Original Article

Comparison and Description of the Synthesis of New Compounds from Azetidin and the Study of their Biological Activity

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Abstract

New organic compounds with one group, two groups and three groups were prepared from azetidine-2-one, respectively.

That is through two first steps: New compounds with one group, two groups and three groups of azomethine were prepared, through the reaction of benzaldehyde derivatives with primary amine compounds with mono-, di- and triple-amino groups. The result was diagnosed by following TLC, FT.IR. The second step: The azomethine compounds prepared in the previous step were reacted with acetic acid dichloride with different molar numbers (1:1, 1:2, 1:3) and the spectroscopic and physical (TLC, FT.IR, H1. NMR., C13.NMR., and CHNX.) results were discussed to confirm the correctness of the structural formula of the resulting compounds. Finally, the effect of these prepared compounds on types of gram-positive and gram-negative bacteria (*Escherichia Coli, Klebsiella pneumoniae, Staphylococcus aureus P.aeruginosa.*) was studied and the results were compared with types of drugs available in pharmacies (Cefotaxime (C.C.X 10) 5 mg/ disc, Chloramphenicol (C.C.30) 30mg/ disc, Cefixime (C.F.M5) 10mg/ disc, Amoxicillin (A.M.C30) 30 mg/ disc). The results were very satisfactory against the growth of types of bacteria, and the reason was due to the increase in the number of azetidine-2-one rings, meaning the greater the number of these rings, the greater the killing of bacteria.

Keywords: New Organic Compounds, Azomethine, Heterocyclic, Azetidine-2-one.

DOI: 10.47750/PNR.2022.13.S03.189

INTRODUCTION

In recent years, there has been a lot of interest in (azetidin-2-one) due to its biological importance and its many therapeutic uses (Jaberi et al., 2019)**.** It consists of only four atoms, one of which is nitrogen. Azetidin-2-one known as β-lactam is also still one of the most used antibiotics (Asif, 2018)**.** For the treatment of bacterial infections as well as microbial diseases (Aljamali and Aljammali, 2016) and the most widely used and widely used antibiotics are penicillin (Prescott, 2013)**,** ampicillin (Sayer et al., 2021)**,** nocardicin (Aoki et al., 1976)**,** and carmonam, all of which contain azetidin-2-one))-β-lactam ring (Galletti and Giacomini, 2011). Through studies, it was observed that a large number of lactams-Chloro monocyclic β-3 possess strong antimicrobial (Chavan and Pai, 2007) and anti-inflammatory (Saturnino et al., 2000) as well as antibacterial activities (Lee et al., 2017; Pawar et al., 2012). As potential antifungal agents By reacting chloroacetyl chloride with the compound N-(4-difluoro methoxy)-3-hydroxy benzylidene. In dioxane in the presence of TEA (Dandia et al., 2007; Sulthana and Quine, 2018).

Under these circumstances, these medicines have become unrewarding, and the reason is due to their misuse or through the development of these microbes for these antibiotics, so it has become necessary to find a development in the structure of these antibiotics.

EXPERIMENTER

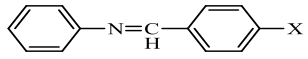
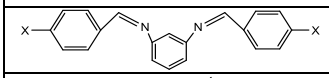
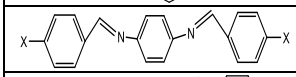
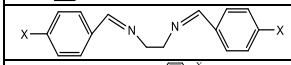
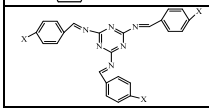
1) Synthesis of azomethine derivatives (Racha, 2016)

In a (50) mL conical flask, fitted with a magnetic stirrer and condenser, equal molar volumes in a 1:1 ratio of aldehyde with the primary monoamine amine were mixed, wherein (0.01) mol (1.51 g) of (4-nitrobenzaldehyde) was dissolved in 20 mL of Absolute ethanol is slightly heated. Then 3 drops of glacial acetic acid are added to it as a catalyst and then left to stir a little, then gradually added to (0.01) mol (0.93 g) of (aniline). We notice the color change when adding to yellow or orange, then the reaction rises for 11 hours and after the end of the sublimation period the reaction mixture is cooled

in an ice bath, then the precipitate is filtered, washed and dried to recrystallize after that with absolute ethanol. The completion of the reaction was confirmed by using TLC technology for the resulting materials and comparing them with the reactants, which showed the disappearance of the reactants. Then the compound was measured spectrophotometrically to confirm its formula using FT-I.R.,., and C.H.N.X.

In the same method as before, five compounds of the mono-, di and tri- **azomethine** were prepared, Depending on the type of primary amine used (single, double or triple) amine, respectively.

Table 1: shows the molecular formulas, molecular weights, percentages and some physical properties of mono-, di and tri-azomethine compounds that were prepared from mono-, di- and tri- amines, respectively.

General Structural formula	Code	X	M.F	M.Wt	M.p	Yield %	Colour
	A_1	P-NO2	C13H10N2O2	226.235	94-92	80	Yellow
	A15	P-NO2	C20H14N4O4	374.356	164-158	60	orange
	A23	P-OH	C20H16N2O2	316.360	>230	74	light green
	E2	P-OH	C16H16N2O2	268.316	220-216	77	beige
	A30	P-H	C24H18N6	390.450	Dec.	80	white

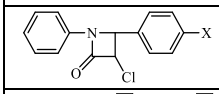
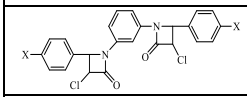
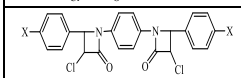
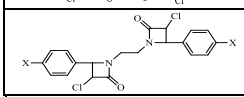
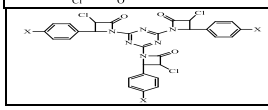
2) Synthesis of azetidine-2-one derivatives (Gilani et al., 2011)

In a conical flask of (50) ml capacity equipped with a magnetic stirrer and condenser, (0.004) mol (0.91g) of the prepared (1-(4-nitrophenyl)-N-phenylmethanimine) (A1) was dissolved in 20 ml of 1, 4-Dioxane with stirring and heating for the purpose of dissolution, then (0.004) mol (0.41 g) of Triethyl amine was added to the solution gradually and with stirring, then (0.004) mol (0.45 g) of Chloro acetyl chloride was added very slowly and gradually to the mixture in Ice bath. We note the turbidity of the solution with a change in color, then the reaction is heated for (6) hours with magnetic stirring. At the end of the reaction time, the product is filtered and left to dry, then crystallization is returned using ethyl alcohol.

The completion of the reaction was confirmed by using TLC technology for the resulting materials and comparing them with the reactants, which showed the disappearance of the reactants. Then the compound was measured spectrophotometrically to confirm its formula using FT-I.R., C^{13}.N.M.R., H^1.N.M.R., and C.H.N. X.

In the same method, all mono-, di- and tri- azetidine-2-one compounds were reacted.

Table 2: represents the molecular formula, molecular weight, percentage and some physical properties of azetidin-2-one compounds.

General Structural formula	Code	X	M.F	M.Wt	M.p	Yield %	Colour
	B_1	P-NO2	C15H11ClN2O3	302.714	212-213	76.4	red
	B_{15}	P-NO2	C24H16Cl2N4O6	527.314	167-168	88.2	dark brown
	B_{23}	P-OH	C24H18Cl2N2O4	469.318	207-208	70.2	pale white
	F_2	P-OH	C20H18Cl2N2O4	421.274	174-175	84	Off white
	B_{30}	P-H	C30H21Cl3N6O3	619.887	Dec.	48	white

Biological effect

Used was the four types of pathogenic germs *Eschershia Coli, Klebsiella pneumonia, Staphylococcus aureus, Ps.aeruginosa*

Preparation of the concentrations of the prepared compounds

Concentrations of some of the prepared compounds were prepared using a special solvent method for each substance and at concentrations (5 10 20 50 100 150) mg/ml compound.

Method of testing the sensitivity of the prepared compounds

The method of propagation in the modified culture medium was used (Modified agar diffusion method).

