

Mini Review on different instrumental approaches applied to some selected drugs for COVID-19 treatment.

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Received: 2 Apr 2023 / Accepted: 26 Apr 2023 / Published online : 3 July 2023

ABSTRACT

The quickest methods for battling the new coronavirus pandemic at the beginning of the COVID-19 outbreak were therapeutic treatments based on approved drugs. Although there are now many vaccines available, it will take time for the global vaccination program to take effect. Therefore, in addition to vaccination, repurposing currently available antiviral, antibiotic, and other types of medications has been suggested as a complementary medical strategy for COVID-19 infections. Analytical methods for assessing drug concentrations in biological fluids and pharmaceutical products are necessary due to the drugs' extensive clinical potential as well as their potential side effects. The following article was introduced by presenting a mini-review of the different methods used for the quantitative determination of these drugs in order to encourage and facilitate collecting literature review for other researchers who will have studies related to the presented compounds. The review discussed techniques used for the determination of each drug quantitatively involving spectrophotometric (UV and visible), spectrofluorimetric, electrochemical and chromatographic (TLC and HPLC) methods either in a biological sample or in the pharmaceutical dosage forms. All methods included in the review are validated and constructed according to ICH guidelines.

Keywords: Covid-19; Remdesivir; Lomefloxacin; Dexamethasone; Analytical methods.

INTRODUCTION

The COVID-19 pandemic, the worst public health emergency in the previous 100 years, struck the world in 2020. Every continent, with the exception of Antarctica, has been hit by the coronavirus disease-2019 (COVID-19) pandemic in December 2019. COVID-19 is a contagious illness linked to SARS-CoV-2, a new coronavirus that causes the severe acute respiratory syndrome. Despite the fact that the world has survived many pandemics in the past, this one is a unique global health challenge that has changed how we live and is having a devastating socioeconomic impact on people worldwide.(Joshi, Parkar et al. 2021) SARS-primary CoV-2's peculiarity is its hazy symptoms, commonly mistaken for the flu and common cold. (Magro 2020) The fact that COVID-19 is unpredictable makes it even more concerning. It is especially scary because it can have fatal outcomes, such as pneumonia and acute respiratory distress syndrome, or cause non-to-mild respiratory tract symptoms in the majority of patients. Thankfully, most individuals who contract the virus can recover with only supportive treatment. This unpredictability of the virus is one more reason why it is important to take the necessary precautions to prevent its spread. Patients with chronic respiratory diseases, cardiovascular diseases, cancers, and immune deficiencies are susceptible to serious pathological complications and death.(Venkatasubbaiah,

Reddy et al. 2020) The serious consequences led to a worldwide search for a virus-specific treatment that would be effective. The level of public mistrust toward such vaccinations is significant, despite the approval and introduction of numerous vaccine types recently. These studies showed that existing therapies could be effective against SARS-COV-2, offering hope for a quicker path to treatment. Furthermore, the results indicated that it is possible to repurpose existing drugs for the treatment of SARS-COV-2.(Scavone, Brusco et al. 2020)

The first recognized therapy for severe coronavirus disease is remdesivir (I) in 2019. It is a novel nucleoside analog with broad antiviral activity against RNA viruses, such as respiratory pathogens and the Ebolavirus.(Malin, Suárez et al. 2020) It is an analog of adenosine and a monophosphoramidate prodrug. Remdesivir is broken down into its active form, which blocks viral RNA polymerase and avoids being checked by viral exonuclease, resulting in a reduction in the production of viral RNA. Remdesivir inhibits the nascent viral RNA of the Ebola virus through a delayed chain termination mechanism (Warren, Jordan et al. 2016). As a result of the immediate need for treatment, various experimental agents that already existed have been tried. As a result, to help control

viral replication and the patient's general health, COVID-19 patients take multiple therapy drugs from various categories. (Moneim, Kamal et al. 2021)

