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Synthesis and characterization of binary compounds of the novel Azetidin-2-one ring and comparison of its biological activity

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***Abstract*---**New organic compounds were prepared with two groups of azetidine-2-one, respectively.And that through the first two steps: New compounds were prepared with two groups of azomethine, by reacting benzaldehyde derivatives with primary amino compounds with di-amino groups. The result was diagnosed by following TLC, M.P, FT.IR.The second step: The azomethine compounds prepared in the previous step reacted with acetic acid dichloride with different molar numbers (1:2) and were diagnosed spectroscopically and physically by (TLC, M.P, FT.IR,H1NMR,C13.NMR.C.H.N.X.) 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*---β*-lactams, Schiff base, antimicrobial, binary azetidin-2-one ring.

Introduction

Beta-lactams are organic compounds that contain a heterogeneous quaternary ring, where the nitrogen atom is the heteroatom, and this ring being a tetrahedron, it has properties that are different from the ternary, pentagonal, and hexagonal rings (1,2). The beta-lactam is a cyclic amide, which was prepared for the first time in 1907 by the scientist (Studinger) (3). -one) where azetidin-2-one compounds and their derivatives occupy a central position among the medically important compounds due to their diverse and interesting properties of antibiotics and their biological activity (4,5). Compounds containing β-Lactam are still among the most used antibiotics in the treatment of Bacterial infection as well as in the treatment of microbial diseases (6), In 1928, penicillin was discovered by the Scottish scientist (Alexander Fleming) as an antibiotic that was able to kill a wide range of harmful bacteria such as streptococcus, meningococcus and diphtheria bacillus, and it is a common antibiotic used They are: (Pencillins, Cephalosporins, Norcardicins, Carbapenems, Clavams, Ampicillin, Ampicillins, Thienamycine, Aztreonam Aztreonam).

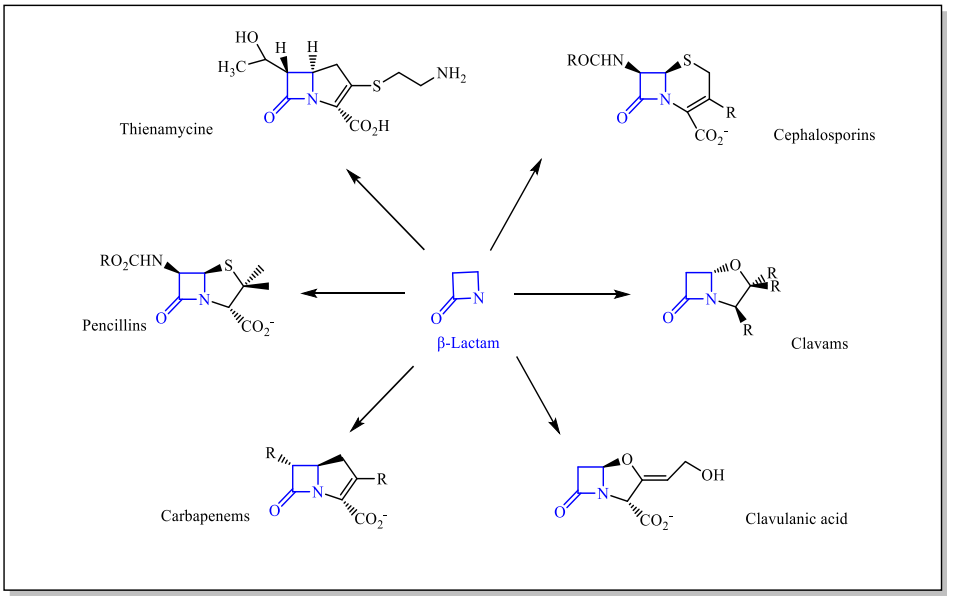


Figure (1) Some antibiotics containing a beta-lactam ring

It is known that azitidinones, which are part of antibiotics, have important biological activities (7).Where it was observed through studies that a large number of (3-chloro monocyclic β-lactams) possesses high antibacterial, antimicrobial, anti-inflammatory activity (8) and anti-tuberculosis activities, compounds and their derivatives possess various pharmacological characteristics such as anti-hypertensive (hypertensive)(9), anti inflammatory (10), anticancer(11), antihyperlipidemic(12).Researchdevelopments have thoroughly demonstrated that azitidine-2 (β-lactams) are present in Effective antimicrobials have outstanding antimicrobial properties (13, 14) and are well documented The fact that they interfere with the biosynthetic pathway, such as penicillin-binding proteins (PBPs) required for the synthesis of peptidoglycan, a vital raw material for the bacterial

cell wall mounting. The azetidine-2-one ring system is the central nucleus of many clinically relevant elementsAntibiotics such as penicillin, cephalosporin, cephamycin, carbapenems, and monobactam.Azetidine-2-one has also been reported as anti-tuberculosis, anticancer, anticonvulsant, and antiviral, Enzyme inhibition and hypoglycemic actions (15-18)

Expermental

General procedure for the synthesis method of azomethine compounds (Schiff bases)

this was done by using the method of thermal condensation of aromatic and aliphatic amines with the carbonyl group of the aromatic aldehydes through escalation using an ethanol solvent with the addition of drops of Glacial acetic acid as a reaction catalyst(19) .

