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RESEARCH ARTICLE

Synthesis and Description of Some New Heterocyclic Imideis Compounds Derived from Ciprofloxacin Drug

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ABSTRACT

The target of this work included synthesis of several new derivatives (B-B17) from Ciprofloxacin drug and evaluating antibacterial activities for some derivatives. The analogs were synthesized, designed, and characterized by ^{1}HNMR, and FTIR. The first step involved the preparation of a 2-Chloroacetyl Ciprofloxacin drug from the reaction of Ciprofloxacin with chloroacetyl chloride in the presence of triethylamine. Then, the yield B with 2-aminobenzothiazole in the presence of glacial acetic acid as a catalyst to produce derivatives (B1–B8), Potassium phthalimide or Succinimide was used to prepared (B9–B12) compounds, and the (B13–B17) compounds were synthesis from 4-acetyl ciprofloxacin (B). The antibacterial and antifungal activity showed effectiveness against Gram-positive bacteria (Staphylococcus), Gram-negative bacteria (Pseudomonas aeruginosa), and fungi (Candida Albicans).

Keywords: 2-Aminobenzothiazole derivatives, Biological activities, Ciprofloxacin drug, Heterocyclic compounds, Imide derivatives

Introduction

Heterocyclic systems are widespread occurrence in nature, particularly in such natural products as nucleic acids, plant alkaloids and chlorophyl. Heterocyclic compounds are considered one of an important type of organic compounds due to their application in drugs and industrial studies. A variety of atoms, such as N, O, S, can be incorporated into the ring structures The triazoles are two isomers, namely 1,2,3-triazole or 1,2,4-triazole, with the formula ($C_2H_3N_3$)[1] Several 2-aminobenzothiazole derivatives have long been known for their diverse biological properties, mainly as antibacterial, antifungal, antitumor and anti-inflammatory agents.[2] In addition, heterocycles bearing 1,2,4 triazole or 1,3,4- thiadiazole or 1,3,4 oxadiazole moieties represent an interesting class of compounds possessing a wide spectrum of biological activities such as anti-inflammatory, antiviral, antimicrobial, anti-inflammatory, antitumor, antifungal and antibacterial properties.[3] Similarly diazo compounds also show a biological activity such as antibacterial, antiviral, antifungal.[4] Ciprofloxacin is a broad-spectrum antibiotic that plays a vital role in suppressing the growth of both gram positive and gram-negative bacteria. Extensively involved in the synthesis of original Ciprofloxacin derivatives, medicinal chemists continuously contribute to this sector.[5]

Materials and methods

All chemicals and solvents were supplied by Fluka and Sigma-Aldrich. Melting points were measured using capillary melting point equipment from Gallen Kamp. We also performed FT-IR measurements with a Shimadzu FT-IR-8400S model. Further H-NMR

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Table 1. Physical properties and structures of the compounds (B-B17).

Comp. No.	Structures	Yield %	Color	M.P°C
B	$C_{19}H_{19}ClFN_3O_4$	92	white	230–232
B5	$C_{27}H_{23}Cl_2FN_4O_4S$	70	Beige	174–176
B6	$C_{26}H_{23}FN_6O_6S$	60	Light Yellow	208–210
B7	$C_{26}H_{22}ClFN_6O_6S$	98	Orang	260–262
B8	$C_{26}H_{24}FN_5O_4S$	85	White	262–264
B9	$C_8H_4NO_2^-K^+$	95	Light Yellow	310–312
B10	$C_4H_4NO_2^-K^+$	90	White	254–256
B11	$C_{27}H_{23}FN_4O_6$	80	White	160–162
B12	$C_{23}H_{23}FN_4O_6$	85	Broun	186–188
B13	$C_{32}H_{36}FN_3O_6$	Broun	80	140–142
B14	$C_{26}H_{23}FN_4O_8$	Black	90	130–132
B15	$C_{34}H_{33}FN_4O_6$	Gray	80	150–152
B16	$C_{26}H_{25}FN_4O_6$	Black	85	124–126
B17	$C_{33}H_{32}FN_3O_7$	Broun	75	136–138

spectra were obtained in DMSO-d (6).[6] using TMS as an internal standard and the super shield of a Bruker spectrophotometer at 300 MHz.

Synthesis of (7-(4-(2-chloroacetyl) piperazin-1-yl)-1-cyclopropyl-6-fluoro-4-oxo-1,4-dihydroquinoline-3-carboxylic acid) B[6]

Combine 0.02 mol of ciprofloxacin and 15 ml of diethyl ether with 0.025 mol of trimethylamine in a round-bottom flask. Subsequently, 0.025 mol of chloroacetyl chloride was added drop-wise at 5–10°C. After stirring for 8 hours, the reaction mixture was left at room temperature for 1 day, then pouring it over crushed ice. The separated substance was dried and recrystallized using an equal ratio of absolute ethanol and water. Table 1 provides a list of the physical characteristics.

Synthesis of Substituted-2-aminobenzothiazole (B1–B4)[7]

In a round-bottom flask with a dropping funnel, 0.03 moles of substituted aromatic primary amine and 0.01 moles of ammonium thiocyanate were dissolved and added dropwise, with stirring and cooling to a solution of 1.2 ml of bromine in 10 ml of glacial acetic acid. The mixture was stirred for an additional two hours. Then, following vigorous stirring, the resulting solution was added to iced water. The final product, which was filtered, rinsed, dehydrated, and recrystallized from a 1:1 mixture of absolute ethanol and water, is a solid.

Synthesis of N-(2-aminoacetyl substituted benzothiazole) (B5–B8)[8]

A mixture of compound (B) (0.001 mol) in 10 ml of absolute ethanol and 0.005 mol of anhydrous potassium carbonate was refluxed and added dropwise to a solution of substituted-2-amino benzothiazole (B1–B5) (0.001 mol) in 30 ml of absolute ethanol. The reaction mixture was then refluxed for ten hours. After cooling, the mixture was filtered, and the precipitate was separated and recrystallized using ethanol as a solvent. Data of melting points and yield percent are presented in Table 1.

Synthesis of Potassium Phthalimide, Succinimide (B9, B10)[9,10]

Either phthalimide or succinimide (0.01 mol) was dissolved in 20 ml of absolute ethanol and then heated in a water bath until it reached boiling point. The clear solution obtained was then added to an alcoholic potassium hydroxide solution with continuous stirring and cooling. The resulting precipitate was filtered and dried. Table 1 lists the melting points and percent yield information.