Since the start of the COVID-19 pandemic, scientists have concentrated on finding new uses for current antibiotics, antivirals, and anti-inflammatory medications. Being chemically derived from quinoline, the prodrug of chloroquine, fluoroquinolones are synthetic, broad-spectrum antimicrobial agents. Curiously, fluoroquinolones have been shown to have antiviral effects on the vaccinia virus, papovavirus, CMV, VZV, HSV-1, HSV-2, HCV, and HIV. (Karampela and Dalamaga 2020) Fluoroquinolones such as lomefloxacin (**II**) were suggested to be used as adjuncts in treating patients who have COVID-19 in light of their potential antiviral activity against SARS-CoV-2, along with their immunomodulatory properties, favorable pharmacokinetics, and excellent safety profile (Karampela and Dalamaga 2020). According to coronavirus disease 2019 (COVID-19) treatment guidelines, dexamethasone can be used in the treatment protocol. Corticosteroids' ability to treat pneumonia caused by COVID-19 and other coronaviruses was demonstrated in recent studies that showed this to be true both in vitro and in vivo. Dexamethasone (**III**) at low doses could

decrease mortality in patients with severe COVID-19 disease, but it did not affect the mortality rate in patients with a milder form of the disease. (Ahmed and Hassan 2020)

There is an urgent need for straightforward and reliable bioanalytical methods for drugs quantification in the human plasma matrix in order to advance clinical research and high-throughput monitoring. Here, we provide an overview of methods of instrumental analysis for drugs used in covid-19 treatment especially remdesivir, lomefloxacin and dexamethasone.

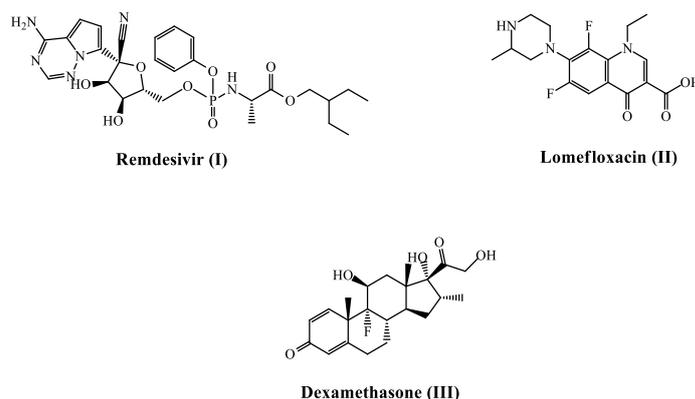


Fig. 1: Chemical structure of remdesivir (**I**), lomefloxacin (**II**) and dexamethasone (**III**).

Methods of analysis of selected drugs in this study

1. Reported methods of remdesivir

1.1. Spectrophotometric methods:

UV spectrophotometric methods have been reported for determination of remdesivir, including:

- Formation of complex with acid dye bromophenol blue to produce a yellow ion-pair complex which can be measured at 418 nm. The best acid dye was chosen for this method by using computational and theoretical studies. (Abdelazim and Ramzy 2022)
- The synthesis of a novel charge transfer complex (CTC) between chloranilic acid (CLA), an electron acceptor, and REM, an electron donor, is described in this study for the first time. Different spectroscopic and thermal gravimetric methods were used to characterize the CTC through the development of a new broad absorption band with a maximum absorption peak (max) at 530 nm. UV-visible spectroscopy was demonstrated the formation of the CTC in methanol. (Darwish, Khalil et al. 2022)

1.2. Spectrofluorimetric methods:

Fluorescent spectroscopy has also garnered a lot of interest. Its benefits include environmental sustainability and analytical performance. Pharmaceutical quality control procedures must be delicate, quick, and economical to offer high throughput at a fair

price. (El-Awady, Elmansi et al. 2022)

Spectrofluorimetric methods have been reported for the determination of remdesivir, including:

- One study was based on measurements of fluorescence (pH = 4) between 244 and 405 nm. Calibration was completed over the 1.0 - 65.0 ng/mL range to improve sensitivity at detection and quantitation limits of 0.287 and 0.871 ng/mL, respectively. Other variables affecting this technique were also studied. (Elmansi, Ibrahim et al. 2021)
- The fluorescence intensity for remdesivir was recorded at λ emission (410 nm) after λ excitation at 241 nm. (Attia, Boushra et al. 2022)

1.3. Electrochemical technique:

In this study, an anodic process utilizing a composite of Squaraine Dye and Ag₂O₂ has been assessed. The electro-analytical process has a branched mechanism, which suggests relatively dynamic behavior. However, the associated mathematical model analysis, conducted using the theories of linear stability and bifurcation, supports the composite electro-analytical efficiency as an electrode modifier. (Tkach, Kushnir et al. 2021)

1.4. Chromatographic methods:

1.4.1. HPLC chromatographic methods:

Table (1): HPLC methods reported for the determination of remdesivir.