Preparation of compound (1)
1,1'-(1,4-phenylene)bis(N-phenylmethanimine)

In a circular flask with a capacity of (50) ml, equipped with a magnetic stirrer and a condenser, equal molar amounts in a ratio of (2:1) each of aromatic aldehyde and amine were mixed. Where (0.00745) mol (0.791 g) of terephthaldehyde is dissolved in 20 ml of absolute ethanol, heated slightly, and then added to it. 3 drops of ice acetic acid are added to it as a catalyst and then left to stir a little, then gradually (0.0149) mol (1.402 g) of aniline is added. We notice the color change upon addition, then the reaction is raised, and after the escalation period, the reaction mixture is cooled in an ice bath, Then the precipitate was filtered, washed and dried to be recrystallized afterwards using absolute ethanol. As shown in Table (1). The reaction was followed up by T.L.C. The product was diagnosed spectrophotometrically by FT.I.R.

Preparation of compound (2)
N,N'-(ethane-1,2-diyl)bis(1-p-tolylmethanimine)

In a circular flask with a capacity of (50) ml, equipped with a magnetic stirrer and a condenser, equivalent molar amounts of (1:2) each of aromatic aldehyde and diamine were mixed, where (0.018) mol (2.72 g) of 4-methoxybenzaldehyde was dissolved in 20 ml of absolute ethanol. It 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 (0.009) mol (1.24 g) mol of ethlene di amine of the amine that has been previously dissolved in 20 ml of absolute ethanol is added. Color upon addition, then the reaction was raised (10-12) hours and after the end of the sublimation period the reaction mixture was cooled in an ice bath, then the precipitate was filtered, washed and dried to be recrystallized after that using absolute ethanol. . As shown in Table (1). The reaction was followed up by T.L.C. The product was diagnosed spectrophotometrically by FT.I.R.

Preparation of compound (3)
N,N'-(1,3phenylene)bis(1(4methoxyphenyl)methanimine)

In a circular flask with a capacity of (50) ml, equipped with a magnetic stirrer and a condenser, equivalent molar amounts of (1:2) each of aromatic aldehyde and diamine were mixed, where (0.018) mol (2.72 g) of 4-methoxybenzaldehyde was dissolved in 20 ml of absolute ethanol. It 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 (0.009) mol (1.24 g) mol of meta-Phenelen di amine of the amine that has been previously dissolved in 20 ml of absolute ethanol is added. Color upon addition, then the reaction was raised (10-12) hours and after the end of the sublimation period the reaction mixture was cooled in an ice bath, then the precipitate was filtered, washed and dried to be recrystallized after that using absolute ethanol. . As shown in Table (1). The reaction was followed up by T.L.C. The product was diagnosed spectrophotometrically byFT.I.R.

Preparation of compound (4)
N,N'-(1,4phenylene)bis(1(4methoxyphenyl)methanimine)

In a circular flask with a capacity of (50) ml, equipped with a magnetic stirrer and a condenser, equivalent molar amounts of (1:2) each of aromatic aldehyde and diamine were mixed, where (0.018) mol (2.72 g) of 4-methoxybenzaldehyde was dissolved in 20 ml of absolute ethanol. It 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 (0.009) mol (1.24 g) mol of Para-Phenelen di amine of the amine that has been previously dissolved in 20 ml of absolute ethanol is added. Color upon addition, then the reaction was raised (10-12) hours and after the end of the sublimation period the reaction mixture was cooled in an ice bath, then the precipitate was filtered, washed and dried to be recrystallized after that using absolute ethanol. . As shown in Table (1).The reaction was followed up by T.L.C. The product was diagnosed spectrophotometrically by FT.I.R. Shown in Table (2)

General procedure for the synthesis of azetidin-2-one compounds.

azetidin-2-one compounds were prepared using azomethine compounds with Chloro Acetyl Chloride in the presence of TriethylAmine and using an appropriate solvent. Escalation or stirr(20).

Compound preparation (5)
3S,4S)-
3chloro4(4((2R,3R)3chloro4oxo1phenylazetidin2yl)phenyl)1phenylazetidin2-one

In a circular flask with a capacity of (50) ml equipped with a magnetic stirrer and a condenser, (0.004) mol (1.137 g) of (the compound of the preparation 1) was dissolved in 20 ml of 1,4-Dioxane with stirring and heating for the purpose of dissolution, then (0.008) mol was added (0.809 g) of Triethyl amine over the solution and with stirring, then (0.008) mol (0.904 g) of Chloro acetyl chloride was added to the mixture in an ice bath. We note the turbidity of the solution with a color change, then the reaction was heated for (6) hours with stirring At the end of

the reaction time, the product was filtered, allowed to dry, and then crystallized again using ethyl alcohol. The reaction was followed up by T.L.C. The product was diagnosed spectrophotometrically by H1.N.M.R., C.H.N.X., FT.I.R. and C13.N.M.R.