Synthesis of 4-(N-Phthalimido, succinimido) acetyl Ciprofloxacin (B11, B12)[11]

Compound B (0.01 mol) was dissolved in 20 ml of absolute ethanol. Then, 0.01 mol of prepared potassium succinimide or phthalimide was gradually added with stirring. The mixture was continuously stirred for six hours until it cooled to room temperature. The precipitate was filtered and washed with a 10% NaHCO3 and water solution. Finally, it was refined by recrystallization from acetone. Table 1 displays the physical characteristics of compounds B11 and B12.

Synthesis of 4-acetyl Ciprofloxacin derivatives (B13-B17)[12]

A suitable round-bottom flask was filled with a mixture of B (0.01 mol), the appropriate 0.011 mol of B, 0.01 mol of sodium iodide, 0.011 mol of trimethylamine and 10 ml of DMF. This mixture was stirred at 85°C for 3 hours. The resulting precipitate was then dried. The physical properties of the product are listed in Table 1.

Biological activity

Antibacterial activity against pathogenic bacteria and fungi isolates

The agar well diffusion method was used to detect the antibacterial activity of (B-B17) against pathogenic bacteria and fungi, using the concentration of 100-50-25-10 mg/ml. as shown in Fig. 1.

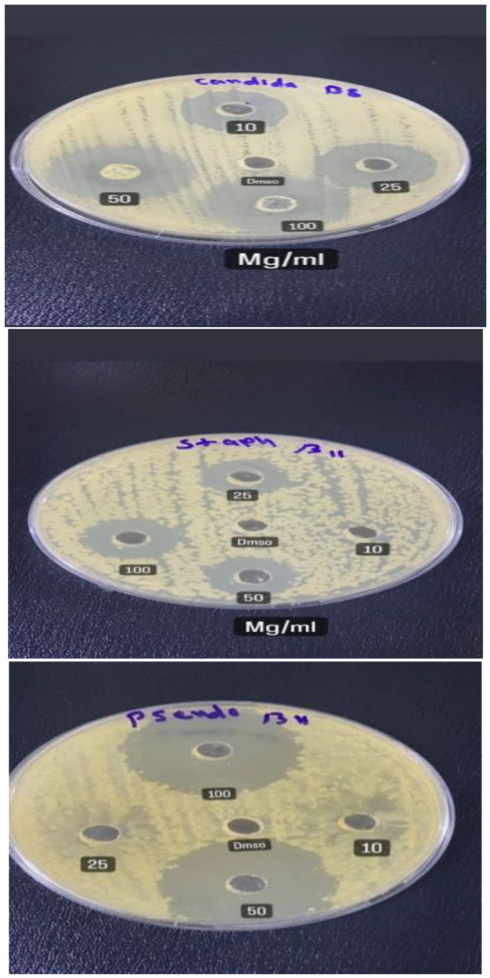


Fig. 1. Efficacy of compounds (B-B17) that inhibit *P.aeruginosa* bacteria (*Staphylococcus aureus*) and fungi (*Candida albicans*).

1- In the current study, we produced various new heterocyclic compounds and evaluated them using the disk diffusion method against *staphylococcus aureus* (Gram-positive bacteria), *p.aeruginosa* (Gram-negative bacteria), and the antifungal (*Candida Albicans*).
2- After the incubation period, a volume of 0.1 ml of each bacterial suspension was spread on the surface of the nutrient agar and incubated at 37 °C for 24 hrs.
3- A single colony was added to a test tube containing 5 mL of normal saline, yielding a bacterial suspension with modest turbidity roughly equivalent to a standard turbidity solution. This approximately equaled 1.5 × 108 CFU/mL.
4- Using a sterile cotton swab, a portion of the bacterial suspension was carefully and evenly spread on the Mueller-Hinton agar medium, which was then left for 10 min to absorb.
5- Five millimeter in diameter wells were made in the previous agar layer (5 wells per plate). The agar discs were removed and 50 µl of (B-B17) were added to each well using a micropipette. DMSO was added to the middle well as a control. The plates were incubated at 37 °C for 18 hrs. Following this, the diameters of the inhibition zones were recorded.[13]

Results and discussion

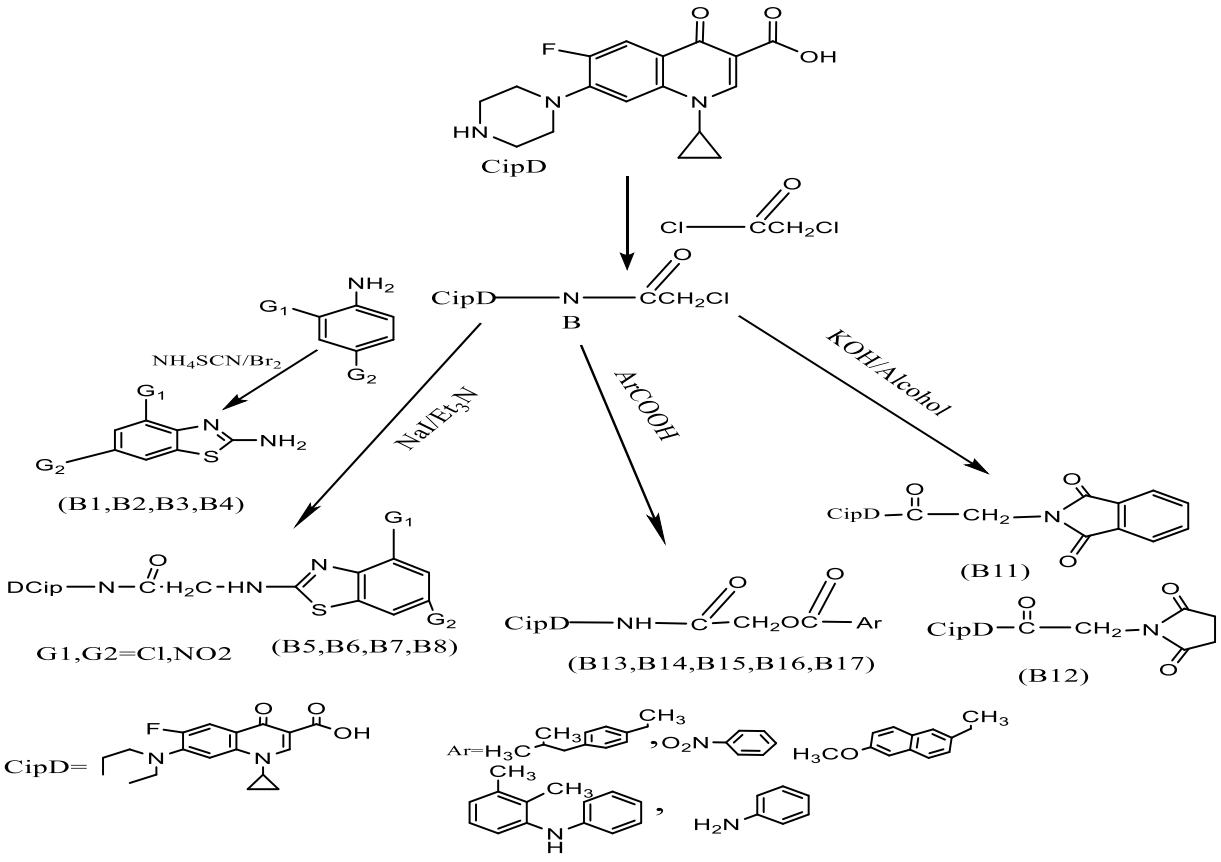
The new derivatives were created in accordance with the reaction arrangements of Scheme 1. Compound B was prepared by a nucleophilic substitution reaction, CipD, using chloroacetyl chloride and trimethylamine as catalysts in the temperature range of (5–10 °C), This compound was characterized by FTIR at (3500-2500) cm^{-1} (O-H stretch, -COOH) and (1720, 1710) cm^{-1} (C=O stretch, -COOH) as shown in Fig. 2. The ^{1}HNMR spectrum of Compound B also revealed the distinctive chemical alterations (DMSO-d6, ppm) specified below. For (B), a double peak at (3.56,3.29) and a singlet signal of CH2Cl protons at (4.24) were detected in the spectrum, as shown in Fig. 3.