Which is called Kerby-Bauer method (Drew et al., 1972), when the nutrient medium was prepared and sterilized by an autoclave, then distributed in dishes, left to solidify and incubated at a temperature of (37° C) for (24 hours) to ensure that it was not contaminated after that. Then it was incubated at a temperature of (37 °C) for one hour, then the dishes were dug at a rate of six holes in the circumference of each dish and one of the prepared concentrations was added in each hole, and then the dishes were incubated at a temperature of (37 °C) for a period of (24 hours), then the results were read on the day The following shows the sensitivity of the derivatives used, which depends on the diameter of the inhibition, as the increase in the diameter of the inhibition means an increase in the biological activity of the prepared compounds.

And comparing it with the following drug with concentrations shown against each one of them:

Cefocaxime (C.C.X10) 5mg/ disc

Chloramphenicol (C.C.30) 30mg/ disc

Cefixime (C.F.M5) 10mg/ disc

Amoxitillin (A.M.C30) 30 mg/ disc

Results and Discussion

The interaction took place in two steps

The first step

With an equal number of moles of aromatic aldehydes with monoamines and through escalation for certain periods, azomethine compounds were prepared using ethanol as a solvent, as shown in the general equation of the reaction as well as the reaction mechanism (Abid and Mahdy, 2017)**:** (In the same way, two-azomethine and three-azomethine compounds were prepared, But by using primary amines that are mono-, di- and tri-amines, with benzaldehyde compounds of different substitutions.).

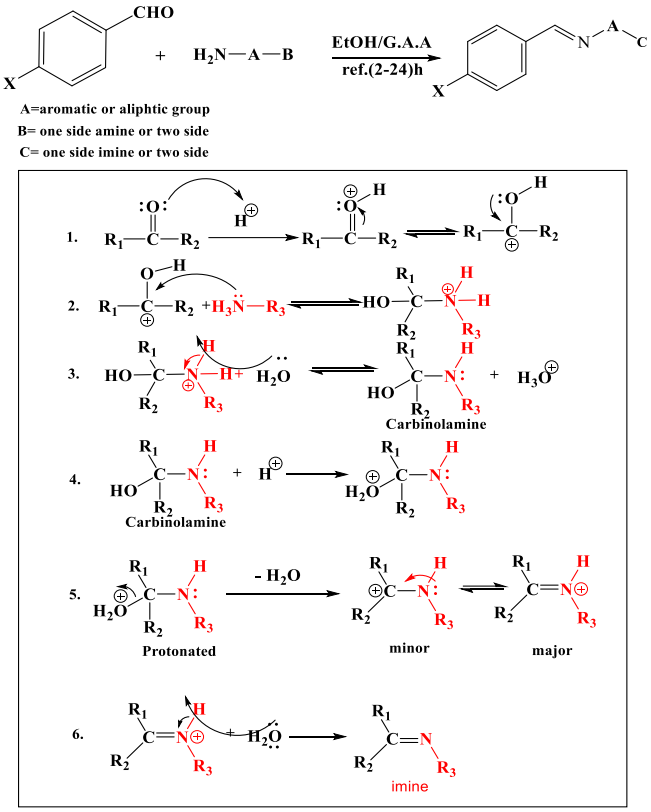


Figure 1: the general equation and mechanism for the preparation of azomethine

Also, through the physical properties and results of (FT-IR and C.H.N.X.) spectrum of the prepared compounds, the structural structure of the prepared compounds was confirmed.

Step two

In this step, heterocyclic compounds of the azetidine -2-on type were formed from the reaction of the results of the first step (beta-lactam) acetic acid chloride with a number of moles according to the number of isomethane for the compound in the first step, and according to the general equation and the following reaction mechanics (MahmoodHelmi et al., n.d.)**:**

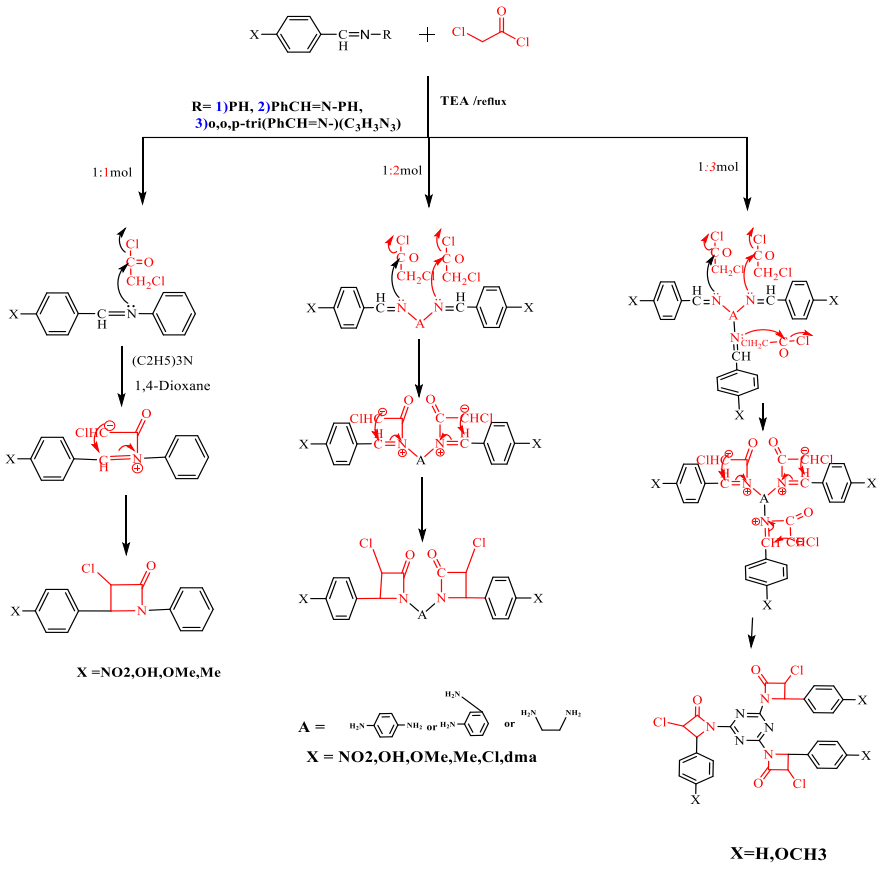


Figure 2: the general equation and mechanism for the preparation of azetidin-2-one

Through the physical properties and the results of spectroscopic measurements (FT.IR., CHNX., H1.NMR. and C13NMR) the structural formula of the resulting compounds was confirmed, as shown as follows. Note the table (3).

Infrared Spectrum (FT-IR) for comp. (A1,A15,A23,A30,E2)

Through the method of condensation between the aromatic aldehyde with amines (mono, di, or triple), modifying different moles to obtain mono, di, or tri-imine compounds (Schiff bases) and using ethyl alcohol as a solvent in addition to glacial acid as a catalyst for the reaction and imine compounds were obtained (C-A1) According to the method of work described previously. According to the mechanism followed in the preparation of azomethane compounds, the reaction of preparing azomethane compounds can be explained by the general equation as follows:

By following T.L.C. And some physical changes such as color and melting point indicate the end of the reaction. In order to confirm the structural formula of the prepared compounds, the prepared imine compounds were diagnosed spectrophotometrically, for example, they were diagnosed by infrared (FT-IR) spectroscopy. whose range ranges between (1720-1760) cm-1, and the disappearance of the symmetric and asymmetric vibration absorption bands of the amine group (-NH2), whose range ranges between (3200-3300) cm-1, and the emergence of the stretching-vibration-absorption band of the imine group (C = N), whose range ranges between (1594.87-1660.99) cm-1, in addition to aromatic (C-Harom) absorption bundles whose range ranges between (3020.27-3138.96) cm-1, and aliphatic absorption bundles (C-Haliph), whose range ranges between (2807.67-2986.22) cm^{-1}

Table 3: values of the absorption bands in the infrared spectrum for the prepared imine compounds.