Preparation of the compound (6)
1,1'-(ethane-1,2-diyl)bis(3-chloro-4-(p-tolyl)azetidin2one)

In a circular flask with a capacity of (50) ml equipped with a magnetic stirrer and a condenser, (0.003) mol (0.979) of (prepared imine compounds 2) were dissolved in 20 ml of 1,4-Dioxane with stirring and heating for the purpose of dissolution, then (0.006) was added (0.607 g) of Triethyl amine over the solution and with stirring, then (0.006) mol (0.678 g) of Chloro acetyl chloride was slowly added to the mixture in an ice bath. With stirring, and at the end of the reaction time, the product was filtered and left to dry, then crystallization was returned using ethyl alcohol. The reaction was followed up by T.L.C. The product was diagnosed spectrophotometrically by H1.N.M.R., C.H.N.X., FT.I.R. and C13.N.M.R.

Preparation of the compound (7)
1,1'(1,3phenylene)bis(3chloro4(4methoxyphenyl)azetidin-2-one)

In a circular flask with a capacity of (50) ml equipped with a magnetic stirrer and a condenser, (0.002) mol (0.537 g) of (compounds of the preparation 3) were dissolved in 20 ml of 1,4-Dioxane with stirring and heating for the purpose of dissolution, then (0.004) was added Mole (0.404 g) of Triethyl amine over the solution and with stirring, then (0.004) mole (0.452 g) of Chloro acetyl chloride was slowly added to the mixture in an ice bath. With stirring, and at the end of the reaction time, the product was filtered and left to dry, then crystallized again using ethyl alcohol. The reaction was followed up by T.L.C. The product was diagnosed spectrophotometrically by H1.N.M.R., C.H.N.X., FT.I.R. and C13.N.M.R.

Preparation of compound (8)
1,1'(1,4phenylene)bis(3chloro4(4methoxyphenyl)azetidin-2-one)

In a circular flask with a capacity of (50) ml equipped with a magnetic stirrer and a condenser, (0.002) mol (0.749 g) of (compounds of the preparation 4) were dissolved in 20 ml of 1,4-Dioxane with stirring and heating for the purpose of dissolution, then (0.004) was added Mole (0.404 g) of Triethyl amine over the solution and with stirring, then (0.004) mole (0.452 g) of Chloro acetyl chloride was slowly added to the mixture in an ice bath. With stirring, and at the end of the reaction time, the product was filtered and left to dry, then crystallized again using ethyl alcohol. The reaction was followed up by T.L.C. The product was diagnosed spectrophotometrically by H1.N.M.R., C.H.N.X., FT.I.R. and C13.N.M.R. Tables (1) (2) represents the molecular formula, molecular weight, percentage and some physical propertiesofthepreparedazomethinecompounds1,2,3,4,and thepreparedaztidin-2-onecompounds 5,6,7,8.

Table (1) Molecular formula, molecular weight, percentages and some physical properties of the prepared compound

Some properties of diazomethane compounds						
No.	Name	M.F.	M.Wt.	M.P.	Yeild %	colour
1	1,1'-(1,4-phenylene)bis(N-phenylmethanimine)	C20H16N2	284.362	150-156	87	Lemon yellow
2	N,N'-(ethane-1,2-diyl)bis(1-p-tolylmethanimine)	C18H20N2	264.372	-152150	80	white
3	N,N'-(1,3phenylene)bis(1(4methoxyphenyl) methanimine)	C22H20N2O2	344.414	-182180	59	green
4	N,N'-(1,4phenylene)bis(1(4methoxyphenyl) methanimine)	C22H20N2O2	344.414	-190184	78	green

Table (2) Molecular formula, molecular weight, percentages and some physical properties of the prepared compound

Some properties of binary Azetidin-2-one ring compounds						
No.	Name	M.F.	M.Wt.	M.P.	Yeild %	colour
5	(3S,4S)3chloro4(4((2R,3R)3chloro4oxo1phenylazetidin-2-yl)phenyl)-1-phenylazetidin-2-one	C24H18Cl2N2O2	437.320	194-198	87	light beige
6	1,1'-(ethane-1,2-diyl)bis(3-chloro4(p-tolyl)azetidin2one)	C22H22Cl2N2O2	417.33	205-207	75.5	pale white
7	1,1'(1,3phenylene)bis(3chloro4(4mehoxyphenyl)azetidin-2-one)	C26H22Cl2N2O4	497.372	204-205.3	68.4	yellowish white
8	1,1'(1,4phenylene)bis(3chloro4(4methoxyphenyl)azetidin-2-one)	C26H22Cl2N2O4	497.372	198-201	67.7	pale yellow

Spectroscopic Characterisation

AZOMETHINE

Through the method of condensation between the aromatic aldehyde with di amines modifying different moles to obtain di-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 (1,2,3,4) According to the method of work described previously. 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 azomethine compounds

Symb.	ν C-H arom.	ν C-H aliphatic	ν C=N	νC=Carom	Others
1	3059.07	2877	1614.80	1480.64	————————
2	3022.80	2910.64	1635.49	1507.85	1372.31 CH3
3	3116.4	2883.49	1600.47	1520.27	1164.52 -OCH3
4	3014.46	2879.56	1602.38	1507.55	1243.44 -OCH3

AZETIDIN-2-ONE

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 (C-H) bond. arom), which is within the range (3010 -3102) cm^{-1}, 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) and as shown in Table (4) the values of the absorption bands of the infrared spectrum FTIR for the prepared compounds 5,6,7,8).