Matrix	Column	Mobile phase	Detector	Ref No.
Pharmaceutical formulations	An agilent Extend C18	acetonitrile : KH ₂ PO ₄ solution (50:50, by volume)	UV at 247 nm	(Bulduk and Akbel 2021)
Plasma with Abacavir (internal standard)	Chromosil C18	Methanol :Acetonitrile: 0.1% OPA (30:65:5 v/v)	UV at 272 nm	(Kishore, Prasad et al. 2021)
Spiked human plasma in the presence of frequently co-administered medications	Reversed phase agilent C18	Gradient elution using (a) acetonitrile (b) water acidified at pH 4 with orthophosphoric acid.	Diode array detector at 240 nm Fluorescence $\lambda_{ex} = 245$ nm $\lambda_{em} = 390$ nm	(Moneim, Kamal et al. 2021)
Rat plasma	Inertsil ODS column	Isocratic elution (a) Buffer of triethyl amine (b) Acetonitrile (50:50 v/v)	Triple quadrupole mass detector	(Rao, Adimulapu et al. 2022)
Sublingual tablet dosage form	C18 column	Acetonitrile : Ammonium acetate buffer (pH 4.0) (40:60 % v/v)	Photo Diode Array Detector.	(Padhye ¹ , Sonawane et al.2022)
Rat plasma with Hydroxychloroquine -Favipiravir -Oseltamivir	C18 column	(a) Water (b) acetonitrile, (c) 0.1 % (v/v) formic acid	Triple Quadrupole MS	(El Azab 2022)
Plasma with -Favipiravir -Dexamethasone	Reversed phase BEH C18 column	Acetonitrile:methanol : water acidified at (pH 4) with orthophosphoric acid (35: 15: 50 , v/v)	Diode array detector	(Emam, Abdelaleem et al. 2022)
In human plasma with its active metabolite (GS441524)	Reversed phase agilent C18	Acetonitrile:Dimethyl Sulfoxide (50:50 v/v)	Triple Quadrupole MS	(Skaggs, Zimmerman et al. 2022)

In human serum with chloroquine, hydroxychloroquine lopinavir ritonavir favipiravir azithromycin	Reversed phase C18	(a) 0.1% formic acid (b) and acetonitrile	Triple Quadrupole MS	(Habler, Brügel et al. 2021)
In human plasma with its active metabolite (GS-44152)	Reversed phase agilent C18	(a) formic acid (b) acetonitrile	tandem quadrupole MS	(Kumar, Keerthana et al. 2022)
In human plasma	Reversed phase C18	(a) acetonitrile (b) 0.1% formic acid	quadrupole tandem mass spectrometer	(Alvarez, Moine et al. 2020)

2. Reported methods of Lomefloxacin

2.1. Spectrophotometric methods:

UV spectrophotometric methods have been reported for determination of lomefloxacin hydrochloride, including:

- Formation of complex with praseodymium at pH 6.5–8.5 which can be measured using the second derivative spectra at 357 nm. (Wang, Ren et al. 2000)
- Measurement of the absorbance of the drug aqueous solution using distilled water at 280 nm. (Gomes and Salgado 2005)
- First derivative for lomefloxacin determination in presence of its acid degradation product with zero crossing point at 295.2 nm. (Salem, El-Guindi et al. 2006)
- Measuring the absorbance at the 287 nm using different media such as water, 0.1N HCl 0.1N NaOH and chloride buffer that used as solvent. (Amran, Hossain et al. 2011)
- Measuring the absorbance at the 281 nm using urea solution (8M) as solubilizing agent. (Jain, Jain et al. 2012)
- Determination of the drug in presence of gemifloxacin mesylate and photodegradation products using two wavelengths 327 and 278 nm. (Tammam 2014)
- Measurement of the absorbance of the

drug aqueous solution using distilled water at $\lambda_{\max} = 287.1$ nm. (Singh and Singh 2014)