Symb.	ν C-H arom•	ν C-H aliphatic	ν C=N	ν C=C arom	Others
A_1	3041.99	2878.99	1625.0	1595.00	1448 C-NO2 Asy. 1345 C-NO2 sy.
A_{15}	3103.12	2849.11	1626.69	1517.04	1491.20C-$NO_{2\ Asy.}$ 1343.33 C-$NO_{2\ sy}$
A_{23}	3010.2	2939	1635	1597	3145.89 O-H
E_2	3028.12	2857.33-2903.22	1609.10	1478.83	3224.2 O-H
A_{30}	3138.96	2807.67	1660.99	1487.37	1508.81 C=N ring

Infrared Spectrum (FT-IR) for comp

The compounds B1were prepared by reacting the prepared azomethine compounds (A1) with 1 mole of chloroacetyl chloride and using dioxane as a solvent, as shown in the (previous) paragraph in the working method and the reaction was carried out according to the equation The steps shown in Figure (3) show the reaction of preparing the compounds B1, B2, B3, B4), as follows:

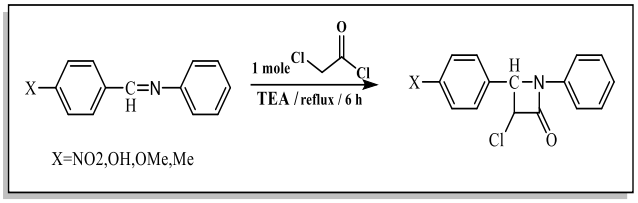


Figure 3: Compounds preparation equation

The above reaction included a nucleophilic attack by the electron pair of the nitrogen atom in azomethine compounds (A1, A15, A23,E2,A30) on the carbon of the carbonyl group (C = O) forming chloroacetyls, followed by closing the intermediate material to form azetidinone derivatives. According to the above mechanism.

The prepared compounds were characterized by infrared (FT-IR) spectra. The spectra of the prepared compounds indicated the appearance of absorption bands (1689-1650cm-1) due to the stretching (C=O) of the beta-lactam ring, in addition to the vibration-elastic vibration absorption bands of the (νC-) bond. Harom), which is within the range (3010 cm-1-3102), in addition to the appearance of the absorption bands (νC-HAliph.) whose range is between -2867 cm-(2992) and the appearance of the stretchable vibration absorption bands (C-Cl) within the range (673). -739) (134,133) and as shown in Table (4) the values of the absorption bands of the infrared spectrum FTIR for the prepared compounds B1, B2).

Diagnostics (B15B23, F2)

Compounds were prepared from **(B15,B23,F2)** by reacting the prepared azomethine compounds (E2-A15) with 2 moles of chloroacetyl chloride and using dioxane as a solvent, as shown in the method of work(Experimenter) and this was done according to the equation and steps and Figure (4) The reaction of preparing the ring for these compounds is shown as follows:

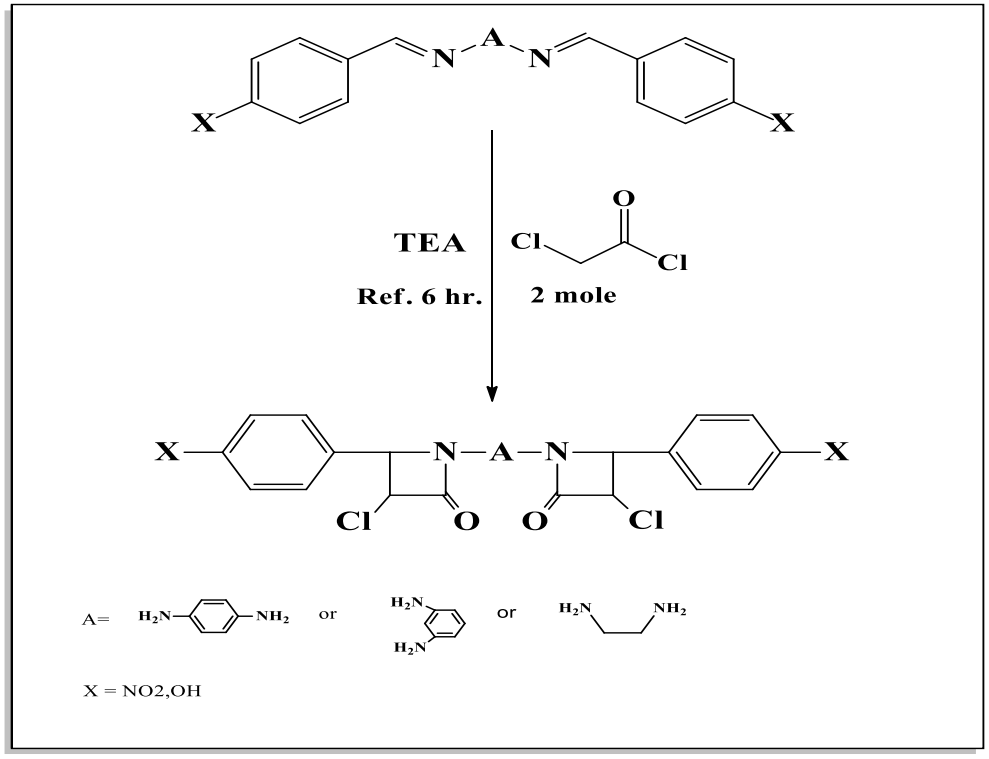


Figure 4: Compounds preparation equation B15,B23,F2

The above reaction included a nucleophilic attack by the electron pair of the nitrogen atom forming the imine bond on the carbon atom constituting the carbonyl group in the chloroacetyl chloride compound, and this attack was repeated again on the second mole of chloroacetyl chloride.

The prepared compounds were characterized by infrared spectra (FT-IR). The spectra of the prepared compounds indicated the appearance of absorption bands (1685.86-1593.83cm-1) due to the stretching (C = O) of the beta-lactam ring, in addition to the absorption bands of the elastic vibration of the (νC) bond. –H arom), which is within the range (13017.92-3136 cm), in addition to the appearance of the absorption bands (νC-H Aliph.), whose range is between (127.82-2987.82 cm), and the appearance of the stretchable vibration absorption bands (C-Cl) within the range (681-830.31) (134,133) and as shown in Table (4) the values of the absorption bands of the FTIR spectrum for the prepared compounds F6….B15)).

Diagnosis of the two compounds (B30)

The two compounds (B30) were prepared by reacting the prepared azomethine compounds (A30) with 3 moles of chloroacetyl chloride and using dioxane as a solvent, as shown in the method of work(Experimenter), the reaction was carried out according to the proposed mechanism in figure (2), and the two compounds were diagnosed in the infrared spectrum (FT-IR) and as in Table (4) clarification of the values of the absorption bands for the two compounds (B30), and the reaction was done according to the equation and steps, and Figure (5) shows the reaction of preparing the ring for these compounds As follows:

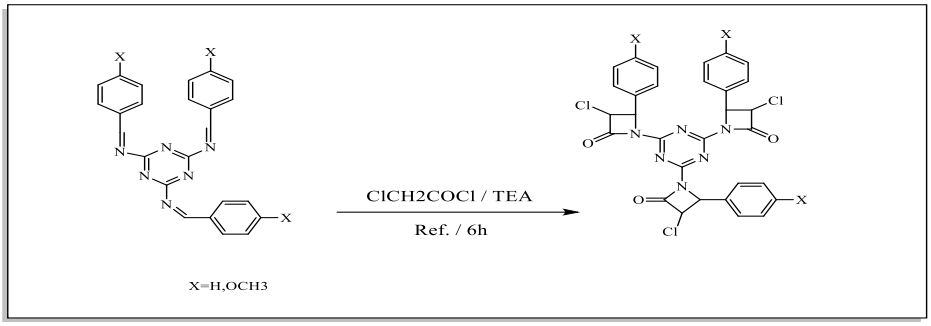


Figure 5: Compound preparation equation B30

Table 4: values of the absorption bands in the infrared spectrum FT-IR for the prepared compounds (B15, B23,F2,B30) measured in cm-1.

