Regular monitoring of ciprofloxacin concentrations in commercial formulations is essential for quality assurance and regulatory compliance in the pharmaceutical sector. For patient safety, the amount of ciprofloxacin in each dose form must stay within the authorized ranges. High-performance liquid chromatography (HPLC), liquid chromatography-mass spectrometry (LC-MS), and UV-visible spectroscopy are among the analytical techniques available for ciprofloxacin estimation. However, because of its affordability, low sample preparation needs, and very short analysis durations, UV-visible spectroscopy stands out as a desirable choice for many pharmaceutical businesses. Additionally, UV-visible spectroscopy is easily adaptable for routine quality control in pharmaceutical labs as well as research. (Singh et al., 2016).

A tried-and-true method for measuring the active medicinal components in various medication formulations is UV-visible spectroscopy. UV-Visible spectroscopy has many benefits, including the fact that it does not require complicated chemicals or expensive equipment. Additionally, it is capable of handling a broad range of matrix conditions and sample types. Given that ciprofloxacin comes in a variety of forms, including tablets, injectables, and ocular preparations, this is very important to consider while studying it. Without requiring a lot of sample processing, the method's simplicity makes it ideal for analyzing ciprofloxacin in complicated matrices. Because of the method's versatility and affordability, UV-visible spectroscopy is a preferred option for quality control labs and pharmaceutical producers. (Nair et al., 2014).

The development and validation of UV-visible spectrophotometric techniques for the measurement of ciprofloxacin in various dose forms has been the subject of several investigations in recent years. These investigations' main goal has been to provide straightforward, quick, dependable, and adaptable techniques for a range of ciprofloxacin formulations. To improve the method's sensitivity and accuracy, researchers have concentrated on refining experimental parameters such as solvent choice, wavelengths, and calibration methods. Verifying the robustness and repeatability of these techniques requires validation. Method validation usually entails evaluating factors including specificity, linearity, accuracy, precision, limits of quantification (LOQ), and limits of detection (LOD). Research has demonstrated that, when properly evaluated, UV-visible spectroscopy yields precise and reliable findings. (Joshiet al., 2015).

Finding the ideal solvent solution to dissolve the medication with the least amount of excipient interference is a common step in the development of methods for UV-visible spectrophotometry in ciprofloxacin quantification. The choice of solvent is important as it influences ciprofloxacin's absorption properties and, in turn, the estimation's accuracy. Methanol, ethanol, and phosphate-buffered saline are a few examples of common solvents. According to research, the amount of ciprofloxacin in marketed tablets and other dosage forms may be precisely measured by using certain solvents in conjunction with wavelengths that have been tuned (Kumar & Gupta, 2013).

Quantitative analysis's calibration curve also affects how reliable UV-visible spectroscopy is for estimating ciprofloxacin. Plotting absorbance readings against known ciprofloxacin concentrations yields a well-established calibration curve that makes it possible to determine the drug concentration in unknown samples. Numerous studies have examined the linearity of the calibration curves for ciprofloxacin in different dosage forms, and the findings consistently demonstrate that absorbance and concentration follow Beer-Lambert's law and have a good linear association. These results highlight how useful the approach is for estimating the amounts of ciprofloxacin in pharmaceutical formulations in a precise and repeatable manner. (Sengupta et al., 2022).

There are more uses for UV-visible spectroscopy in ciprofloxacin estimation outside tablet formulations. Additionally, scientists have created UV-visible techniques to measure the amount of ciprofloxacin in liquid forms such as eye drops, injections, and oral solutions. The safety and effectiveness of treatment depend on precise measurement of ciprofloxacin, which is frequently prepared as an intravenous or ocular solution. One clear benefit in these situations is the method's capacity to work with liquid matrices without requiring intricate sample preparation. In order to estimate the amount of ciprofloxacin in eye drop formulations, successfully used UV-visible spectroscopy, demonstrating the method's adaptability to different drug forms. (Srinivas et al. 2018).

The simplicity of use of UV-visible spectroscopy is another feature that makes it especially desirable for regular pharmaceutical analysis. The capacity to employ a comparatively low-cost method that needs little training is advantageous to pharmaceutical businesses, particularly those operating in low-resource environments or with limited resources. With just a simple spectrophotometer and a few consumables needed, UV-visible spectroscopy is more accessible than high-performance liquid chromatography (HPLC), which needs expensive equipment and chemicals. Because of its precision, speed, and affordability, UV-visible spectroscopy is a perfect technique for quality control in both small pharmaceutical labs and big production facilities. (Mehta et al., 2019).