Imide compounds were prepared from reactions using potassium 1,3-dioxoisoindolin-2-ide and potassium 2,5-dioxopyrrolidin-1-ide with compound B, resulting in new imide derivatives (B11 and B12). These compounds were characterized by FTIR ranges (1728-1620) cm^{-1} due to anhydride (asymmetric and symmetric stretching, imide group) for (B11, B12) as shown in Fig. 4, as well as absorption bands for a functional group in CipD.

Compounds (B5, B6, B7, and B8) as shown in Fig. 5 B8 were prepared by reacting compound B with substituted 2-aminobenzothiazole derivatives according to Scheme 2. The FTIR spectrum exhibited in Fig. 5 shows (2500–3500) cm^{-1} (O-H stretch, -COOH), 1720 cm^{-1} (C=O stretch, -COOH), and 1643 cm^{-1} (-CON- Amide, C=O stretching).

Compounds (B13, B14, B15, B16, and B17) were prepared from a reaction of compound B with substituted benzoic acid in the presence of sodium iodide and triethylamine as catalysts, as depicted in Scheme 3. These compounds were characterized by FTIR and ^{1}HNMR as displayed in Figs. 6 and 7.

For B14, FTIR shows an expansion of the vibration band to the C-O-N Amide group at 1650 cm^{-1} and absorption bands to the C=O group at 1690 cm^{-1}, as evidenced by the compound's ^{1}H-NMR data of 5.06 (s, 2H, N(C=O)), 8.25 (m, 4H, Ar-H), and 3.56 (d, 2H, N(C=O)).



Scheme 1. Mechanism steps for preparation of compound (B-B17).

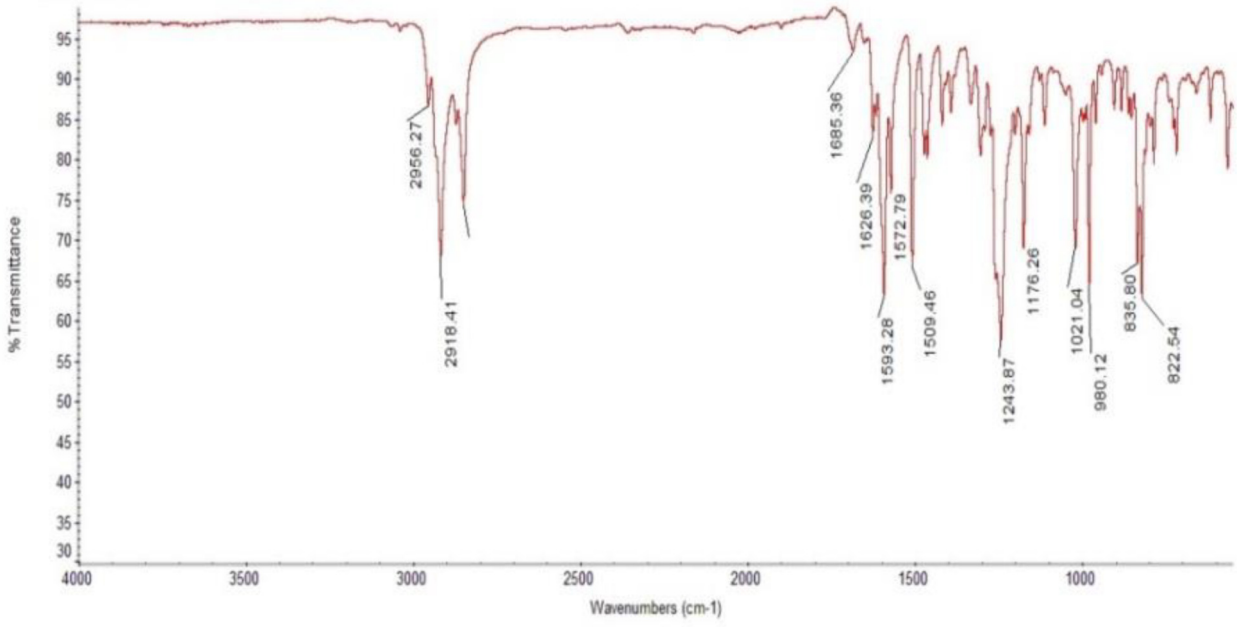


Fig. 2. Compound FT-IR spectrum B.