Table (4): values of the absorption bands in the infrared spectrum for the prepared azetidin-2-one compounds

Symb.	ν C-H arom.	ν C-H aliphatic	ν C=C arom	ν $C=O_{lactam}$	ν C-N	ν C-Cl	Others
5	3092	2953.77	1520.60	1688.73	1213.09	737	————————
6	3017.92	2958.12	1512.92	1680.03	1273.6	748	1327CH/CH3 Bend
7	3043.23	2881.99	1509.14	1685.86	1258.07	739	1207 -OCH3
8	3037.38	2945.23	1511.10	1654.95	1172.26	751	1217 -OCH3

3S,4S)-3-chloro-4-(4-((2R,3R)-3-chloro-4-oxo-1-phenylazetidin-2-yl)phenyl)-1-phenylazetidin-2-one

Yield 87%;m.p. (194-198)^{O}C ; colour(light beige); IR (cm-1): 3092 (ArC-H str), 1688(C=OLactam),1520 (C=Cstr),2953 $(C-H)_{aliphatic}$, 1213 (CH-N str), 737(C-Cl str); 1H-NM(DMSO-d6,400 MHz): 4.85-4.87ppm (d, 2H, =C-H), 5.44-5.45ppm (d, 2H, -CH-C=O), 7.01-7.38ppm(m,14H,ArH):13CNMR(DMSOd6):δ=160.45ppm(C=O),δ=115.86142.49ppm(Caromatic),δ=71.74ppm (-CH-Cl), δ=64.57 ppm (=C-CH-) ,anal. calcd. For

C24H18Cl2N2O2 : C 65.91, H 4.15, N 6.41 , Cl 16.21 ; found C 65.24, H 3.85, N 6.12 Cl 15.84 .

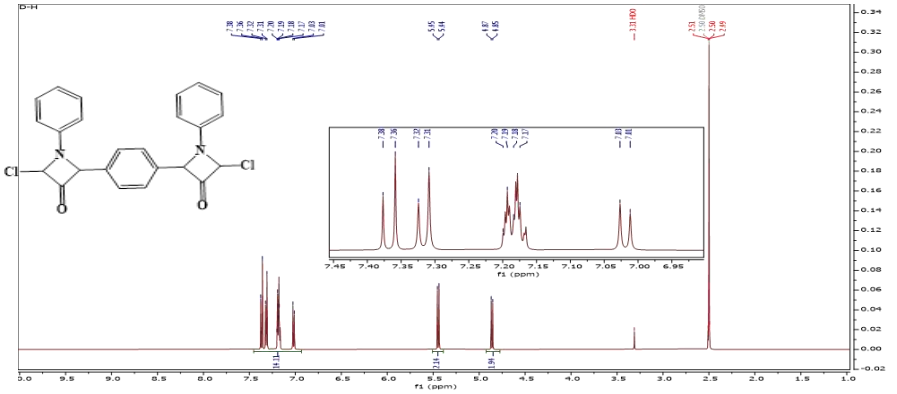


Figure (2): Condensed and expanded 1H-NMR spectrum for compound 5

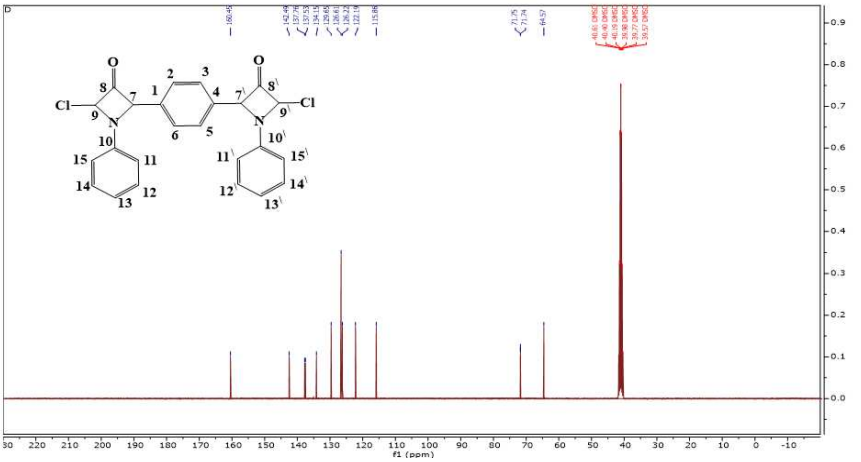


Figure (3): Condensed and expanded 13C-NMR spectrum for compound 5

1,1'-(ethane-1,2-diyl)bis(3-chloro-4-(p-tolyl)azetidin-2-one)