The regulatory approval of UV-visible spectroscopy also has an impact on its extensive use in the pharmaceutical sector. Regulatory

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organizations, including the European Medicines Agency (EMA) and the U.S. Food and Drug Administration (FDA), have acknowledged UV-visible spectroscopy as a legitimate and trustworthy technique for pharmaceutical product examination. Additionally, the United States Pharmacopoeia (USP) and other pharmacopoeial recommendations advocate the use of UV-visible spectrophotometry for ciprofloxacin measurement in pharmaceutical dosage forms. This regulatory support has further strengthened the pharmaceutical industry's embrace of this technology. (Patel et al., 2020).

In summary, a very dependable, affordable, and easily accessible technique for the quantitative assessment of ciprofloxacin in commercially available dosage forms is UV-visible spectroscopy. It is a favored analytical instrument for pharmaceutical makers and quality control labs because to its benefits in terms of ease of use, speed, and minimal sample preparation. Numerous investigations have shown that UV-visible spectroscopy is a useful method for quantifying ciprofloxacin in a variety of medication forms, including tablets and injectable solutions. UV-Visible spectroscopy will continue to be a crucial component of pharmaceutical analysis as the pharmaceutical industry prioritizes patient safety and drug quality, offering precise and effective findings for the estimate of ciprofloxacin and other pharmaceutical chemicals. (Sharma et al., 2021).

II. REVIEW OF LITERATURE

Joshi et al. (2015) examined different spectrophotometric approaches for the determination of ciprofloxacin and highlighted UV-Visible spectroscopy as one of the most reliable and accessible techniques. They reviewed many studies that used UV-visible spectroscopy to analyze ciprofloxacin, describing the best wavelengths, solvent combinations, and the method's suitability for use in the pharmaceutical sector. The study also underlined how crucial technique validation is to guaranteeing the precision and correctness of the findings. According to the authors, UV-visible spectroscopy is very appropriate for both industrial and research contexts since it yields fast and accurate findings.

Nair et al. (2014) examined how to determine the amount of ciprofloxacin in pharmaceutical formulations using UV-visible spectroscopy, with a special emphasis on tablet dosage forms. For the quantitative measurement of ciprofloxacin, they found that UV-visible spectroscopy at 278 nm was perfect, yielding highly reproducible findings. Their investigation also looked at the effects of excipients on estimating accuracy and the usage of various solvents. The results showed that regular quality control in the pharmaceutical sector might apply UV-visible spectroscopy successfully to ensure that ciprofloxacin dosages in marketed formulations are correct.

Kumar et al. (2023)examined the use of UV-visible spectroscopy to determine the presence of ciprofloxacin in pharmaceutical formulations, highlighting how easy and affordable it is for regular analysis. The study showed that, even in complicated pharmacological forms like tablets and injections, ciprofloxacin could be properly estimated using UV-visible spectroscopy. Using statistical techniques, the authors verified the procedure and demonstrated the UV absorbance at 278 nm's linearity, accuracy, and precision. According to this new study, UV spectroscopy provides a quick and accurate way to determine the amount of ciprofloxacin present in marketed formulations, including both raw materials and final goods.

Sengupta et al. (2022)examined the application of spectrophotometric techniques for the quantitative measurement of ciprofloxacin, highlighting a range of analytical methodologies such as high-performance liquid chromatography (HPLC) and UV-visible. Their results showed that UV-visible spectroscopy provides a competitive advantage in terms of ease of use, affordability, and quick analytical time. With an emphasis on the necessity of certain analytical techniques to track the amount of ciprofloxacin in pharmaceutical goods, the research also covered the standardization of ciprofloxacin formulations in the pharmaceutical sector. The great sensitivity and repeatability of UV-visible spectroscopy make it stand out as a potent instrument.

Sharma et al. (2021)have out research that concentrated on using UV-visible spectroscopy to identify ciprofloxacin in tablet dose forms. The authors examined the linearity, accuracy, and precision of ciprofloxacin in many commercially available brands using a straightforward and verified UV-visible spectrophotometric technique at 277 nm. According to the study's findings, the UV approach worked well for routinely analyzing ciprofloxacin and produced consistent results with no interference from excipients frequently included in tablet formulations. This study helped to strengthen the case for UV spectroscopy as a crucial analytical method for pharmaceutical

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quality assurance.