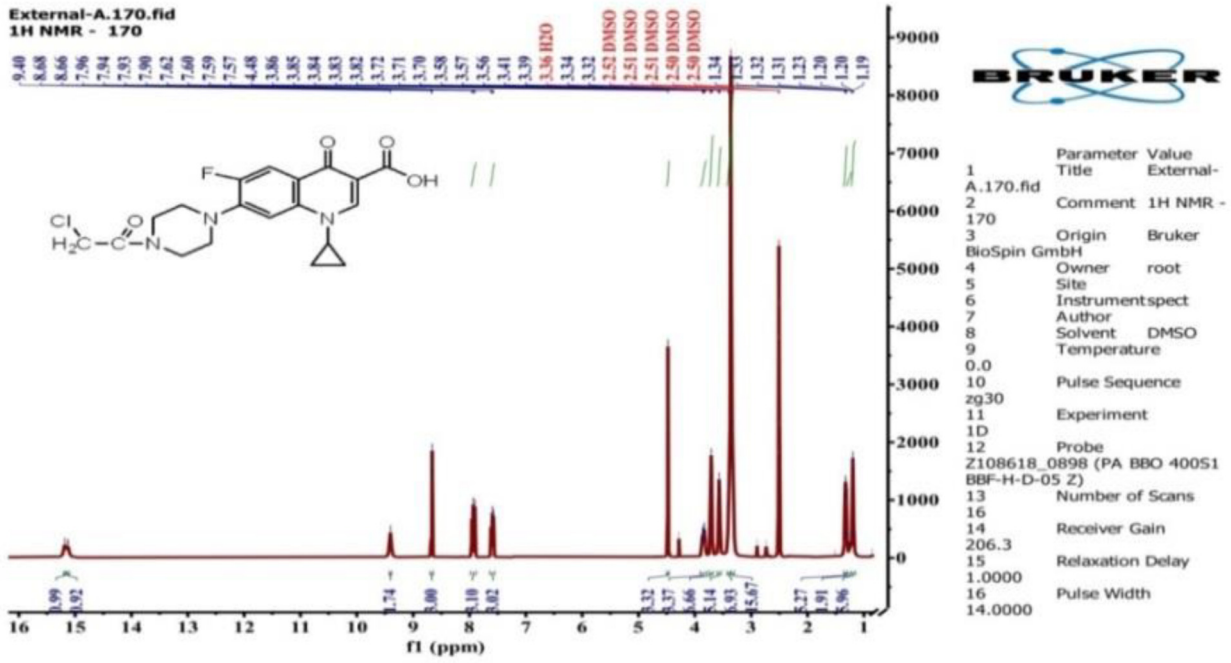


Fig. 3. 1H-NMR compound spectral B.

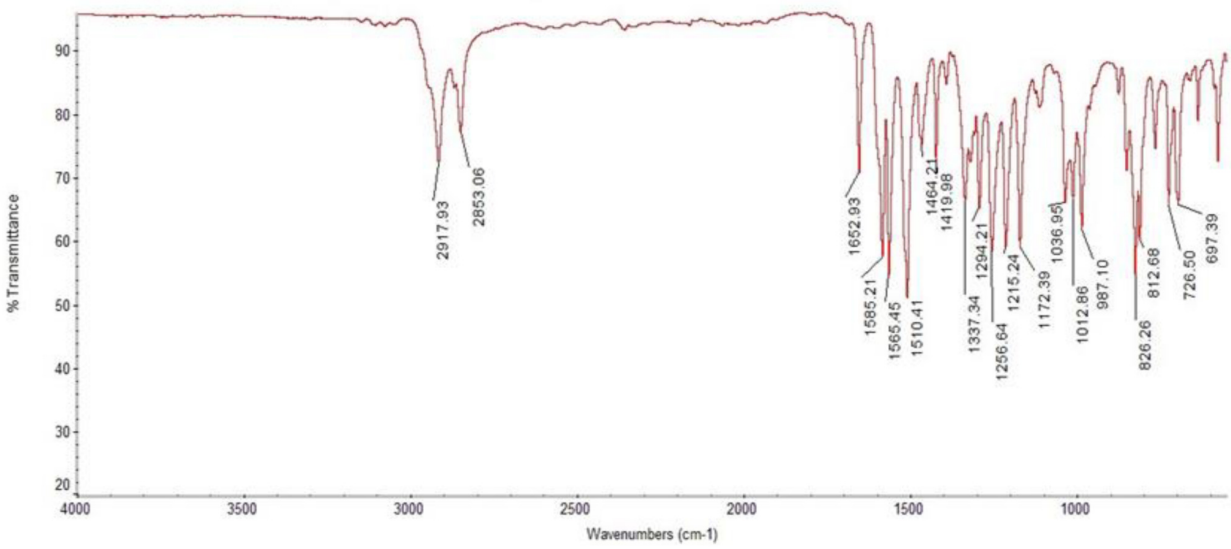


Fig. 4. Compound FT-IR spectrum B11.

FT-IR spectral data of synthesized compounds from B to B17, represented in cm^{-1}, is shown in Table 2.

Antibacterial activity

The antibacterial activity of 3 selected derivatives (B-B17) has been evaluated against 3 isolates *P.aeruginosa, Candida Albicans and Staphylococcus Aureus*. All of the isolates used were taken from people with health issues, such as urinary tract infections, burns, and wounds. Most of them are resistant to most antibiotics, yet the compounds' effectiveness proved their ability to inhibit pathogenic bacteria. Four concentrations of the 3 chemical derivates (100, 50, 25, and 10 mg/ml) were applied on the 3 isolates. Regarding *Candida albicans*, B8 demonstrated