2.2. Spectrofluorimetric and chemiluminescence methods:

- One method depends on complex formation between the drug and terbium ion (Tb^{3+}) to enhance the fluorescence intensity with $\lambda_{\text{ex}} = 320$ nm and $\lambda_{\text{em}} = 545$ nm. (Tieli, Huichun et al. 1999)
- Chemiluminescence method depends on that the redox reaction between cerium (Ce^{4+}) and Na_2SO_3 can be greatly enhanced by the complex of terbium ion (Tb^{3+}) and the drug with four emission peaks at 490, 545, 585 and 620 nm. (Nie, Zhao et al. 2002) □
- Another method depends on native fluorescence of the drug in 0.1 N H_2SO_4 with $\lambda_{\text{ex}} = 290$ nm and $\lambda_{\text{em}} = 450$ nm. (Salem 2005)
- One method depends on the quenching effect after binding of the drug to bovine lactoferrin in a dilute aqueous solution with $\lambda_{\text{ex}} = 295$ nm and emission range from 300 – 550 nm. (Chen, Fan et al. 2006)
- Flow injection chemiluminescence method depends on reaction of the drug with either cerium and sodium sulphite in acid medium or cerium in acid condition sensitized by rhodamine 6G or luminol-

KIO₄-calcein in alkali medium with emission range from 350 – 550 nm.

(Ling–boa, Jie et al. 2007)

- Another method was based on charge transfer complex formation between lomefloxacin hydrochloride and bromanil with $\lambda_{ex} = 275$ nm and $\lambda_{em} = 459$ nm. (Salem, Fada et al. 2007)
- Another process relied on the complex formation of the drug with an aluminum ion to produce a high-fluorescent end product. The amount of sodium dodecyl sulfate added increased the amount of fluorescence that was observed at 429 nm after being excited at 332 nm. (Derayea, Hassan et al. 2023)
- The developed method is dependent on the formation of a metal-chelation compound using LMX as a ligand and zinc (II) in an acetate buffer (pH 5.5). The types of metal, their concentrations, pH values, buffer types, and solvents used to dilute them were all optimized. The best reaction conditions were determined after careful investigation to be 0.2 mM zinc, 2.0 ml acetate buffer (pH 5.5), and water as the diluting solvent. When LMX was excited at 284 nm and then excited at 450 nm, a significant increase in fluorescence intensity was achieved. (Attia, Omar et al. 2022)
- Also, for the purpose of lomefloxacin detection, a nanocomposite fluorescent probe based on fluorescence quenching was created. The created probe combined the excellent selectivity of

molecularly imprinted polymer, the high adsorption affinity of graphene oxide, and the high sensitivity of quantum dots. For monitoring lomefloxacin, the probe demonstrated good sensitivity, high specificity, and rapidity. Lomefloxacin reduced fluorescence emission linearly from 0.10 to 50.0 $\mu\text{g L}^{-1}$, and the probe showed a low limit of detection of 0.07 $\mu\text{g L}^{-1}$. (Orachorn and Bunkoed 2019)

- Lomefloxacin hydrochloride was found in human urine, and a quick, accurate spectrofluorometric method was developed to detect it. The technique is based on the determination of lomefloxacin's native fluorescence in 2×10^{-4} mol·L⁻¹ at emission = 451 nm following excitation at 323 nm. (Boltia, Soudi et al. 2019)

2.3. Electrochemical methods:

- This is adsorptive voltametric method depends on using Hg electrode and supporting electrolyte containing Britton-Robinson buffer (pH 8.8) - 0.02 M KCl. The reduction peak of lomefloxacin hydrochloride showed a potential of -1.40 V (vs. Ag/AgCl). (CEZYG 2001)
- Another method is based on the polarographic catalytic current produced by lomefloxacin hydrochloride in a phosphate buffer (0.125 M) at pH = 6.6 and 2-iodoacetamide solution (2.5×10^{-4} M). The second-order derivative peak current of the catalytic wave of the drug

is proportional to its concentration.(Song, Shao et al. 2001)

- A differential pulse adsorptive stripping voltametric method using acetate buffer solution (0.04 M) at pH= 4 and accumulation potential of -0.30 V (vs.Ag/AgCl) and accumulation time was 2 minutes.(Vílchez, Araujo et al. 2001)
- Using a poly-melamine layer modified glassy carbon electrode (p-(melamine)/GCE), a sensitive electrochemical method for the determination of lomefloxacin has been developed. Horizontal Attenuated Total Reflectance-Infrared Spectroscopy (HATR-IR), Field Emission Scanning Electron Microscopy (FE-SEM), and Electrochemical Impedance Spectroscopy (EIS) were used to characterize the surface morphology of the modified sensor. Square wave voltammetry and cyclic voltammetry were used to measure the electrochemical reactions. The electrode that had been modified with polymer demonstrated excellent electrocatalytic activity in the electrochemical oxidation of lomefloxacin, with a clearly defined voltammetric peak at about 980 mV.(Gupta, Yadav et al. 2014)
- This study developed a green direct potentiometric method to measure the antibacterial Lomefloxacin hydrochloride