Mehta et al. (2019) developed a spectrophotometric technique that uses UV-visible spectroscopy to quantify ciprofloxacin in tablet and bulk medication dose forms. Their study went into great depth on how to optimize the experimental setup, including choosing the right solvent and figuring out the wavelength for optimum absorption. The investigation concluded that ciprofloxacin in pharmaceutical formulations may be routinely and accurately analyzed using UV-visible spectroscopy at 277 nm. Further validation of the method's linearity, limit of quantification (LOQ), and limit of detection (LOD) showed its potential for quality control in the pharmaceutical sector.

Srinivas et al. (2018) investigated the suitability of using UV-visible spectroscopy to estimate the amount of ciprofloxacin in eye drop formulations. The particular goal of this work was to address the difficulties in assessing liquid formulations, which are generally more complicated than solid dosage forms. With little interaction from other ingredients, the researchers were able to accurately estimate the amounts of ciprofloxacin in these formulations. The study verified that ciprofloxacin in a range of dosage forms, including liquids, could be reliably and effectively analyzed using UV-visible spectroscopy at a wavelength of 278 nm.

Patel et al. (2020)centered on creating a UV-visible spectroscopic technique for the quantitative measurement of ciprofloxacin in tablet and bulk form. Their research demonstrated a linear relationship between ciprofloxacin concentration and absorbance at 278 nm, confirming the precision of UV-visible spectroscopy in ciprofloxacin quantification. Additionally, the study proved the method's repeatability and robustness across a broad range of concentrations. Additionally, the writers discussed issues like matrix effects and excipient interference, recommending sample preparation methods to reduce such problems.

Patil et al. (2017)examined the estimation of ciprofloxacin in tablet dosage forms using a UV-visible spectrophotometric approach and contrasted it with HPLC-based techniques. They discovered that UV-visible spectroscopy was accurate enough for regular pharmaceutical examination, particularly when resources are scarce, even if HPLC techniques were more complex. This study's technique was easy to use, quick, and economical, which made it a great substitute for quality control in many pharmaceutical settings. To ensure the method's dependability for the pharmaceutical business, the study also concentrated on optimizing experimental parameters, such as the concentration range and solvent utilized.

Singh et al. (2016)highlighted how crucial it is to validate UV-visible spectroscopy methods for identifying ciprofloxacin in pharmaceutical formulations. With little interference from excipients in tablet forms, their study showed that UV spectroscopy was very useful for ciprofloxacin analysis. The study emphasized the benefits of this method, such as its quick implementation and lack of costly equipment. According to the authors, UV-visible spectroscopy provides a high level of precision and dependability, making it a useful instrument for routine analysis of pharmaceuticals.

Kumar & Gupta (2013)developed and approved a UV-visible spectrophotometric technique to measure ciprofloxacin in medicine dose forms. According to the authors, the technique for determining the amount of ciprofloxacin in tablets was simple, economical, and yielded accurate findings. With a specified linear range for ciprofloxacin concentration, they validated the method's accuracy, precision, and resilience. The study offered valuable information on how to enhance the experimental setup to increase the precision of UV-visible spectrophotometric analysis in the detection of ciprofloxacin.

PLAN OF WORK

1. **Literature survey**

To gather details on the medication (Ciprofloxacin), such as its physical and chemical properties and analysis.

2. **Procurement of the drug**

To get the drug's functioning standard is of the highest importance.

3. **Determination of the solubility of the drug**

To find out if a medicine is soluble in a certain solvent.

4. **Experimental work**

To prepare the serial dilution and stock solution.