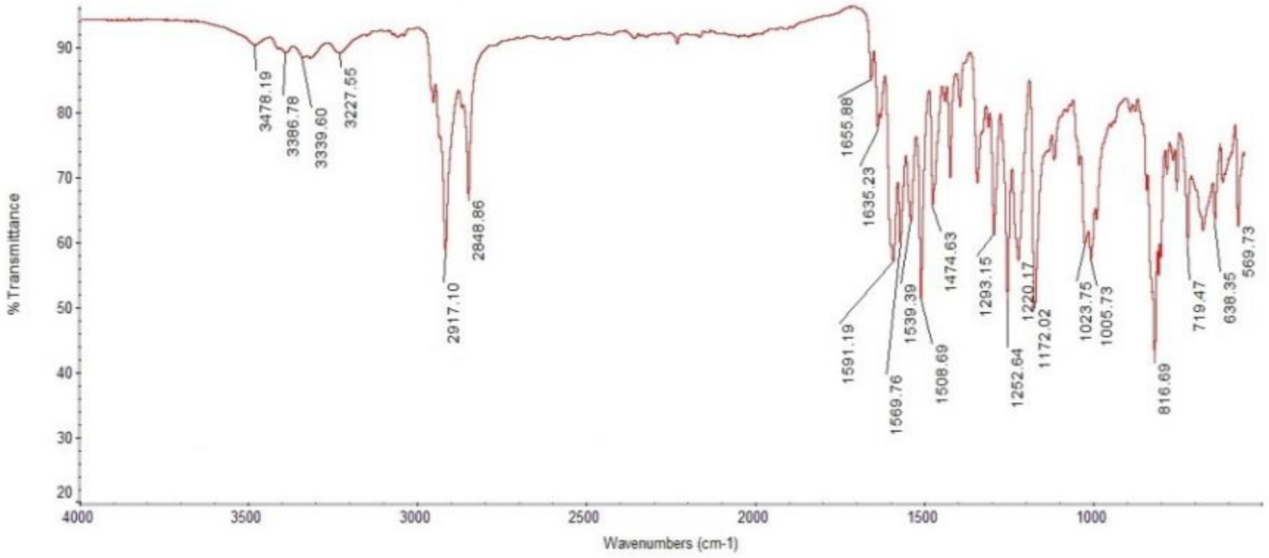
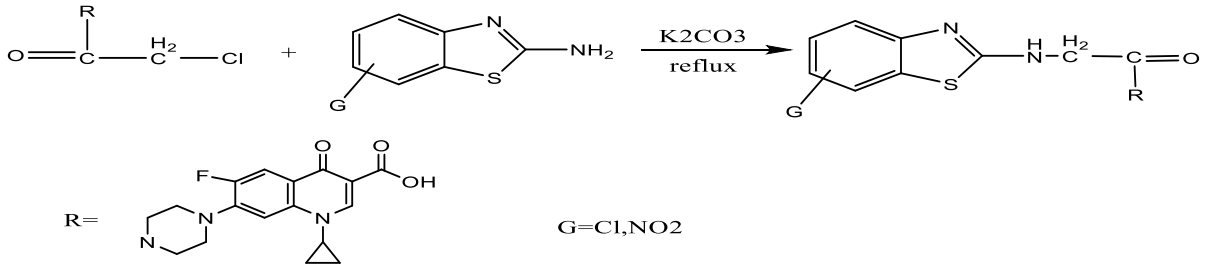
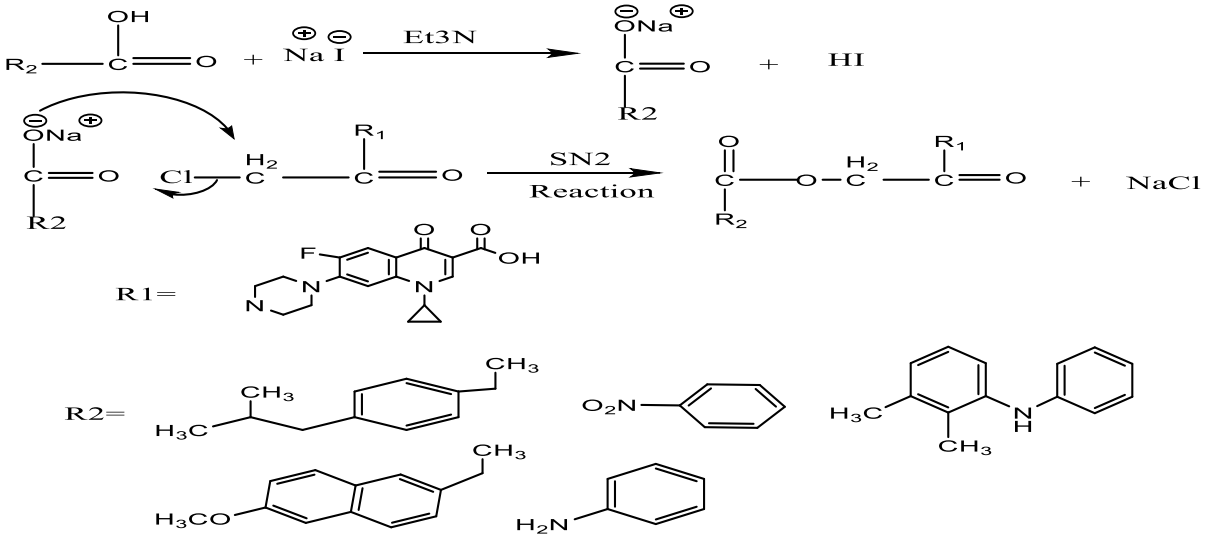


Fig. 5. Compound FT-IR spectrum B8.



Scheme 2. Mechanism steps for synthesis of compound B5–B8.



Scheme 3. Mechanism steps for synthesis of compound B13–B17.

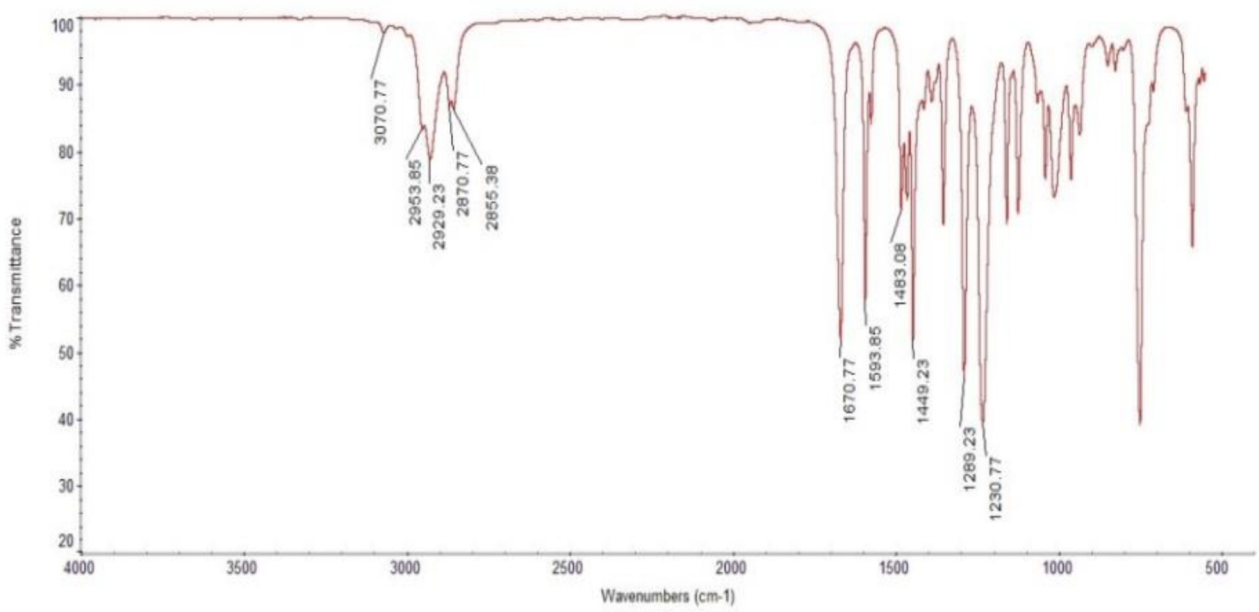


Fig. 6. Compound FT-IR spectrum B14.