in urine using electrodes that were made in-house. The method uses non-hazardous chemicals and doesn't require sample preparation. The sensor was created using a membrane made of poly vinyl chloride, potassium tetrakis (4-chlorophenyl) borate as a cation exchanger, 2-Nitrophenyloctylether as a plasticizer, and 2-hydroxypropyl--cyclodextrin as a specific molecular recognition component. According to IUPAC recommendations, the proposed sensor was validated, and it displays a linear dynamic range from 1×10^{-5} to 1×10^{-2} mol.L⁻¹, with a Nernstian slope of 58.914 mV/decade.(Boltia, Soudi et al. 2019)

- For the first time, a novel optical sensor for lomefloxacin was based on the plasma resonance characteristics of silver nanoparticles (AgNPs). The change in color and absorption spectra of the AgNPs suspension caused by the hydrogen bonds and electrostatic force between lomefloxacin and AgNPs provided a theoretical foundation for the optical detection of lomefloxacin. Additionally, we increased the sensitivity of the AgNPs-lomefloxacin detection system by adding cystine, which allowed it to reach the critical point of discoloration. Furthermore, it was looked into how the AgNPs-lomefloxacin detection system was affected by variables like temperature, reaction time, and pH 12.

products at 288nm using ammonia buffer and methanol (20:80, v/v) as a mobile phase.(Hassib, El-Bagary et al. 2007)

2.4. Chromatographic methods:

2.4.1. Thin layer chromatographic methods:

- The first method depends on densitometric evaluation of thin layer chromatograms of lomefloxacin hydrochloride with its acid degradation product at 288 nm using ammonium chloride solution (0.3 M) : n-propanol: conc. ammonia (1:8:1, by volume) as a mobile phase.(Salem, El-Guindi et al. 2006)
- Another method is based on densitometric evaluation of thin layer chromatograms of lomefloxacin hydrochloride and ciprofloxacin hydrochloride in the presence of their acid induced degradation
- Also there is another method that relies on stability indicating densitometric evaluation of thin layer chromatograms of lomefloxacin hydrochloride in the presence of its degradation products at 288 nm using chloroform: conc. ammonia :methanol (10:3:7, by volume) as a mobile phase.(Chitlange, Ranjane et al. 2009)
- The last method is depending on densitometric evaluation of thin layer chromatograms in bulk drug and tablet dosage form at 288 nm using 2-propanol: conc. ammonia :water (86:6:8, by volume) as a mobile phase.(Rajasree, Radha et al. 2013)

2.4.2. High and ultraperformance liquid chromatographic methods:

Table (2): HPLC methods reported for the determination of lomefloxacin.

Matrix	Column	Mobile phase	Detector	Ref No.
In plasma and urine with norfloxacin (internal standard)	BondaPak C18	(a) Acetate buffer at pH = 4.8 (b) Acetonitrile (80:23, by volume)	Fluorescence $\lambda_{ex} = 280 \text{ nm}$ $\lambda_{em} = 430 \text{ nm}$	(Shibl, Tawfik et al. 1991)
In plasma with enoxacin (internal standard)	Anion exchange Vydac	acetonitrile : Phosphate buffer at pH =7 (10:90, by volume)	UV at 280 nm	(Carlucci, Cilli et al. 1993)
In plasma with fenbufen and felbinacin	Anion exchange Supelcosil LC-SAX	Acetonitrile Phosphate buffer at pH= 7	UV at 280 nm	(Carlucci, Mazzeo et al. 1996)
In plasma with sarafloxacin (internal standard)	Novapak C18	Acetonitrile : Phosphate buffer at pH 3 (20:80, v/v)	Fluorescence $\lambda_{ex} = 338 \text{ nm}$ $\lambda_{em} = 425 \text{ nm}$	(Garcia, Solans et al. 2001)
In seminal plasma with ofloxacin (internal standard)	Spherisorb S5 ODS1-C18	Acetonitrile : Phosphate buffer at pH 7 (20:80, v/v)	Fluorescence $\lambda_{ex} = 280 \text{ nm}$ $\lambda_{em} = 440 \text{ nm}$	(Kumar and Goyal 2017)
In waste water with: - Pipemidic acid - Norfloxacin - Ciprofloxacin - Enrofloxacin - Ofloxacin - Sarafloxacin - Difloxacin - Tosufloxacin	YMC ODS-AQ S-3C18	Gradient elution using: (A) Water (B) Acetonitrile	Tandem mass spectrometry	(Nakata, Kannan et al. 2005)
In plasma with ofloxacin	Hibar Lichrospher 100 -C8	0.5 % triethyl amine at pH= 2.5 with phosphoric acid: acetonitrile (85:15, v/v)	UV at 280 nm	(Zendelevska and Stafilov 2005)