5. **SELECTION OF WAVE LENGTH.**
6. **CALCULATION.**

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DRUG PROFILE
CIPRO FLOXACIN

Ciprofloxacin is a synthetic Antibiotic Ciprofloxacin, Ciprofloxacin

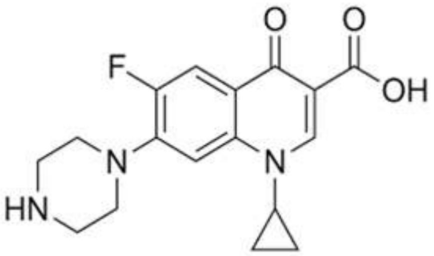

Figure: Structure of Ciprofloxacin

Molecular Weight:-331.34 g/mol
Chemical Formula:-$C_{17}H_{18}FN_3O_3$

A member of the fluoroquinolone class of antibiotics, ciprofloxacin is used to treat bacterial infections, including pneumonia and urinary tract infections. The FDA has approved ciprofloxacin for the treatment of gastrointestinal infections, lower respiratory tract infections, anthrax, plague, salmonellosis, typhoid fever, skin, bone, joint infections, prostatitis, urinary tract infections, and sexually transmitted diseases (gonorrhea and chancroid). Furthermore, individuals with mixed infections or those who have risk factors for Gram-negative infections might benefit from ciprofloxacin as a therapy choice. Members of the interprofessional team must evaluate the indications, coverage, contraindications, and adverse event profile of ciprofloxacin, a broad-spectrum quinolone antibiotic, to manage patients' infectious infections as effectively as possible.

Mechanism of Action

Ciprofloxacin belongs to the fluoroquinolone medication family and is a bactericidal antibiotic. By blocking bacterial DNA topoisomerase and DNA-gyrase, it prevents DNA replication. Ciprofloxacin is the fluoroquinolone class's most effective antibiotic against gram-negative bacilli, particularly those belonging to the Enterobacteriaceae, which includes Salmonella, Shigella, Neisseria, and Escherichia coli. Additionally, ciprofloxacin works well against some gram-positive bacteria. Of all the quinolones, ciprofloxacin is the most effective against Pseudomonas aeruginosa. There have been reports of P. aeruginosa susceptibility gradually declining in North America, South America, and Europe, mainly in hospital or nursing home settings with known risk factors. One of the few oral medicines used to treat P. aeruginosa infections is ciprofloxacin.

Mechanism of Resistance

Efflux pump-mediated, plasmid-mediated, and DNA gyrase mutations all give resistance to fluoroquinolones, including ciprofloxacin. The GyrA component of gyrase is often the main mechanism of resistance for Escherichia coli. In some therapeutic contexts, when used appropriately, ciprofloxacin can be less expensive and more cost-effective than conventional parenteral regimens. It would be beneficial to do more carefully planned research to further define the most economical application of this antibacterial drug. However, ciprofloxacin resistance has increased in E. coli-associated UTIs, especially in hospital settings as opposed to community settings. It is important to evaluate ciprofloxacin usage as empirical treatment on an individual basis.

Pharmacodynamics

A second-generation fluoroquinolone that works against a variety of Gram-positive and Gram-negative bacteria is ciprofloxacin. It works by inhibiting the bacterial enzymes topoisomerase IV and DNA gyrase. The affinity of ciprofloxacin for bacterial DNA gyrase is 100 times greater than that of mammalian DNA gyrase. Since fluoroquinolones and other antibiotic groups do not cross-react, they may be useful in therapeutic settings when other antibiotics are no longer working. Researchers are also looking at how ciprofloxacin and its derivatives work against AIDS, cancer, and malaria.

Pharmacokinetics

1. **Absorption**: Despite its ease of absorption, ciprofloxacin usually does not reach full absorption. Between 70 and 80 percent of oral ciprofloxacin is bioavailable. Following oral administration, the time to peak concentrations (Tmax) is between one and one and a half hours. Due to reduced absorption, avoid taking ciprofloxacin at the same time as dairy products or drinks with added calcium.
2. **Distribution**: Ciprofloxacin has a large volume of dispersion (2 to 3 L/kg). Following oral ingestion, the body distributes ciprofloxacin widely. Ciprofloxacin reaches therapeutic concentrations in saliva, bronchial secretions, lymph, bile, the prostate, and urine,

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and tissue concentrations typically surpass serum values. Although CSF concentrations are typically lower than plasma values, they do rise when meningeal inflammation is prevalent. Additionally found in the aqueous humor of the eye are ciprofloxacin-based topical medications.