	Major FTIR Absorption cm^{-1}						
Symb.	**ν C-H $_{arom.}$**	**ν C-H (-CH$_2$-) $_{aliphatic}$**	**ν C=C $_{ring}$**	**ν C=O $_{lactam}$**	**ν C-N**	**ν C-Cl**	**Others**
B1	5630	2992	1562	1689	1472	723	1415 C-NO2 Asy. 1339 C-NO2 sy.
B15	3053	2987	1670	1669	1271	681	1410 C-NO2 Asy. 1325 C-NO2 sy.
B 23	3089.77	2945.54	1475.28	1673.71	1241.01	807.26	3375.54 O-H
F 2	3067.56	2955.3	1539.32	1678.31	1189	772	3197 O-H
B30	3013	2917	1468	1662	1228	677	1544 C=N ring mel

Proton nuclear magnetic resonance (H1-NMR) spectra

Also, the structural formula of the prepared compounds was confirmed by 1H-NMR proton nuclear magnetic resonance spectrometry, as shown below and illustrated in Figures (6) to (10) as follows:

Vehicle Diagnostics (B1)

Compound B1 was diagnosed by proton nuclear magnetic resonance spectrum (1H-NMR) and using (DMSO-d6) as a solvent and as shown in Figure (3-16), where the prepared compound (B1) showed a binary signal between [δ = (4.65). -4.67) ppm, (d,1H), N-CH-] This reference refers to the heterogeneous quaternary ring proton, and as indicated by the integral area of its return, which is equal to one proton, a binary signal appeared between [δ=(5.15-5.16) ppm, (d,1H), -CH-C=O] This signal belongs to the heterogeneous quaternary ring proton, and as indicated by the integral area of the correctness of its return, which is equal to one proton, and a multiple signal appeared between [δ=(7.12-8.06) ppm,(m, 9H), -Ar-H.] This reference refers to the aromatic ring protons and has an integral area of nine protons.

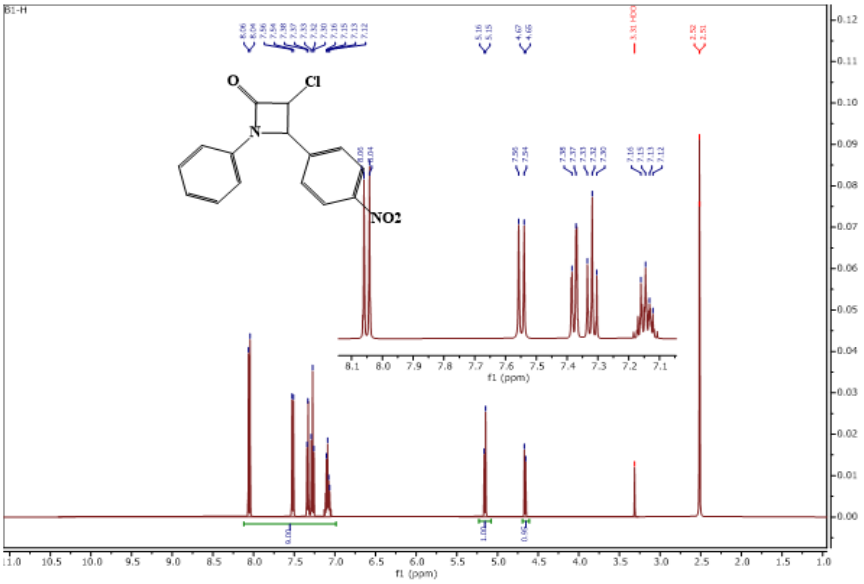


Figure 6: Condensed and Expanded 1H-NMR Spectrum for Compound 1B

Diagnosis of the compound (B15)

The compound (B15) was diagnosed by proton nuclear magnetic resonance (H-NMR) spectrometry (1H-NMR) and using (DMSO-d6) as a solvent and as shown in Figure (3-20), where the prepared compound (B15) showed a binary signal between [δ = (5.11). -5.12) ppm, (d, 2H), N-CH-] This signal refers to the heterogeneous tetragonal proton, and as indicated by the integral area of its return, which is equal to two protons, and a binary signal appeared between [δ=(5.61-5.63) ppm,(d,2H), -CH-C=O] This signal refers to the heterogeneous tetragonal proton, and as indicated by the integral area of the correctness of its return, which is equal to two protons, and a multiple signal appeared between [δ=(7.13-8.04) ppm,(m,12H), -Ar-H.] This reference refers to the aromatic ring protons with the integral area of twelve protons.

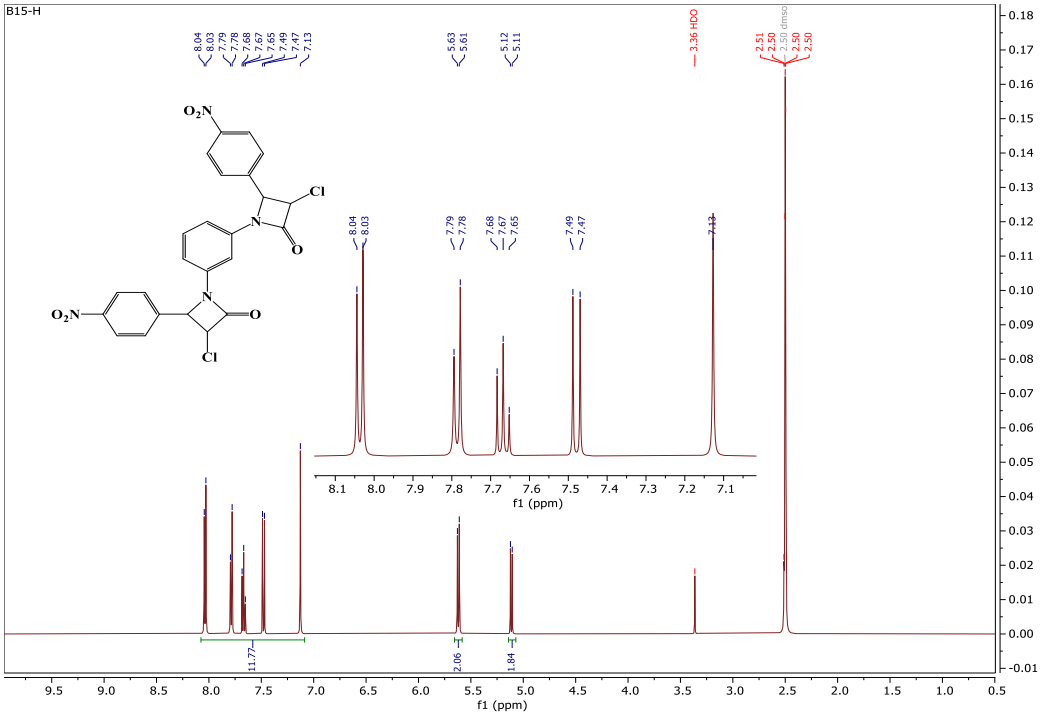


Figure 7: Condensed and expanded 1H-NMR spectrum for compound B15

Diagnosis of the compound (B23)

Compound B23 was diagnosed by proton nuclear magnetic resonance spectrometry (1H-NMR) and using (DMSO-d6) as a solvent and as shown in Figure (3-25), where the prepared compound (B23) showed a binary signal between [δ = (5.05)

-5.07) ppm, (d,2H), N-CH-] This signal refers to the heterogeneous quaternary ring proton, and as indicated by the integral area of its return, which is equal to two protons, a binary signal appeared between [δ=(5.38-5.40) ppm,(d,2H), -CH-C=O] This signal is due to the heterogeneous tetragonal ring proton and as indicated by the integral area of the correctness of its return, which is equal to two protons, and a multiple signal appeared between [δ=(6.84-7.61) ppm,(m,12H), -Ar-H.] This sign belongs to the aromatic ring protons and has an integral area of twelve protons, and it shows a single sign at [δ=(9.30) ppm,(s,2H, -OH]] belongs to the two compensated hydroxyl groups on the aromatic ring and has an area of complementary to two protons.