In raw material and tablet with excipients	Phenomenex C18	1% Acetic acid: methanol :acetonitrile (70:15:15, by volume)	UV at 280 nm	(Tozo and Salgado 2006)
In pharmaceutical preparations with: - Gatifloxacin - Levofloxacin - Pefloxacin	LiChrospher 100-C18	0.3% of triethylamine at pH = 3.3 with phosphoric acid with acetonitrile :water (20:80, v/v)	UV from 279-295 nm	(Santoro, Kassab et al. 2006)
In pharmaceutical preparations with degradation product	Inertsil C18	Water: acetonitrile: triethyl amine (80:20:0.6, by volume) at pH= 3 with orthophosphoric acid	UV at 328 nm	(Gupta, Yadav et al. 2014)
In marine products and animal tissues	Symmetry C18	Gradient elution using: (a) Acetonitrile (b) 0.1% formic acid at pH =2.5	Fluorescence $\lambda_{ex} = 280 \text{ nm}$ $\lambda_{em} = 450 \text{ nm}$	(Chang, Wang et al. 2008)
In pharmaceutical preparations with excipients	Inertsil ODS-C18	Acetonitrile : 0.025 M phosphoric acid (20:80, by volume)	UV at 287 nm.	(Amran, Hossain et al. 2011)
In pharmaceutical preparations with enrofloxacin and ofloxacin	Neucleosil C18	Acetonitrile :Phosphate buffer at pH = 2.4 (20:80, v/v)	UV at 294 nm	(Amin, Dessouki et al. 2011)
In pharmaceutical preparations with enrofloxacin and ofloxacin	μ Bondapak C18	0.31% ammonium acetate at pH= 2.2 and 0.65% sodium perchlorate and with orthophosphoric acid: acetonitrile (81:19, by volume)	UV at 294 nm	(Amin, Dessouki et al. 2011)

a honey sample. With ofloxacin, ciprofloxacin, enrofloxacin, lomefloxacin, and difloxacin.	C18 column	Gradient elution using: (a) methanol (b) acetonitrile (c) 10 mmol/L NaH ₂ PO ₄ ·2H ₂ O at PH=3	fluorescence $\lambda_{em} = 480 \text{ nm}$	(Tian, Ren et al. 2022)
Oxidation of lomefloxacin and balofloxacin	Kinetex 5u XB-C18 100A column	isocratic elution using acetonitrile and 0.05 M phosphate buffer at pH = 3.20 adjusted with o-phosphoric acid (13:87 v/v for lomefloxacin; 20:80 v/v for balofloxacin).	a photodiode array detector	(Žuromska-Witek, Žmudzki et al. 2020)
poultry eggs with enrofloxacin, ciprofloxacin, ofloxacin, pefloxacin, norfloxacin, and sarafloxacin	C ₁₈ column	Gradient elution using: (a) 0.1% (V/V) formic acid (b) acetonitrile	Tandem mass spectrometry	(Huang, Fan et al. 2019)
eye drops used in cataract surgery	Phenomenex Luna [®] C18 column	methanol:water:formic acid (70:29:1, by volume)	Tandem mass spectrometry	(Nassar, Attia et al. 2020)

3. Reported methods of dexamethasone

3.1. Spectrophotometric methods:

- Dexamethasone sodium phosphate is directly determined at pH = 6 using a double-beam spectrophotometer at 242.5 nm (Al-Owaidi, Alkhafaji et al. 2021) and using water : ethanol (1:2 v/v) as background electrolyte at 240 nm.(Sversut, Vieira et al. 2015)
Oxidation of dexamethasone by iron (III) followed by complexation of iron (II) with potassium hexacyanoferrate (III) to form bluish green complex with absorbance at wavelength = 780 nm is another method. (Singh and Verma 2008)

3.2. Chromatographic techniques:

3.2.1. Thin layer chromatographic method:

- Development of HPTLC method for determination of dexamethasone using hexane–propan-2-ol (90:10 ,by volume) as a mobile phase.(Huetos, Ramos et al. 1999)

3.2.2. High and ultraperformance liquid chromatographic methods:

Table (3): HPLC methods reported for the determination of remdesivir.