3. **Metabolism**: Ciprofloxacin inhibits cytochrome P450 1A2 (CYP1A2) in humans. Ciprofloxacin co-administration with other medications that are CYP1A2-metabolized raises the levels of these medications in the plasma and may be hazardous.
4. **Excretion**:Ciprofloxacin has a 4-hour elimination half-life. Urine contains 40–50% of the antibiotic ciprofloxacin in an unaltered form. Tubular secretion is the predominant mechanism in the renal elimination of ciprofloxacin since the renal clearance of the antibiotic is around 300 mL/minute, which is higher than the typical GFR of 120 mL/minute. Feces might contain anywhere from 20% to 35% of an oral dosage. Fecal excretion is mostly dependent on biliary clearance and transintestinal elimination.

Administration

Oral, injectable, and topical forms of ciprofloxacin are all accessible. For seven to fourteen days, or at least two days after the infection's signs and symptoms have subsided, ciprofloxacin is taken orally twice a day. For mild to moderate urinary tract infections, 250 mg twice daily is the recommended oral dosage regimen; for severe or complex infections, 500 mg twice daily. 500 mg twice daily is the recommended dosage for the treatment of mild to moderate infections of the skin, soft tissues, or respiratory tract. For severe or complex infections, 750 mg twice a day is the recommended dosage. Ciprofloxacin should be administered with meals to reduce gastrointestinal distress.

For mild-to-moderate infections, an intravenous dosage of 200–400 mg twice a day is advised; for severe, life-threatening infections, the dosage might reach 400 mg every 8 hours. Those with significant renal impairment (creatinine clearance = 1.2 L/hour) should reduce their daily dosage by 50%. It takes 60 minutes to deliver ciprofloxacin intravenously via gradual infusion. Maintaining enough hydration and urine production is crucial. Avoid using antacids, or at the very least, give ciprofloxacin two hours before or six hours after taking antacids, whether the formulation is immediate-release or extended-release. It is not advisable to deliver the oral suspension through feeding tubes since it may stick to the tube. Compared to ciprofloxacin pills, otic ciprofloxacin is a safe and efficient antibiotic for treating chronic otitis media.

Specific Patient Populations

1. **Patients with Hepatic Impairment**: There have been no discernible alterations in the pharmacokinetics of ciprofloxacin in individuals with liver cirrhosis. But little is known about the pharmacokinetics of ciprofloxacin in individuals suffering from acute hepatic failure. Hepatotoxicity is another possible side effect of ciprofloxacin. In individuals with compromised liver function, use with care.
2. **Patients with Renal Impairment**: Ciprofloxacin is mostly excreted by the kidneys, as was covered in pharmacokinetics; dose modification is necessary, particularly in cases of severe renal impairment.250–500 mg per 24 hours (after dialysis) for individuals receiving hemodialysis or peritoneal dialysis.The suggested dosage for sepsis in CRRT patients is 200–400 mg every 8–12 hours.
3. **Pregnancy Considerations**: Ciprofloxacin and other fluoroquinolones are generally not recommended during pregnancy because of the risk of bone and cartilage damage. However, there is no evidence of a drug-associated risk of serious congenital defects, miscarriage, or poor pregnancy outcomes based on the clinical data currently available. Therefore, in cases of antimicrobial resistance or intolerance to first-line antibiotics, it is advised to permit the use of fluoroquinolones, including ciprofloxacin, throughout the early stages of pregnancy. Only use ciprofloxacin for strong reasons, such as anthrax inhalation. Likewise, save ciprofloxacin for severe Crohn's disease with perianal illness; in other cases, amoxicillin-metronidazole is an excellent option. (Guides of the American Gastroenterological Association).
4. **Breastfeeding Considerations**: Because of worries about potential negative effects on growing joints, ciprofloxacin has not historically been advised for nursing moms. Although there is no clinical evidence to support this theory, the calcium in milk may

reduce the absorption of trace levels of fluoroquinolones in milk. It is permissible to use ciprofloxacin in nursing mothers for the necessary purposes while keeping an eye out for any negative medication responses, such as diarrhea or candidiasis. One potential tactic to prevent exposing a baby to avoid nursing for three to four hours following the last ciprofloxacin dosage if there is ciprofloxacin in the breast milk.

Uses

Ciprofloxacin works well for many different types of infections. It is widely used for empirical treatment of any illness due to its broad-spectrum bactericidal action, oral effectiveness, and acceptable tolerability; nevertheless, it should not be used for mild cases or in situations where gram-positive organisms and/or anaerobes are the primary cause. Therapy for severe infections may begin with intravenous infusion and later transition to oral administration.