Yield 75.5 %;m.p. (205-207)^{O}C ; colour(pale white); IR (cm-1): 3017 (ArC-H str), 1680(C=OLactam),1512 (C=Cstr), 2958(C-H)$_{aliphatic}$, 1273 (CH-N str), 748(C-Cl str); 1H-NM(DMSO-d6,400 MHz):(δ=(2.12) ppm ,(s,6H), -CH3),(δ=(3.56-3.60) ppm ,(t,4H), -CH2-CH2-),(δ=(4.78-4.80) ppm ,(d,2H), =C-CH-),(δ=(5.18-5.20) ppm ,(d,2H), -CH-C=O),(δ=(7.24-7.42) ppm ,(dd,8H) , -Ar-H.).13C-NMR(DMSO-d6): δ= ppm , (-C=O), δ=113.80-157.78 ppm , (C $_{aromatic\ ring}$), (δ= 67.72ppm , (-N-CH-),(δ= 62.15ppm , (-CH-Cl), (δ= 56.93ppm (OCH3),anal. calcd. For C22H22Cl2N2O2: C63.32, H 5.31, N 6.71 ,Cl 16.99;found C 62.57, H 4.63, N 6.09,Cl 16.31.

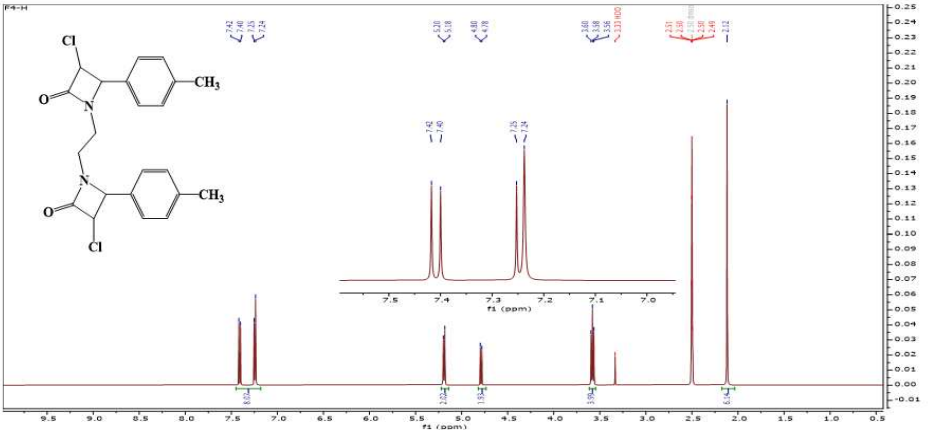


Figure (4): Condensed and expanded 1H-NMR spectrum for compound 6

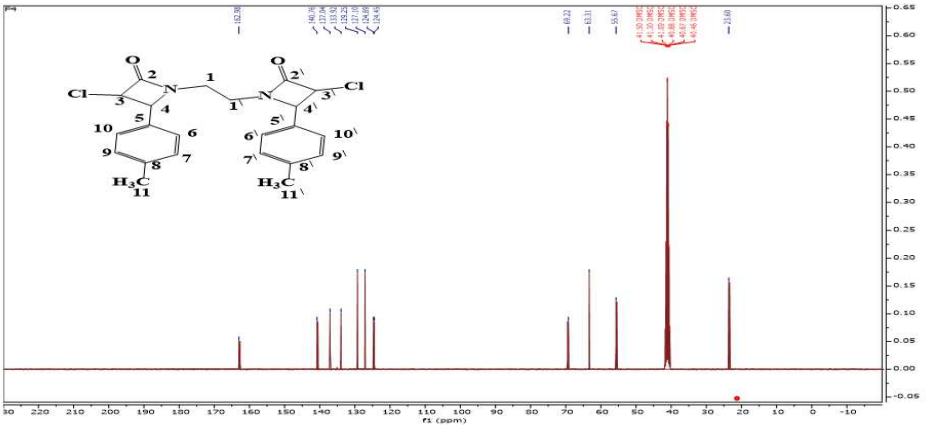


Figure (5): Condensed and expanded 13C-NMR spectrum for compound 6

1,1'-(1,3-phenylene)bis(3-chloro-4-(4-methoxyphenyl)azetidin-2-one)