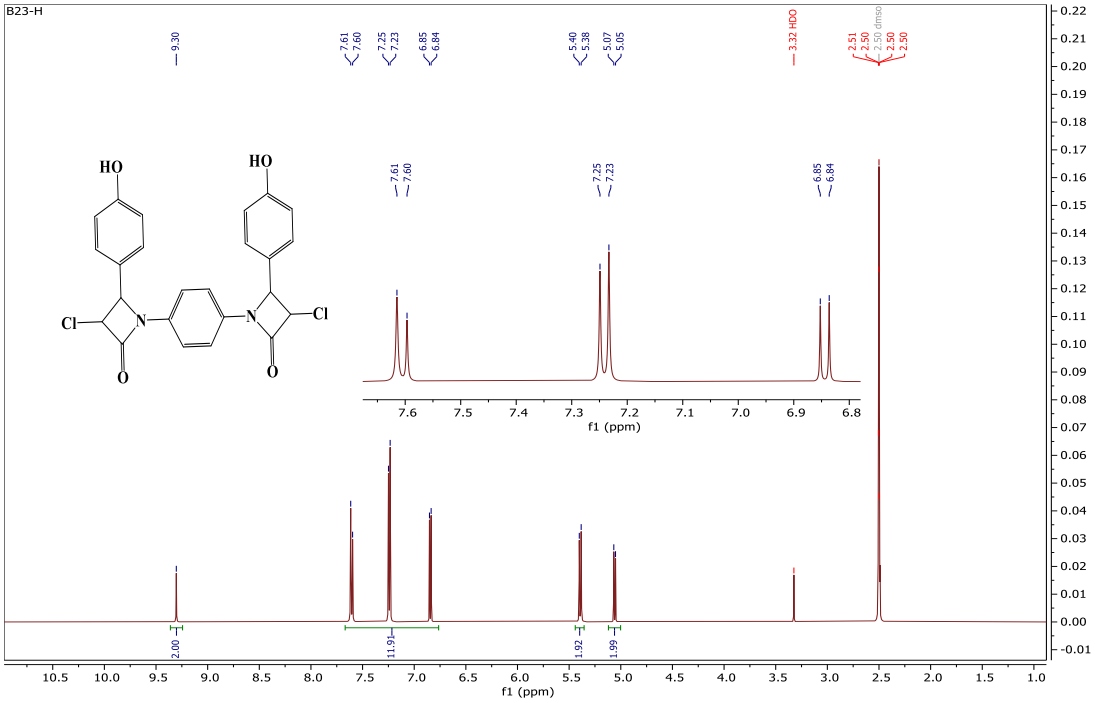


Figure 8: Condensed and expanded 1H-NMR spectrum for compound B_{23}

Compound Diagnosis (F2)

The compound (F2) was diagnosed by proton nuclear magnetic resonance spectrometry (1H-NMR) and using (DMSO-d6) as a solvent and as shown in Figure (3-31), where the prepared compound (F2) showed a triple signal between [δ=(3.50). -3.53) ppm,(t,4H), -CH2-CH2-] This sign refers to the protons of the alkane group of the amine, and as indicated by the integral area of the validity of its return, which is equal to four protons, a binary sign between [δ=(4.92-4.93) ppm,(d,2H), =C-CH-] This signal refers to the heterogeneous tetragonal proton, and as indicated by the integral area of the validity of its return, which is equal to two protons, and a binary signal appeared between [δ=(5.34). -5.36) ppm,(d,2H), -CH-C=O] This signal belongs to the heterogeneous tetragonal proton, and as indicated by the integral area of the validity of its return, which is equal to two protons, a binary, binary signal appeared between [δ=(7.17-7.76)) ppm,(dd,8H), -Ar-H.] This signal refers to the aromatic ring protons with an integral area of eight protons, and show a single signal at [δ=(9.30) ppm,(s,2H), -OH] this returns The reference to the two hydroxyl groups substituted on the aromatic ring with an integral area belonging to two protons.

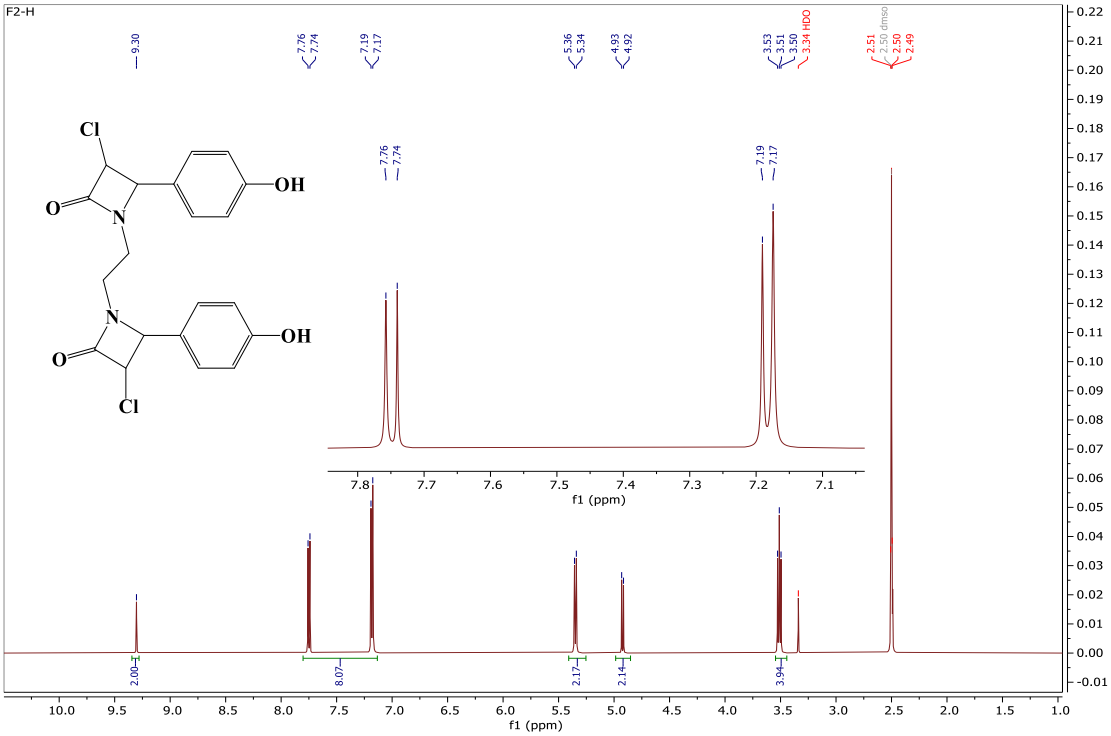


Figure 9: Condensed and expanded 1H-NMR spectrum for compound F_2

Compound (B30) diagnosis

The compound (B30) was diagnosed by proton nuclear magnetic resonance (1H-NMR) spectrometry and using (DMSO-d6) as a solvent and as shown in Figure (3-35), where the prepared compound (B30) showed a binary signal between [δ = (5.37). -5.39) ppm,(d,3H), =C-CH-] This signal refers to the heterogeneous quaternary ring proton, and as indicated by the integral area of its return, which is equal to three protons, and a binary signal appeared between [δ=(5.67-5.68) ppm,(d,3H), -CH-C=O] This signal is due to the heterogeneous tetragonal ring proton, and as indicated by the integral area of the correctness of its return, which is equal to three protons, and a multiple signal appeared between [δ=(7.28-7.41) ppm,(m),15H), -Ar-H.] This reference refers to the aromatic ring protons and has an integral area of fifteen protons.