1. **Urinary tract infections**: Even complex cases and those with indwelling catheters or prostatitis have shown high cure rates. Compared to cotrimoxazole, comparative trials have shown greater success rates. Chronic infections caused by Pseudomonas react less fully.
2. **Gonorrhoea**: A single 500 mg dosage was initially almost 100% curative for both PPNG and non-PPNG infections; however, the cure rate has decreased as a result of resistance, and it is no longer a first-line medication; nonetheless, it may still be administered if the strain is susceptible.
3. **Chancroid**: For three days, 500 mg BD is a second-line substitute for ceftriaxone/azithromycin.
4. **Bacterial gastroenteritis**: It is now the most commonly used medication for empirical treatment of diarrhea. It should, however, only be used in extreme situations, including infections with Shigella, Salmonella, EPEC, and Campy. jejuni. In cholera, ciprofloxacin can decrease stool volume.
5. **Typhoid**: Since ampicillin, cotrimoxazole, and chloramphenicol have become unreliable owing to the development of resistance, ciprofloxacin is one of the first-choice medications for typhoid fever. Up to 95% of S. typhi isolates in India and other countries were ciprofloxacin-sensitive. Nonresponsive instances, however, are becoming more and more common. More often used is ceftriaxone (or ceftriaxone/cefoperazone). The suggested dosage of ciprofloxacin is 750 mg BD for 10 days. Initial treatment for those who cannot take the medication orally may include administering 200 mg intravenously every 12 hours.

Because it is antibacterial, ciprofloxacin has the following benefits:

- Rapid defervescence: fever typically goes away in four to five days, but it might take longer today.
- Early symptom relief; minimal risk of recurrence and consequences.
- High biliary and intestinal mucosal concentration, excellent penetration into infected cells, and cidal activity prevent the carrier state. 750 mg BD for 4–8 weeks is another way to treat typhoid carriers. This has a 92% eradication rate, while ampicillin only achieves 50%.

6. **Bone, soft tissue, gynaecological and wound infections**: caused by gram-negative bacteria that react to ciprofloxacin and resistant Staph. Although osteomyelitis and joint infections have shown significant cure rates, extended therapy (6–8 weeks) with large dosages (750 mg BD) is necessary. It works well for diabetic foot when taken with clindamycin or metronidazole (to cover anaerobes).
7. **Respiratory infections**: The limited and unpredictable susceptibility of pneumococci and streptococci makes ciprofloxacin an inappropriate first-line treatment. Nevertheless, in addition to gram-negative infections, it can treat Mycoplasma, Legionella, H. influenzae, and Brucella. catarrhalis, and some streptococcal and pneumococcal infections. There are currently several second-generation FQs available to treat chronic bronchitis and pneumonia. For the post-exposure treatment of inhaled anthrax that may result from bioterrorism, the US FDA has authorized the use of ciprofloxacin.
8. **Tuberculosis**: It is a second-line drug which can be used as a component of combination chemotherapy against multidrug-resistant tuberculosis. Recently, even FQ-resistant TB (extensively drug resistant or XDR-TB) have arisen.
9. **Gram-negativesepticaemias**: It is possible to mix parenteral ciprofloxacin with either an aminoglycoside or a third-generation

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cephalosporin.

10. **Meningitis**: Ciprofloxacin has proven an effective treatment for gram-negative bacterial meningitis, particularly in patients with CSF shunts or immunocompromised individuals, despite its poor penetration in CSF.
11. **Prophylaxis**of infections in cancer patients, neutropenic patients, and other vulnerable individuals.
12. **Conjunctivitis**:Gram-negative bacteria: topical treatment works well.

Adverse effects

At therapeutic dosages, side effects are minimal and mostly restricted to gastrointestinal disturbances, including nausea and diarrhea. Ciprofloxacin's major side effects include photosensitivity, hyperglycemia, and a prolonged QT interval. Drug-induced bullous pemphigoid was one of the uncommon interactions.

Exacerbation of myasthenia gravis, peripheral neuropathy and neuropsychiatric side effects, and tendinitis and tendon rupture are among the FDA's boxed warnings. The Achilles tendon is the most often ruptured. There have also been reports of tendinopathies in the triceps, gluteal, and iliopsoas tendons. Tendonitis was more likely to occur in older adults and those who used steroids. One potential explanation causing tendinopathy is the upregulation of matrix metalloproteinases, which results in the destruction of collagen. The cumulative dosage of oral fluoroquinolone medication, which includes ciprofloxacin, is linked to an elevated risk of peripheral neuropathy. Nerve biopsies can reveal evidence of injury to tiny fibers.