Yield 68.4 %;m.p. (204-205.3)^{O}C ; colour(yellowish white); IR (cm-1): 3043 (ArC-H str), 1685(C=OLactam),1509 (C=Cstr), 2881 (C-H)$_{aliphatic}$, 1258 (CH-N str), 739(C-Cl str); 1H-NM(DMSO-d6,400 MHz): (δ=(3.88) ppm ,(s,6H), -OCH3) , δ=(5.27-5.29) ppm ,(d,2H), N-CH-) (δ=(5.57-5.58) ppm ,(d,2H), -CH-C=O), (δ=(7.05-7.61) ppm ,(m,12H) , -Ar-H). 13C-NMR(DMSO-d6): δ= 165.42ppm , (-C=O), δ=113.80-157.78 ppm , (C $_{aromatic\ ring}$), (δ= 67.72ppm , (-N-CH-),(δ= 62.15ppm , (-CH-Cl), (δ= 56.93ppm , (-OCH3)),anal. calcd. For C26H22Cl2N2O4: C 62.79, H 4.46 , N 5.63 , Cl 14.25 ; found C 62.02, H 4.02, N5.02,Cl 13.55 .

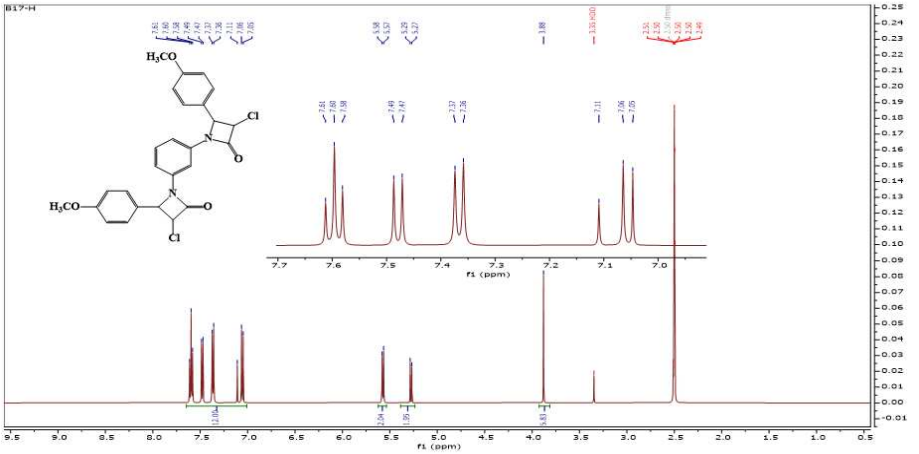


Figure (6): Condensed and expanded 1H-NMR spectrum for compound 7

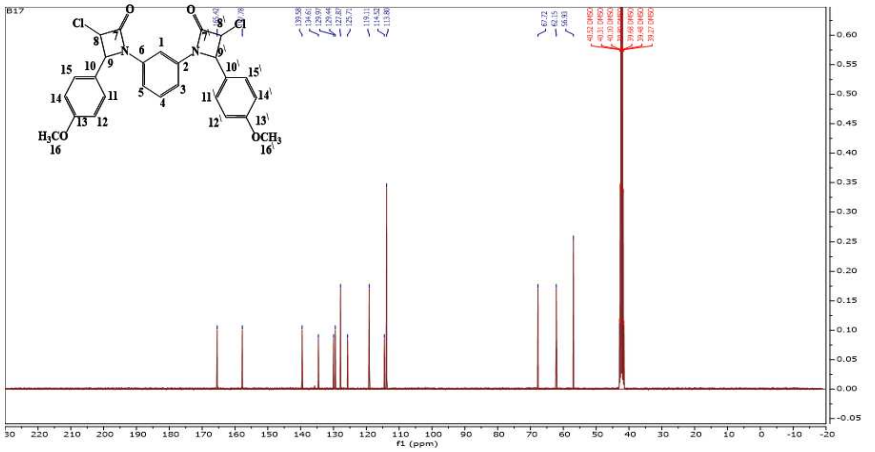


Figure (7): Condensed and expanded 13C-NMR spectrum for compound 7

1,1'-(1,4-phenylene)bis(3-chloro-4-(4-methoxyphenyl)azetidin-2-one).

Yield 67.7 %;m.p. (198-201)^{O}C ; colour(pale yellow); IR (cm-1): 3037 (ArC-H str), 1654(C=OLactam),1511 (C=Cstr), 2945 (C-H)$_{aliphatic}$, 1172 (CH-N str), 751(C-Cl str); 1H-NM(DMSO-d6,400 MHz): (δ=(3.73) ppm ,(s,6H), -OCH3), (δ=(5.12-5.14) ppm ,(d,2H), N-CH-), (δ=(5.37-5.38) ppm ,(d,2H), -CH-C=O) ,(δ=(6.92-7.46) ppm ,(m,12H) , -Ar-H.).13C-NMR(DMSO-d6):): δ= 162.42ppm , (-C=O), δ= 113.80-156.04ppm , (C aromatic ring), (δ=67.25 ppm , (-N-CH-),(δ= 60.87ppm , (-CH-Cl), (δ= 54.17ppm , (-OCH3),anal. calcd.: C 62.79, H 4.46, N 5.63 , Cl 14.25; found C62.13, H 4.22, N 5.18 , Cl 13.83.