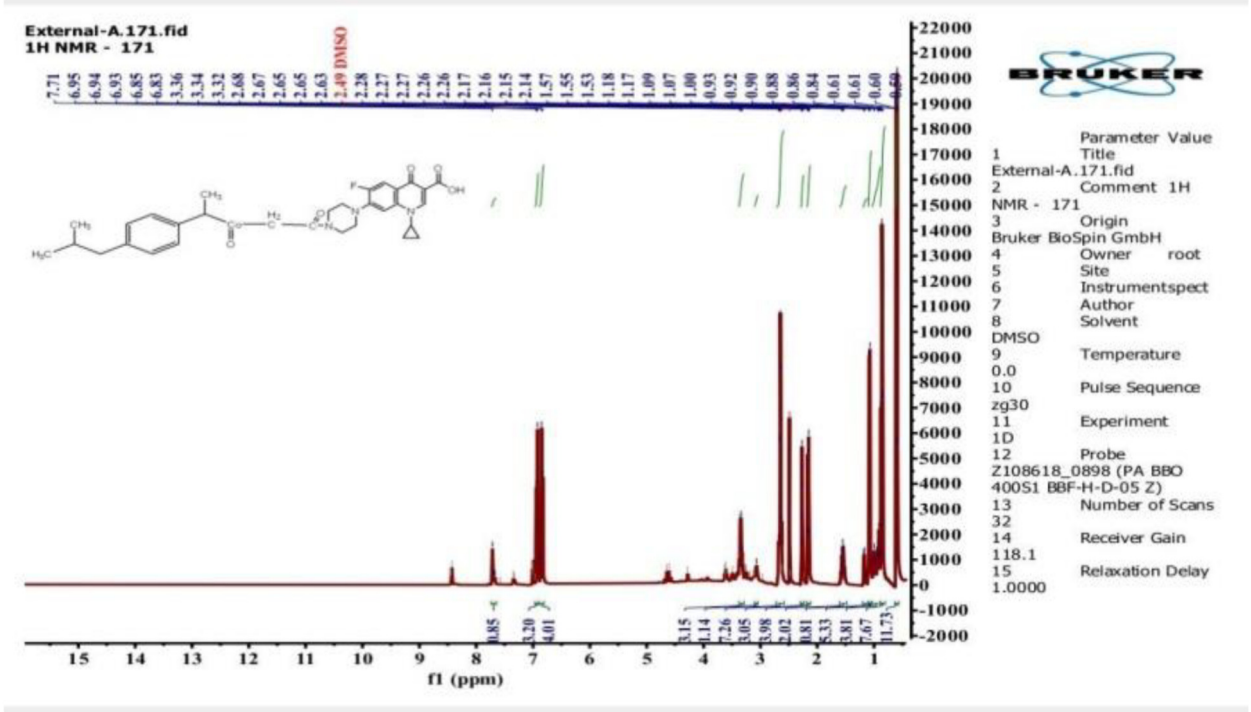


Fig. 7. ^{1}H-NMR compound spectral B1.

the highest antifungal activity. At a concentration of 10 mg/ml, there was a high inhibition of 23.3, which progressively increased as the treatment concentration increased to 25.3, 30.3, and 35.3 at concentrations of 25, 50, and 100 mg/ml, respectively, Table 3. Less antibacterial activity was observed when *Staphylococcus aureus* isolate was treated with B8. No inhibition was shown at low concentration of administration (10mg/ml) and started to show a small inhibition zone (7.6) at 25 mg/ml and this inhibition zone was approximately doubled (14) upon 100 mg/ml treatment. On the other hand, B8 possessed

Table 2. FT-IR Spectral data of synthesized compounds (B-B17) in cm^{-1}.

Comp. No.	υN-H	υC-H Aromatic	υC-H Aliphatic	υC=O of amide	υC=O of ketone	υC=C aromatic	Others
B1	3370	3082	2970,2872	1638	1653	1555	650 υ (C-Cl)
B2	3382	3070	2964,2839	1642	1662	1573,1494	ν (NO_2) 1460
B3	3390	3060	2978,2921	1635	1666	1566,1483	ν (NO2) 1456
B4	3365	3066	2972,2864	1643	1622	1575,1584	v (C-S) 767
B5	3367	3083	2933,2860	1640	1660	1575,1494	742 υ (C-Cl)
B6	3276	3054	2932,2862	1641	1663	1573,1476	ν (NO2) 1466
B7	3255	3047	2966,2873	1635	1653	1580,1481	ν (NO2) 1469
B8	3259	3068	2970,2871	1737	1653	1535	v (C-S) 783
B11	3367	3076	2924,2854	1738	1660	1485,1446	–
B12	3370	3099	2965,2945	1645	1658	1540	–
B13	3355	3027	2980,2834	1646	1661	1524	ν (NO2) 1456
B14	3464	3054	2974,2939	1634	1660	1473,1396	–
B15	3330	3067	2934,2925	1647	1653	1580,1560	–
B16	3280	3047	2988,2976	1630	1661	1565,1556	–
B17	3285	3045	2984,2965	1645	1664	1545,1540	–

a slight low inhibition activity against *P. aeruginosa* (inhibition zone of 6.6 at 100 mg/ml treatment).