Hallucinations, seizures, agitation, tremors, and psychosis are examples of neuropsychiatric adverse effects.

Fluoroquinolone usage has been linked to aortic dissection and aortic aneurysm. Older age and prolonged fluoroquinolone treatment are the related risk factors. If there is a suspicion of aortic dissection, stop taking ciprofloxacin right away.

Contraindications

Patients who have a history of confirmed hypersensitivity to ciprofloxacin or its formulation ingredients are contraindications. There have been reports of anaphylaxis and anaphylactoid responses after the initial ciprofloxacin dosage in the literature. It is also not recommended to use tizanidine for muscular spasms at the same time. Ciprofloxacin's CYP1A2 inhibition changes the pharmacokinetics of tizanidine, resulting in higher tizanidine levels and lower blood pressure, heart rate, and psychomotor activity. Patients with myasthenia gravis should not use ciprofloxacin or any of the fluoroquinolone family since this might make their muscular weakness worse.

Fig: Marketed drug of Ciprofloxacin tablets(CIPLA)

EXPERIMENTAL WORKS

The pharmaceutical preparation Ciprofloxacin tablet has following composition:

1. Ciprofloxacin IP
2. Baciluslactic acid

In a color coated tablet formulation Color: quinoline yellow WS.

- Ciprofloxacin's analysis of quantitative estimation (Quality Control) method begin with a study of physiochemical properties of drug substances.

Study of solubility:

Marketed drug Ciprofloxacin is showing high solubility in glacial acetic acid and poorly soluble in methanol, ethanol, chloroform and water.

MATERIALSANDMETHODS

UV Spectrophotometer: Shimadzu 1800 double beam UV/V Spectrophotometer with 1cm matched quartzcells.

Digitalbalance: Shinko analytical balance.

The other chemicals and glasswares were used of analytical grade from market and college.

Standard Stock Solution Preparation:

- Standard stock solution of Ciprofloxacin was prepared by dissolving 10 mg of drug in 10 ml 0.1 N HCL in Volumetric flask.
- Then take 1ml of prepared solution in other flask and make volume up to 10ml with 0.1 NHCL.

Standard Serial Dilution Preparation:

Std.–1:Take 1ml of stock Solution in 10ml of 0.1

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NHCL(10µg/ml)

Std. – 2: Take 0.6 ml of stock Solution in 10ml of 0.1N HCL (6µg/ml).

Sample Stock Solution Preparation:

- Sample Stock Solution of Ciprofloxacin was prepared by Crushing 20 Tablets of marketed Drug into fine powder in dissolved 10 ml in of powdered drug in 10 ml of 0.1NHCL(1000µg/ml).
- Then take 1ml of prepared solution in 10ml 0.1NHCL(10µg/ml).

Sample Serialdilution Preparation:

- Take 0.1ml of stock solution of 10µg/ml and dissolve in10m l0.1NHCL.

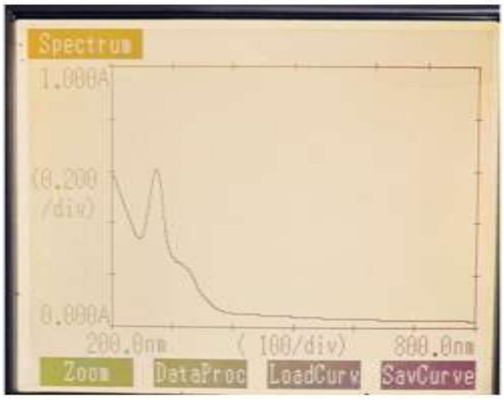
Calibration curve: Spectroscopic method was performed for the prepare diluted sample solution to find out the λ max in the wavelength region 200-800 nm. The λ max standard and sample was found to be 0.495 -0.295 and 0.488 respectively. the calibration curve is plotted between the absorbance and concentration.

UV–Visible spectroscopy of standard & sample solution:

The spectra of UV-visible spectroscopy is plotted between concentration(Y–axis) and wavelength (X– axis). UV Spectroscopy based on the principle of Lambert and Beer law. This law said that the absorbance of the solution is directly proportional to the concentration of absorbing substance (drug) in the solution and the path length. The following UV-Spectra shows the λ max. Of standard Ciprofloxacin and sample Ciprofloxacin respective.