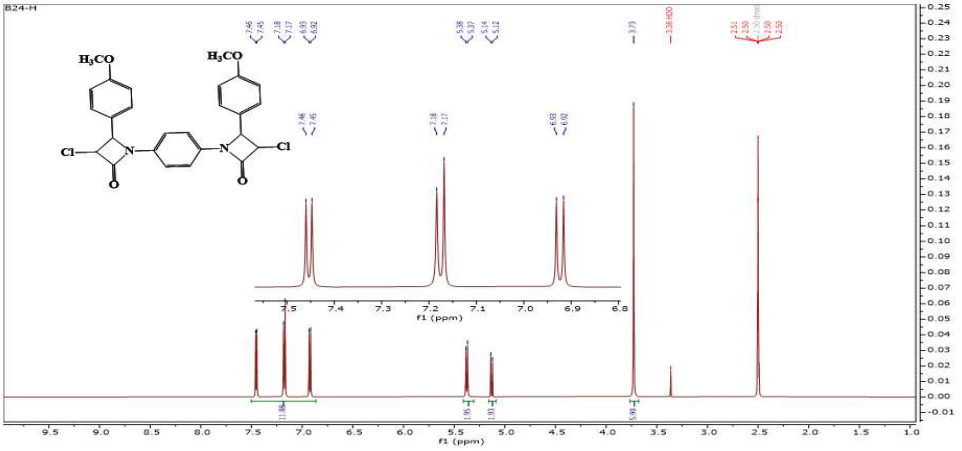


Figure (8): Condensed and expanded 1H-NMR spectrum for compound 8

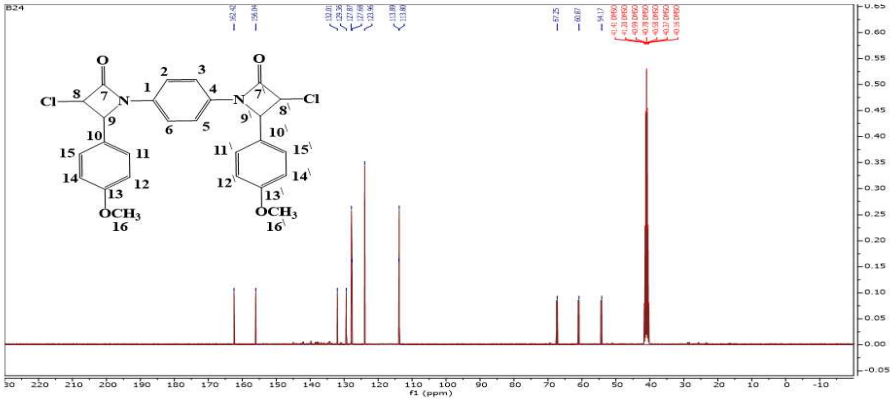
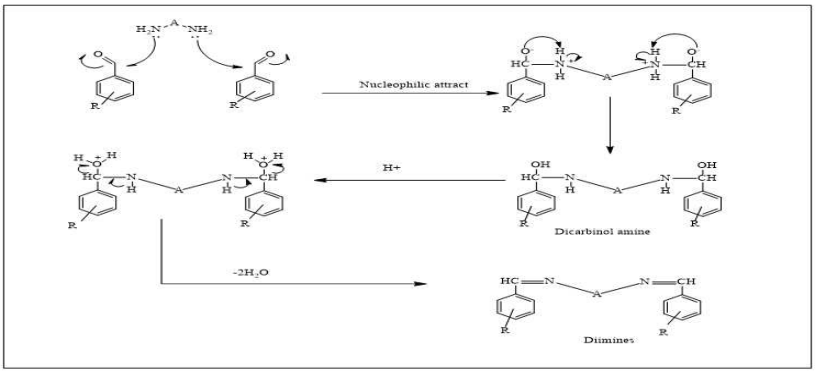