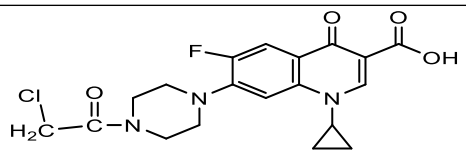
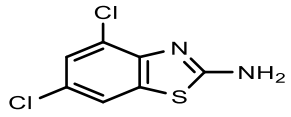
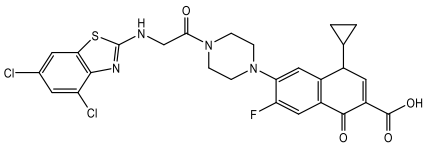
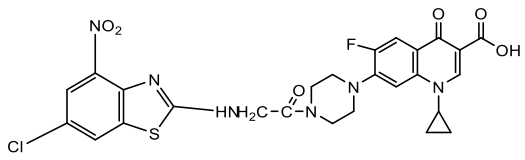
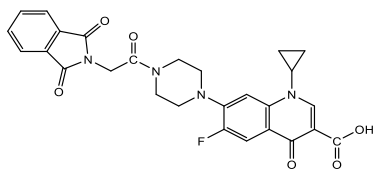
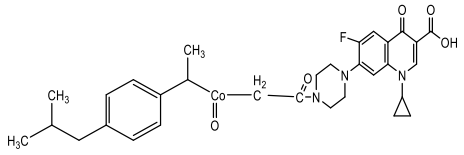
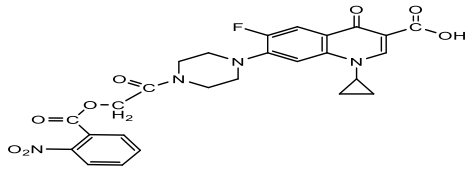
B14 treatment showed similar results to that obtained from B8 treatment. Table 3 shows a significant antifungal activity of B14 at 10 mg/ml which is less than B8 but still reasonably good. It reached 25.3 of kill zone at 10 mg/ml of B14 treatment which is the same inhibition zone observed at 25 mg/ml of B8 treatment. Similarly, treating *S. aureus* with 10 mg/ml of B14 resulted in no notable inhibition while a remarkable inhibition was observed at 25 mg/ml. A slight increase in kill zone is noticed by duplicating the treatment concentration to 50 and 100 mg/ml until it reached 10.3. *P. aeruginosa* was only inhibited upon being exposed to high concentration of B14.

On the other hand, B11 showed different inhibition profile where it can be identified as anti- *P. aeruginosa* agent. Remarkable inhibition zones were detected upon treating *P. aeruginosa* with high doses of B11 (50 and 100 mg/ml) while no inhibition was observed at low concentrations (25-50 mg/ml). Similar results to B8 and B14, a slight low inhibition ability of B11 was observed on *S. aureus* with inhibition zones of 14, 15.6 and 17 at doses of 25, 50 and 100 mg/ml, respectively. Finally, B11 possesses no anti-fungal activity against *Candida Albicans*. Numerous studies have shown that ciprofloxacin possesses a high inhibitory capacity against different types of bacteria.[14] Other studies demonstrated that ciprofloxacin and its derivatives can inhibit both gram-positive and

Table 3. Biological activity for some synthesized compounds.

	B8			
Isolates	100 mg/ml	50 mg/ml	25 mg/ml	10 mg/ml
p.aeruginosa	6.6 ± 0.5	0 ± 0	0 ± 0	0 ± 0
Candida Albicans	35.3 ± 1.5	30.3 ± 1.15	25.3 ± 0.5	23.3 ± 1.5
Staphylococcus aureus	14 ± 1	12.3 ± 2.0	7.6 ± 1.5	0 ± 0
Isolates	B11			
	100 mg/ml	50 mg/ml	25 mg/ml	10 mg/ml
p.aeruginosa	39.6 ± 1.5	35.3 ± 1.5	0 ± 0	0 ± 0
Candida Albicans	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Staphylococcus aureus	17 ± 1	15.6 ± 1.1	14 ± 1	0 ± 0
Isolates	B14			
	100 mg/ml	50 mg/ml	25 mg/ml	10 mg/ml
p.aeruginosa	7.6 ± 1.5	0 ± 0	0 ± 0	0 ± 0
Candida Albicans	25.3 ± 0.5	23.3 ± 1.5	20.3 ± 1.5	16 ± 1
Staphylococcus aureus	10.3 ± 0.5	9.3 ± 0.5	8.6 ± 1.5	0 ± 0
DMSO	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Isolates	ciprofloxacin			
	100mg/ml	50 mg/ml	25 mg/ml	10 mg/ml
p.aeruginosa	6.7 ± 0.5	15 ± 1.5	6.8 ± 0.5	0 ± 0
Candida Albicans	25.3 ± 1.5	20.3 ± 1.15	10.3 ± 0.5	3.3 ± 1.5
Staphylococcus aureus	14 ± 1	11.3 ± 2.0	8.6 ± 1.5	0 ± 0

Table 4. [1]HNMR data for compounds (B,B1,B5, B7,B11, B13, B14) in ppm.

Comp. No.	Compound structure	[1]HNMR data of (δ-H) in ppm
B		1.19–1.20 (4H, m, CH2-CH2), 2.56-Double peak (3.56, 3.29), 2.90–2.97 (1H, m, CH-N), 3.70 (2H, s, N-CH2-N), 7.85–7.97 (2H, m, CH aromatic), Singlet signal of CH2Cl protons (4.24) spectrum
B1	 4,6-dichlorobenzo[*d*]thiazol-2-amine	7.46 (2H, d, CH aromatic), 8.32 (2H, s, NH2),
B5	 4-cyclopropyl-6-(4-((4,6-dichlorobenzo[*d*]thiazol-2-yl)glycyl)piperazin-1-yl)-7-fluoro-1-oxo-1,4-dihydronaphthalene-2-carboxylic acid	5 (2.60) (t, 2H, CH2-N), 6 (3.91) (5, 2H, CH2C-0), 5 (7.8) (S, 1H, NH), 6 (7.59) (d, 2H, CH30), 5 (2.7) (s, 3H, CH30), 5 (2.60) (t, 2H, CH2CH2), 5 (2.06) (s, 3H, CH3-N), 6 (4.88) (t, 2H, CH2-N), 5 (2.64) (q2H, CH2N), 5 (1.3) (t, 3H, CH3-CH2).
B7		0.96–1.29 (4H, m, CH2-CH2), 2.66–2.98 (12H, m, N-CH2-CH2-N), 3.23–3.45 (1H, m, CH-N), 3.25–3.53 (4CH2, m, CH2-O), 3.86 (2H, s, N-CH2-N), 7.14–8.10 (5H, m, CH aromatic), 8.71 (1H, s, CH=C), 9.61 (1H, s, NH)
B11	 1-cyclopropyl-7-(4-(2-(1,3-dioxoisoindolin-2-yl)acetyl)piperazin-1-yl)-6-fluoro-4-oxo-1,4-dihydroquinoline-3-carboxylic acid	(4.30, 31) 6 (3.36) (t, 2H, CH2-N), 8 (3.95) (s, 2H, CH2C=0), 5 (8.37) (S, 1H, NH), 8 (7.84) (s, 1H, NHC-Oamid), 8 (7.82) (d, 2H, CHromatic), 8 (2.9) (s, 3H, CH30), 8 (3.36) (t, 2H, CH2CH2), 8 (2.6) (5, 3H, CH3-N), 8 (3.71) (t, 2H, CH2-N), 8(3.54) (q, 2H, CH2N), 8 (1.7) (t, 3H, CH3-CH2)
B13		1.22 (3H, d, CH3), 1.14–1.28 (4H, m, CH2-CH2), 2.56–2.83, (12H, m, N-CH2-CH2-N), 2.90–2.97 (1H, m, CH-N), 3.77 (2H, s, N-CH2-N), 7.85–7.97 (2H, m, CH aromatic), 8.37 (1H, s, CH=C)
B14		1.00–1.31 (4H, m, CH2-CH2), 2.07–2.69 (12H, m, N-CH2-CH2-N), 2.86–3.23 (1H, m, CH-N), 3.39–3.73 (4CH2, m, CH2-O), 4.22 (2H, s, N-CH2-N), 6.94–7.98 (6H, m, CH aromatic), 8.67 (1H, s, CH=C), 9.52 (1H, s, NH)