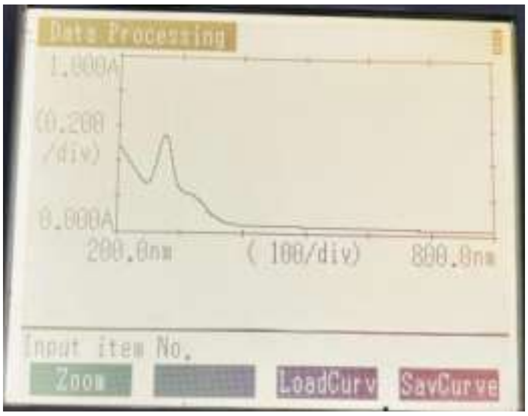
STANDARD UV-DATA

1. STANDARD DATA-1



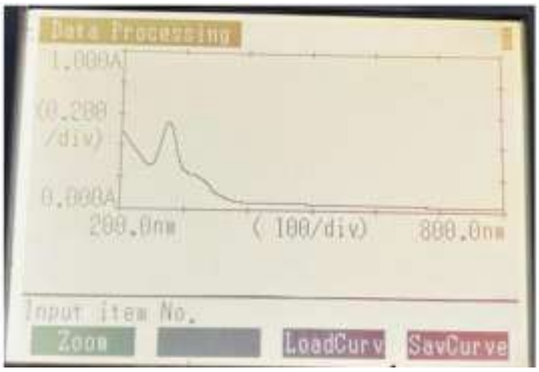
S.No.	Conc.	Absorbance	WaveLength
Std.1	10µg/ml	0.495	274nm

2. STANDARD DATA-2



S.No.	Conc.	Absorbance	WaveLength
Std.2	6µg/ml	0.295	274nm

3. SAMPLEDATA SPECTRA



S.No.	Conc.	Absorbance	WaveLength
Sample	0.8µg/ml	0.488	274nm

CALCULATION:

- **Actual Drug Taken=ASTx Claim/ Equivalent Weight**

=0.01x500/0.511

=9.784

$$C\ Test = \frac{(Atest\text{-}A\ std.\ 1)\ (C\ std.\ 1\text{-}C\ std.\ 2) + Cstd.\ 1\ (A\ Std.\ 1\text{-}A\ Std.\ 2)(A}{Std.\ 1\text{-}A\ Std.\ 2)}$$

$$C\ Test = \frac{(0.488\text{-}0.495)(10\text{-}6)+10(0.495\text{-}0.295)}{(0.495\text{-}0.295)}$$

$$C\ Test = \frac{0.007x4+10x0.2}{0.2}$$

C Test= 10.14µg/ml

- D. F.= (Final Volume ÷ Solute Volume) × Final Volume

D.F.= (10 ÷ 0.8) × 10 = 125

- Concentration of Solution A=D.F. into Concentration of Solution B

=10.14x125

=1267.5µg/m

- %Content=C testx100/10

=10.14x100/10

=101.4%

- **Drug in mg=101.4x500/100**

=507mg

III. RESULT AND DISCUSSION:

At a wavelength of 274 nm, the concentration of Ciprofloxacin was determined to be 101.4% (507 mg). The absorbance of the sample solution was 0.488 at 274 nm, while the absorbance of standards 1 and 2 was 0.495 and 0.295 at 274 nm, respectively. It suggests that the results were accurate.

IV. SUMMARY AND CONCLUSION

At a wavelength of 274 nm, the concentration of Ciprofloxacin was determined to be 101% (507 mg). The absorbance of the sample solution was 0.488 at 274 nm, while the absorbance of standards 1 and 2 was 0.495 and 0.295 at 274 nm, respectively. It suggests that the results were accurate.

ThisUV-spectroscopymethodwasveryreliable,cost-e f f e c t i v e endgave100% accuracyin results.

All things considered, spectroscopy is an effective method for both qualitative and quantitative evaluation of ciprofloxacin, guaranteeing both its effectiveness and safety in medical applications.

Ultimately, it was determined that this approach works well for routine Ciprofloxacin analysis in labs, colleges, and businesses in the future.

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