Figure (9): Condensed and expanded 13C-NMR spectrum for compound 8

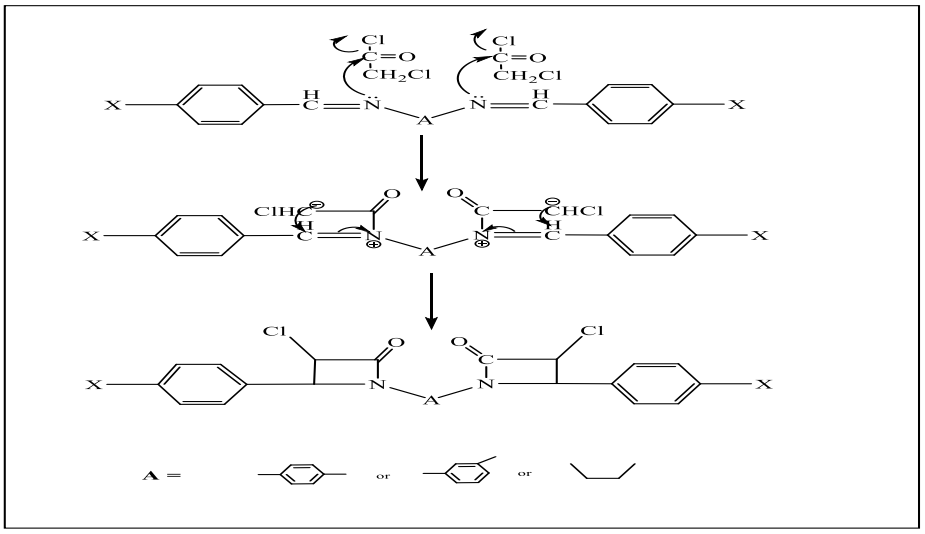
Reactions mechanism

Azomethine: The mechanism involves two steps a nucleophilic attract of the amino groups of the amines in to the carbonyl carbon of the aldehydes to form the carbinol amine in the first step ,followed by elimination of two molecules of water to form the diimines in the second (21) step as in Scheme(1).



Scheme (1):Mechanism steps for synthesis of substituted diimines.

Azetidin-2-one: The reaction involved a nucleophilic attack by the electron pair of the nitrogen atom forming an imine bond on the carbon atom that forms the carbonyl group in the acetyl chloride chloride complex, and this attack was repeated again on the second mole of chloroacetyl chloride(22) as in Scheme(2).



Scheme (2):Mechanism steps for synthesis of substituted di Azetidin-2-one derivatives

Biological activities

In vitro bioactivity examinations were performed to detect the effects of prepared compounds against one type of E.coli bacteria which were *Staphylococcus aureus and also against* fungal strains. However, the bioactivity of the compounds against fungal strains was not promising and not encouraging. The disk diffusion method of Kirby and Bauerwas followed to examine antibacterial activity(23). Through the data obtained from measuring the diameter of inhibition of the effectiveness of the compounds prepared against bacteria, as was expected when starting to prepare these compounds, they have a high and distinctive inhibition

against bacteria but have not shown inhibition against fungal Table 5: inhibition values, for the synthesized against *Escherichia coli.*

Table 5: Inhibition values E.coil

Compounds	Zone of inhibition (diameter) in mm					
	150 µg ml^{-1}	100 µg ml^{-1}	50 µg ml^{-1}	20 µg ml^{-1}	10µg ml^{-1}	5µg ml^{-1}
5	21	24	23	17	14	22
6	-	-	8	-	-	-
7	-	9	-	20	15	-
8	-	8	-	15	-	-
Cefocaxime	0					
Chlorampheniol	0					
Cefixime	0					
Amoxitillin	0					
DMSO&CHCl3	0					

Table 6: Inhibition values pseududoemonas

Compounds	Zone of inhibition (diameter) in mm					
	150 µg ml^{-1}	100 µg ml^{-1}	50 µg ml^{-1}	20 µg ml^{-1}	10µg ml^{-1}	5µg ml^{-1}
5	28	22	20	23	12	9
6	8	-	10	13	-	-
7	-	-	-	12	10	-
8	-	-	9	-	12	8
Cefotaxime	0					
Chlorampheniol	0					
Cefixime	0					
Amoxitillin	0					
DMSO&CHCl3	0					

Table 7: Inhibition values Klebisella

Compounds	Zone of inhibition (diameter) in mm					
	150 µg ml^{-1}	100 µg ml^{-1}	50 µg ml^{-1}	20 µg ml^{-1}	10 µg ml^{-1}	5µg ml^{-1}
5	24	20	19	20	18	10
6	11	-	9	-	18	-
7	-	12	-	21	-	18
8	-	-	12	10	-	8
Cefocaxime	31					
Chlorampheniol	25					
Cefixime	24					
Amoxitillin	0					
DMSO&CHCl3	0					

Table 8: Inhibition values Staphylococcs aureus

Compounds	Zone of inhibition (diameter) in mm					
	150 µg ml^{-1}	100 µg ml^{-1}	50 µg ml^{-1}	20 µg ml^{-1}	10µg ml^{-1}	5µg ml^{-1}
5	19	22	23	21	22	20
6	-	18	12	13	-	10
7	8	20	22	18	-	-
8	-	-	10	-	9	12
Cefocaxime	**25**					
Chlorampheniol	30					
Cefixime	0					
Amoxitillin	10					
DMSO&CHCl3	0					

Conclusion

β-lactam ring is a well-known active compound with exceptional biological activity against various microbes, flasks and canines. However, the bioactivity of penicillin has been significantly reduced due to uncontrolled use by people which has led to antibiotic resistance. In this study, new compounds bearing β-lactam rings were synthesized and their biological activity was examined in the laboratory. In the previous . Thus, 4 β-lactam-bearing compounds were routinely synthesized and confirmed using different spectroscopic methods such as FTIR, NMR and CHNX techniques. The in vitro study of these four ligands showed marked bioactivity , which ranged between (8and 24), respectively. . It can be indicated that the 4 new compounds containing β-lactam dicyclic rings that showed effective bioactivity are promising for future studies in vivo that can be used as antibiotic drug.

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