gram-negative bacteria via inhibiting DNA gyrase. However, its bactericidal effects cannot be entirely reversed by protein inhibitors.[15] Ciprofloxacin is widely used to treat *P. Aeruginosa* infection, however gene mutations that encode the ciprofloxacin target proteins and efflux pump regulators can cause

that these pumps become overexpressed. This can result in reduced effectiveness of the antibiotic.[16] However, in vitro and in vivo studies have reported the high effectiveness of ciprofloxacin against *Staphylococcus aureus* including both methicillin-sensitive and methicillin-resistant Staphylococcus aureus infections.[17] For fungal infections, it was found that ciprofloxacin has a role in enhancing antifungal agent activities against Candida albicans and Aspergillus fumigatus.[18] Ciprofloxacin was also found to affect the fungal activity with higher doses; increasing their growth or affecting their metabolism.[17]

Furthermore, other studies demonstrated ciprofloxacin derivatives' high potential to inhibit both bacteria and fungi at extreme concentrations.[16,19]

^{1}HNMR Spectra

The ^{1}HNMR spectra of some compounds (B-B17) are listed in Table 4.

Conclusion

In the present research, various methodologies involving structural modifications have been attempted for the synthesis of new ciprofloxacin derivatives featuring amide functional groups of the fluoroquinolone scaffold. As detailed above, seventeen carboxamide analogues have been synthesized and characterized. These complexes were characterized by physical and spectral studies. Various newly synthesized compounds, three derivatives where selected (one from each scaffold) from the produced compounds (B8, B11, and B14) to be tested for biological activity against a variety of bacterial strains such as *Pseudomonas aeruginosa*, *Candida Albicans*, and *Staphylococcus aureus*. The agar well diffusion method was used to detect antibacterial activity against these pathogenic bacteria and fungi at concentrations ranging from 10 to 100 mg/ml. Also, we worked on a theoretical study in order to compare the findings to those of the experiment results. Our theoretical results are in a good agreement with the experimental ones.

The results showed that they had good biological activity compared to those reported for ciprofloxacin. Two of them (B8 and B14) showed high anti-fungal activity even with small dose (10 mg/ml) which is much better than ciprofloxacin as previously mentioned in literature. All the three tested structures showed moderate activities against S. aureus derivatives suggesting that they can overreach the bacterial resistance which resulted from ciprofloxacin resistance. Finally, B8 was the derivative to show high effect against P. aeruginosa with no anti-fungal effect. Accordingly, B8 can be specifically used for this bacterial infection.

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Authors' contributions statement

Both authors J.D.A and S.J.K contributed to data analysis, drafting, and revising of the paper and agreed to be responsible for all the aspects of this work.

Author's declaration

- Conflicts of Interest: None.
- We hereby confirm that all the Figures and Tables in the manuscript are ours. Furthermore, any Figures and images, that are not ours, have been included with the necessary permission for republication, which is attached to the manuscript.
- Ethical Clearance: The project was approved by the local ethical committee at University of Baghdad.
- No animal studies are present in the manuscript.
- No human studies are present in the manuscript.
- No potentially identified images or data are present in the manuscript.

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تحضير وتشخيص بعض مركبات الايمايدات الجديدة الحلقية غير المتجانسة من دواء السيبروفلوكسين

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الخلاصة

تم تصنيع مشتقات إيميدات جديدة كجزء من هذا العمل، حيث تم تحضير عقار سيبروفلوكساسين (2-Chloroacetyl) من تفاعل سيبروفلوكساسين مع كلوريد كلورو أسيتيل بوجود ثلاثي إيثيل أمين ثم من الناتج B مع مشتقات 2-أمينوبنزوثيازول ومن محلول بروم وحامض الخليك الثلجي حضرت المركبات (B1-B8)، اما المركبات (B9-B12) حضرت من فثاليك ايماید البوتاسيوم أو سكسينيك ايماید ومشتقات 4-أسيتيل سيبروفلوكساسين المناسبة (B13-B17)، تمت إعادة تدفق هذا الخليط لمدة (8 إلى 10) ساعات مع الحفاظ على درجة الحموضة بين (6 و 6.5) . تم قياس درجات الانصهار، FT-IR، والتحليل الطيفي H-NMR لتشخيص المركبات العضوية ومشتقاتها المتكونة. أظهرت السلالات والفطريات المضادة للبكتيريا أيضًا فعاليتها ضد بكتيريا الجرام الموجبة (Staphylococcus) وسلبية الجرام (Pseudomonas aeruginosa) وبكتيريا الفطريات (Candida Albicans).

الكلمات المفتاحية: مشتقات 2-أمينوبنزوثايوزول، الفعالية البيولوجية، المركبات الحلقية غير المتجانسة، عقار سيبروفلوكساسين، مشتقات إيميدات.