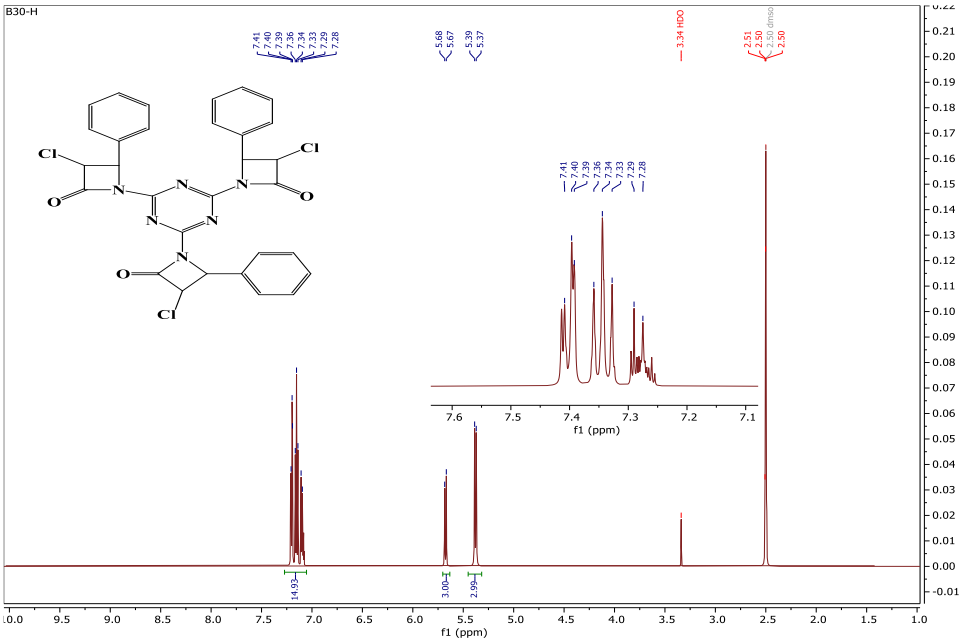


Figure 10: Condensed and expanded 1H-NMR spectrum for compound B_{30}

Carbon Nuclear Magnetic Resonance Spectra (13C-NMR)

Also, the structural formula of the prepared compounds was confirmed by diagnosing them by nuclear magnetic resonance (NMR) spectrum of carbon-13C-NMR as shown

below, as well as in the shapes shown from Figure (11) to Figure (15) as follows:

Vehicle Diagnostics (B1)

The compounds were diagnosed by carbon nuclear magnetic resonance (13C-NMR) spectrometry and using (DMSO-d6) as a solvent and as shown in Figures (3-37), (3-38), (3-39), (3-40) for the compounds Respectively ((B1, B2, B3, B4 prepared), where the shapes indicated the appearance of a signal between [δ=158.25-166.13ppm, (-C=O)] This signal belongs to the carbon (C7), while the carbon atoms of the aromatic rings were observed. Between [δ=110.90-157.32 ppm, (C aromatic ring)] this reference is due to 2 aromatic rings, and between [δ=67.26-72.69ppm, (-N-CH-)] this reference is due to carbon (C9), and a sign between [δ=58.66-65.75 ppm, (-CH-Cl)], this sign belongs to (C8) carbon.

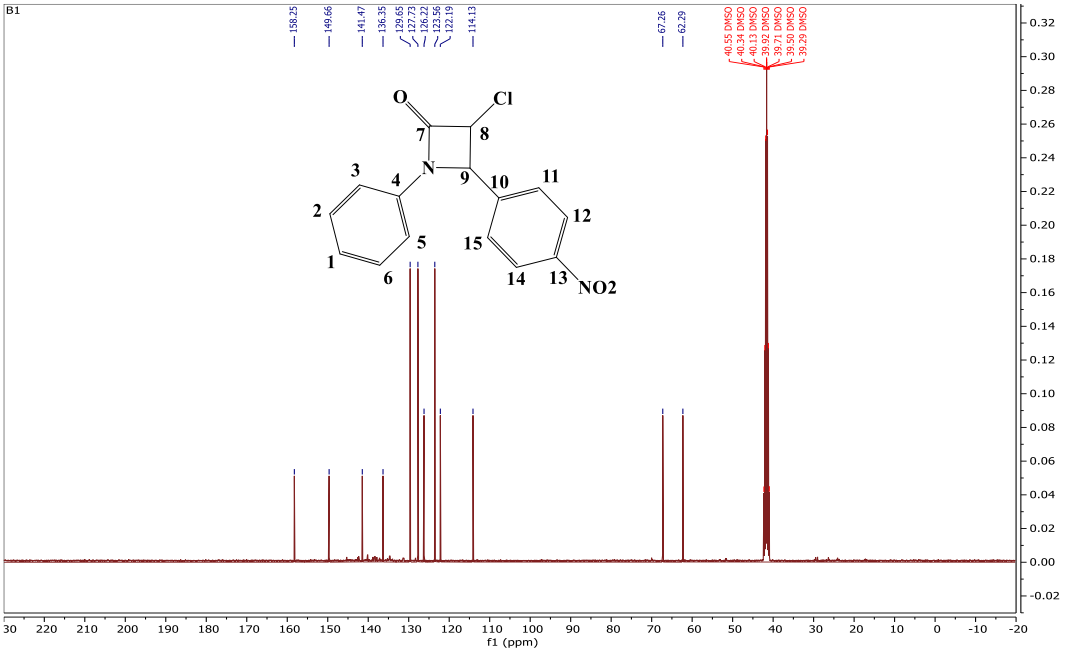


Figure 11: Condensed and expanded 13C-NMR spectrum for compound B_1

Vehicle Diagnostics (B15)

The compounds were diagnosed by carbon nuclear magnetic resonance (13C-NMR) spectrometry and using (DMSO-d6) as a solvent and as shown in Figures (3-41), (3-42), (3-43), (3-44) for the compounds (B15, B16, B17, B20 prepared where the shapes indicated the appearance of a signal between [δ=160.69-165.89ppm, (-C=O)] This signal belongs to the carbon (C7, 7/), while the carbon atoms of the aromatic rings were observed. Its signals between [δ=110.66-157.78ppm, (C aromatic ring)] refer to three aromatic rings, and the signal between [δ=65.05-69.22ppm, (-N-CH-)] is due to carbon (C9)., 9\), and a sign between [δ=57.87-63.07 ppm, (-CH-Cl)] This sign is due to carbon ((C8, 8\).

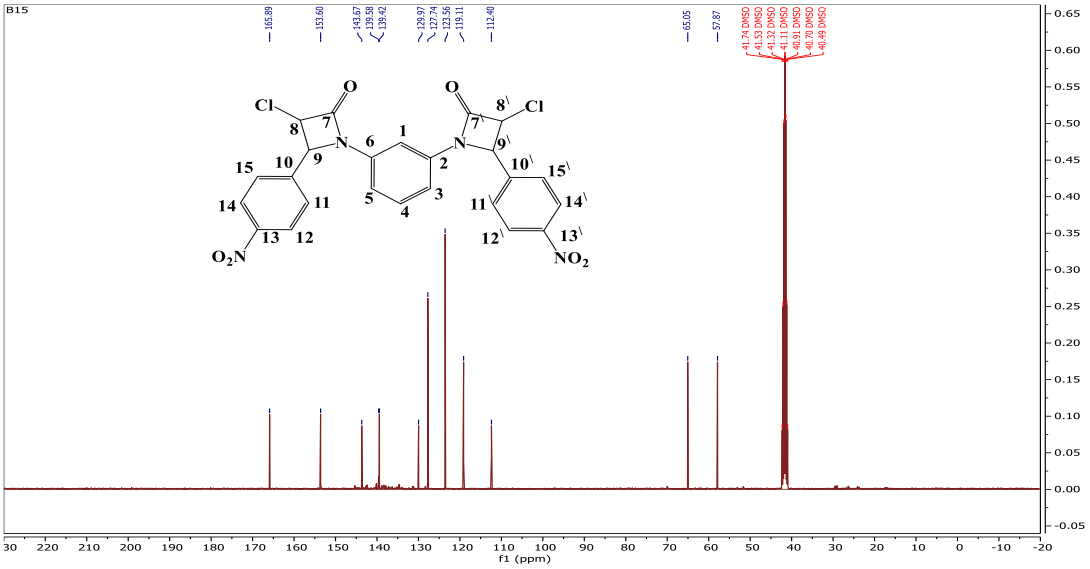


Figure 12: Condensed and expanded 13C-NMR spectrum for compound B_{15}

Vehicle Diagnostics (B23)

The compounds were diagnosed by carbon nuclear magnetic resonance spectrometry (13C-NMR) and using (DMSO-d6) as a solvent and as shown in Figures (3-45), (3-46), (3-47) (48-3),, (3-49) for the prepared compounds (B22, B23, B24, B26, B27 where the shapes indicated the appearance of a signal between [δ=159.51-163.86ppm, (-C=O)] This reference refers to carbon (C7, 7) As for the carbon atoms of the aromatic rings, their signals were observed between [δ=112.90-156.04ppm, (C aromatic ring)], and this signal belonged to three of the aromatic rings, and their signals were between [δ=67.02-69.69ppm, (-N-CH-)] This reference refers to carbon (C9, 9/), and a signal between [δ=58.35-63.07 ppm, (-CH-Cl)] refers to carbon (C8, 8/).