Matrix	Column	Mobile phase	Detector	Ref No.
In microemulsions	RP-18 column	water :methanol (35:65; by volume)	UV at 239 nm	(Urban, Mainardes et al. 2009)
Pharmaceutical Formulations	C ₁₈ column	ammonium acetate buffer (5 mM) : methanol :acetonitrile (43:25:32, v/v)	UV at 240 nm	(Duarah, Sharma et al. 2021)
Pharmaceutical formulations with ofloxacin	C 18 column	Acetonitrile : phosphate buffer at pH= 4 (50:50, v/v)	UV at 236 nm	(Sireesha and Prakash 2012)
Pharmaceutical Formulations with moxifloxacin.	BDS Hypersil C8 column	20 mM phosphate buffer , 0.1% (v/v) triethylamine, at pH = 2.8) and methanol (38.5:61.5 v/v)	diode array detector at 254 nm	(Razzaq, Ashfaq et al. 2017)
Pharmaceutical Formulations with granisetron.	CPS Hypersil CN column	acetonitrile: 100 mM buffer Triethylamine at pH = 3.0 with orthophosphoric acid (25:75 by volume)	UV at 242 nm	(Heda, Kathiriya et al. 2011)
Human plasma	a Sphereclone ODS2 column	10 mM phosphate buffer at pH = 7.0 : acetonitrile (68:32, v/v)	UV at 240 nm	(Song, Park et al. 2004)
In dried blood spot samples	a Zorbax Eclipse Plus C18 colum	water and acetonitrile with formic acid	mass spectrometer	(Patel, Tanna et al. 2010)

CONCLUSION

In this review, simple and clear highlights for the collected information about the most instrumental methods used for determination of compounds used in covid-19 treatment are reported. This review includes HPLC technique, spectroscopy, fluorimetry and electrochemical methods. It was obvious that HPLC technique was the most developed method followed by spectroscopy. The presented methods were validated according to ICH guidelines in addition to some of them were assessed using various green tools.

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مراجعة مصغرة حول الأساليب الآلية المختلفة المطبقة على بعض الأدوية المختارة لعلاج فيروس كورونا المستجد.

قسم الكيمياء الدوائية - كلية الصيدلة - جامعه الزقازيق - مصر

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في بداية تفشي وباء كورونا ، كانت الأنظمة العلاجية القائمة على الأدوية المعتمدة هي أسرع الأساليب لمكافحة جائحة فيروس كورونا الجديد. وبالرغم من توافر العديد من اللقاحات الآن ، إلا أن برنامج التطعيم العالمي سيستغرق وقتاً كبيراً . نتيجة لذلك ، بالإضافة إلى التطعيم ، تم اقتراح استخدام بعض الأدوية الحالية المضادة للفيروسات والمضادات الحيوية وأنواع أخرى من الأدوية كاستراتيجية طبية بديلة لعدوى فيروس كورونا المستجد. علي الرغم من الإمكانيات السريرية الواسعة لهذه الأدوية إلا انه يوجد لها عديد من الآثار الجانبية المحتملة. ومن ثم يلزم وجود طرق تحليلية لمراقبة تركيزات الأدوية في السوائل البيولوجية والمنتجات الصيدلانية. تم تقديم المقالة التالية مع تقديم مراجعة مصغرة للطرق المختلفة المستخدمة في التحديد الكمي لهذه الأدوية من أجل تشجيع وتسهيل مراجعة الأبحاث للباحثين الآخرين الذين سيكون لديهم دراسات تتعلق بهذه المركبات. و قد ناقشت المراجعة التقنيات المستخدمة لتحديد كل دواء كميًا بما في ذلك طرق القياس الطيفي (الأشعة فوق البنفسجية والمرئية) وطرق القياس الطيفي والكهروكيميائي والكروماتوجرافي (TLC و HPLC) إما في العينة البيولوجية أو في أشكال الجرعات الصيدلانية. الطرق المدرجة في المراجعة مدققة وفقاً لإرشادات مؤتمر التنسيق الدولي للمتطلبات الفنية الخاصة بتسجيل الأدوية المعدة للاستخدام البشرى.