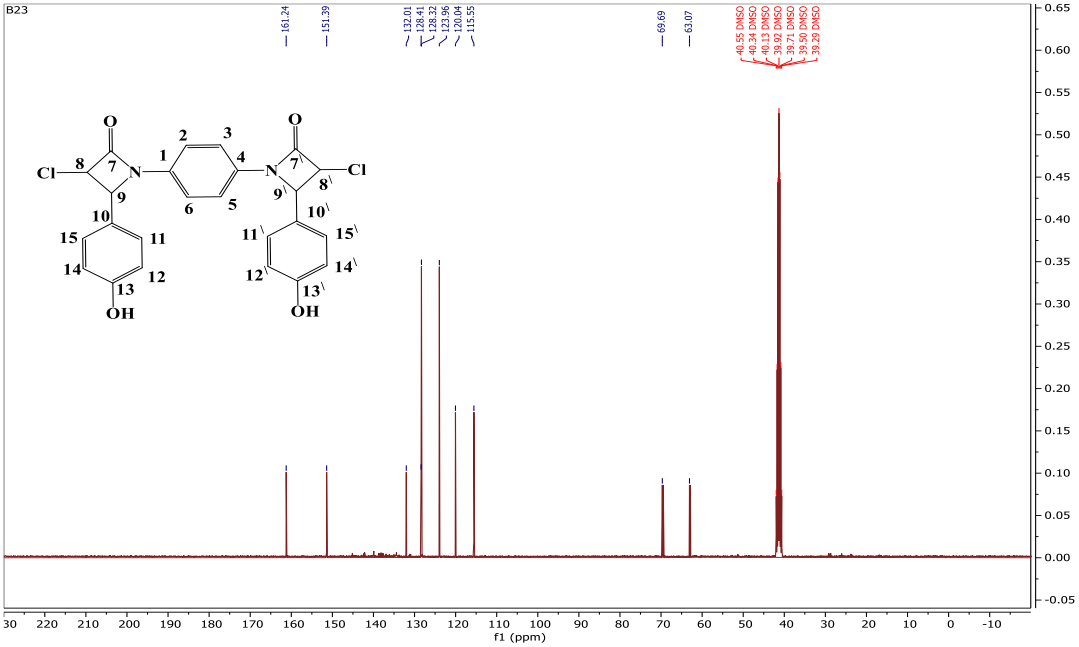


Figure 13: Condensed and expanded13C-NMR spectrum for compound B_{23}

Vehicle Diagnostics (F2)

The compounds were diagnosed by (13C-NMR) carbon nuclear magnetic resonance spectrometry and using (DMSO-d6) as a solvent and as shown in Figures (3-50), (3-51), (3-52) (53-3),, (3-54) for the prepared compounds (F1,F2,F3,F4,F6 where the shapes indicated the appearance of a signal between [δ=162.98-170.38ppm, (-C=O)] This reference refers to carbon (C2,2\) As for the carbon atoms of the aromatic rings, their signals were observed between [δ=113.81-159.04ppm, (C aromatic ring)], this signal belongs to two aromatic rings, and the signal between [δ=64.69.22ppm, (-N-CH-)] This reference refers to carbon (C4, 4\), a signal between [δ=58.11-64.02 ppm, (-CH-Cl)] This reference is returned to carbon (C3, 3\, and a signal between [δ=51.02-55.67 ppm), (-CH2-CH2-)] This reference refers to carbon (, (C1, 1\).

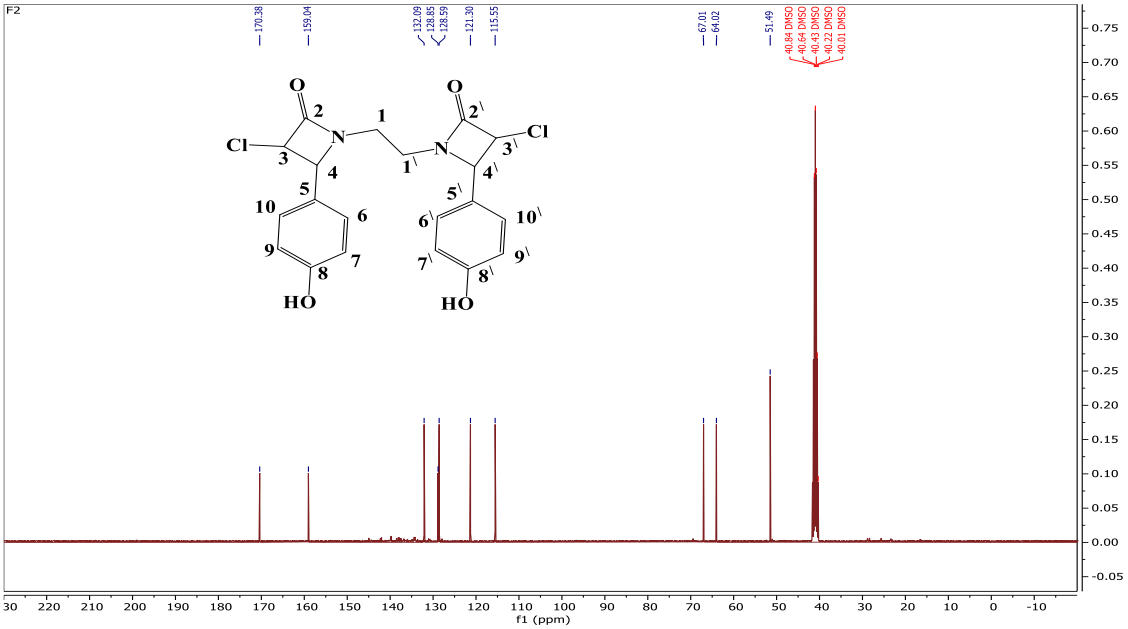


Figure 14: Condensed and expanded 13C-NMR spectrum for compound F_2

Diagnosis of the two compounds (B30)

The two compounds were diagnosed by carbon nuclear magnetic resonance spectrometry (13C-NMR) and using (DMSO-d6) as a solvent and as shown in Figures (3-55), (3-56) for the prepared compounds (B30, B31), where the shapes indicated the appearance of a signal Between [δ=164.71-166.13ppm, (-N=C-)] refers to carbon (C1,2,3), and between [δ=155.57-160.22ppm, (-C=O)] refers to Carbon (C4, 4\,4\\) As for the carbon atoms of the aromatic rings, their signals were observed between [δ=113.80-135.57ppm, (C aromatic ring)]], and this signal belonged to three of the aromatic rings, and a signal between [δ=63.78-65.75ppm, (-N-CH-)] this reference refers to carbon (C6, 6\,6\\), and a signal between [δ=56.69-58.11 ppm, (-CH-Cl)] refers to carbon ((C5, 5\,5\\).

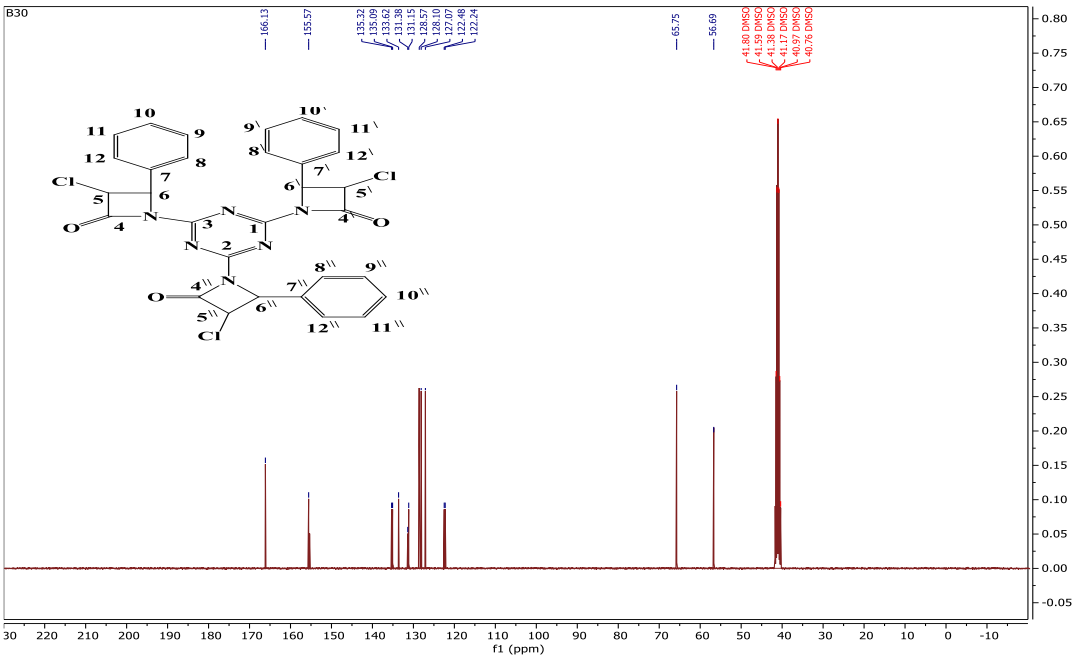


Figure 15: Condensed and expanded 13C-NMR spectrum for compound B_{30}

Accurate analysis of the elements (C.H.N.X)

This technique is used in order to diagnose the chemical compounds that were prepared in the laboratory, and this is done by calculating the ratios of the elements: carbon,

hydrogen and nitrogen and halogen (X=Cl). The results of this analysis are included in a table(5) Comparing the practically obtained values with the theoretically calculated values, it was observed that there is a great convergence between them, and this clearly confirms the validity of the added ratios and the validity of the spectroscopic measurements, which supports the validity of the chemical formulas of the prepared compounds.

Table (5): Results of the microanalysis of the elements C.H.N.X. for the prepared compounds

No.	code	M.F.,MWt. g/mol	C%		H%		N%		CL%	
			theoretical	practical	theoretical	practical	theoretical	practical	theoretical	practical
1	B1	C15H11ClN2O3, 302.714	59.52	59.11	3.66	3.43	9.25	8.78	11.71	11.05
2	B15	C24H16Cl2N4O6 ,527.314	54.67	54.23	3.06	2.65	10.63	9.11	13.45	13.31
3	B23	C24H18Cl2N2O4 ,469.318	61.42	61.21	3.87	3.55	5.97	5.34	15.10	14.62
4	F2	C20H18Cl2N2O4 ,421.274	57.02	56.66	4.31	4.03	6.65	6.43	16.83	15.73
5	B30	C30H21Cl3N6O3 ,619.887	58.13	57.64	3.41	3.32	13.56	13.44	17.16	17.09

Discussion of the Biological Part

The effect of some compounds prepared in this research was studied on the growth of four types of bacteria: *Escherichia Coli, Klebsiella pneumoniae, Staphylococcus aureus P.aeruginosa.*

These germs were chosen due to their importance in the medical field as they cause a number of diseases and also differ in the nature of their resistance to antibiotics and chemotherapeutic substances. The sensitivity of derivatives was studied using the method of diffusion in the modified culture medium.

Modified Agar Diffusion Method

The culture medium was sterilized with the Autoclave device, then the dishes were left to harden and incubated at (37 °C) for a period of (24 hours) in order not to contaminate them. Then the dishes were inoculated with bacteria by diffusion method and then placed in the incubator for an hour

Then drilling was made in this (loopful) the bacteria were spread on the nutrient media in the dishes using which was sterilized with alcohol. Drilling using the compounds under study (Inhibition Zone (370) then measured the amount of inhibition C) in the incubator at a temperature using a millimeter ruler.

This study showed that the biological activity is as high as possible at a concentration of (50) mg/ml, and it was also shown that the solvents (DMSO, CHCI3) used in the study had no effect on the activity of pathogenic bacteria.

Effectiveness of the prepared compounds against the bacteria used: 1.2.3

Table (6) shows that the compounds prepared in the laboratory have an inhibitory activity against all bacteria: for example, compound B1 gave good inhibition values, but it was lower than the rest of the compounds that were tested for biological activity, and the reason is that compound B1 contains a single ring of azetidin-2-on As confirmed by the comparison with other compounds (B15, B23, F2), the last compounds contain two azetidin-2-on rings.

As for comparing the prepared compounds (B15, B23, F2) with compound D, we note that the latter has a very high killing range of bacteria compared to compounds (B15, B23, F2) because this compound contains two groups of benzaldehyde (two groups of carbonyl in a compound). one when prepared).

As for the compounds A30, it is considered to have excellent inhibition values when compared with other compounds and with the drugs used to determine the effectiveness and extent of killing. The reason for this is that these compounds contain three rings of azetidin-2-on, which gives the reason for the high impact range for all bacteria and for different concentrations.

Table 6: Inhibitory activity of a number of prepared compounds on the growth of a number of positive and negative bacteria (The diameter of the damping circle is measured in mm)

Comp. No.	Conc.	E.coli	pseudeudomonas	Klebisella	Staphylococcs aureus
B1	5	—	—	18	—
	10	21	8	—	8
	20	—	—	—	11
	50	13	14	17	—
	100	—	—	20	22
	150	—	24	—	—
B15	5	—	14	—	—
	10	23	19	—	—
	20	—	8	18	—
	50	23	20	—	25
	100	—	21	20	22
	150	—	—	—	19
B23	5	9	—	—	—
	10	—	10	14	10
	20	12	—	—	9
	50	—	18	20	7
	100	—	—	—	8
	150	15	21	9	—
F2	5	—	—	22	—
	10	13	—	—	20
	20	12	10	7	9
	50	—	11	—	16
	100	—	8	—	9
	150	—	12	8	—
B30	5	23	14	16	25
	10	15	10	20	17
	20	17	11	25	12
	50	16	22	18	20
	100	20	17	10	10
	150	19	13	10	22
Cefocaxime(C.C.X10) disc /5mg		0	0	31	25
Chloramphenicol (C.C.30) disc /30mg		0	0	25	30
Cefixime (C.F.M5) disc /10mg		0	0	24	0
Amoxitillin (A.M.C30) disc /30 mg		0	0	0	10
DMSO& CHCl3		0	0	0	0

CONCLUSION

In conclusion, the aim of this study was to synthesize and evaluate β-lactam ring compounds, a well-known active compound within the class (azetidin-2-one), which have exceptional biological activity against various microbes and canines. The hope of discovering new structures serves as powerful pharmacological agents. The prepared compounds were verified by screening and confirming them using different spectroscopic methods such as FTIR, NMR and CHNX techniques. We made new compounds bearing mono-, di- and tri-lactam rings and examined their biological activity in vitro. The in vitro study of these compounds showed remarkable biological efficacy compared to some drugs. It can be indicated that the new mono-, di- and tricyclic β-lactam-containing compounds that showed potent bioactivity are promising, for future studies in vivo that can be used as antibiotic drugs.

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