

## Article

**a special issue** for the scientific conference held by the Department of Chemistry- College of Education for Girls/University of Kufa, under the title:  
**(6'th Postgraduate Students Annual Conference ) (PSAC2025).**  
which held for Tuesday, **15/4/2025.**

# **Synthesis, Characterization and Preliminary Evaluation of New 1,3-Diazetidine-2-one derivatives from Benzimidazole as Antibacterial Agents**

**Marwa Kamel Nazim AL-Husseini <sup>1, a)</sup> and Hanan Faleh Mohsein <sup>1, b)</sup>**

<sup>1</sup> **Department of Chemistry, College of Education for Girls, University of Kufa, Najaf Governorate, Iraq**

<sup>a)</sup> **Corresponding author: marwak.althusseini@student.uokufa.edu.iq** <sup>b)</sup> **hanan.alshebly@uokufa.edu.iq**

## **Abstract**

In this research a new series of 1,3-Diazetidine-2-one derivatives were synthesized by the reaction of 2-(1*H*-benzo[*d*]imidazol-2-yl) acetonitrile with terephthalaldehyde presence of 10%NaOH and absolute ethanol to form a compound alkene derivative. The alkene intermediate then react with 4- amino antipyrine, nicotinic hydrazide respectively, to obtain Schiff base derivatives. Then, it will be converted into Schiff base derivatives which will be treated with 4- bromo phenyl iso cyanate and 4-methoxy phenyl iso cyanate respectively to obtain the final products. The structures of the synthesized compounds were confirmed by the FT-IR, <sup>1</sup>H-NMR, <sup>13</sup>C-NMR. In our conclusion, the antibacterial effects were tested with the use of Gram-positive *Staphylococcus aureus* and Gram-negative *Acinetobacter baumannii*,

**Keywords: Benzimidazole; Schiff base derivatives; 1,3-Diazetidine-2-one; Antibacterial Evaluation**

## **1.INTRODUCTION**

One extremely significant area of organic chemistry is Schiff's bases [1]. The German scientist Hugo Schiff was the first to describe it in 1864. Primary amines and compounds

with carbonyl groups, such as aldehyde, ketone in pure alcohol, and a few drops of glacial acetic acid, condense to form Schiff bases

The electron pair on the nitrogen atom makes Schiff bases significant chemicals that can be used in a variety of ways [2], including antibacterial [3], anticancer [4], antiviral [5], and anti-inflammatory medicines [6]. The field of medicinal chemistry is primarily interested in heterocyclic molecules. Typically, heterocyclic chemistry is one of the most intricate areas of chemistry. Its industrial and medical significance, as well as the variety of its synthetic process and theoretical implications, make it equally interesting. Not only has synthetic heterocyclic chemistry been crucial to all aspects of human existence, but it has also found use in a wide range of fields, including polymers, agriculture, medicine, and other sectors. Many synthesized heterocyclic compounds are utilized as anticonvulsants, hypnotics, antiseptics, and antineoplastics. antihistaminic, antiviral, anti-tumor etc. In every year large number of heterocyclic drugs is being introduced in pharmacopeias. The size and type of ring structures, together with the effective substituent groups of the mother scaffold, showed strongly their physicochemical properties [7]. Imidazole is an organic compound with the formula  $C_3N_2H_4$ . It is a white or colorless solid that dissolves in water and forms a slightly alkaline solution. In chemistry, it is an aromatic

heterocycle, classified as a diazole, and has non-adjacent nitrogen atom An imidazole ring is found in many natural products, particularly alkaloids; these imidazole's share a 1,3- $C_3N_2H_4$  ring but have different substituents. This ring system is found in important biological building blocks like histidine and the related hormone histamine. An imidazole ring is found in many medications, including some antifungal medications, antibiotics from the nitroimidazole series, and the sedative midazolam [8-12]. When coupled with a pyrimidine ring, it forms a purine, the most prevalent nitrogen-containing heterocycle in nature [13]. The German scientist Arthur Rudolf Hantzsch (1857–1935) first used the term "imidazole" in 1887 [14].

## **2. Materials and Methods**

### **2.1. Chemicals**

Chemicals were used in this work as follows (terephthalaldehyde, 4- amino antipyrine, GAA, 4- bromo phenyl iso cyanate, nicotinic hydrazide, 4-methoxy phenyl iso cyanate) without additional purification. FT-IR spectra were obtained utilizing a "Shimadzu FTIR-Prestige Fourier Transform Infrared Spectrophotometer" at the College of Pharmacy, University of Kufa, employing KBr disks within the 4000-400 cm range. Most of the FT-IR spectrum's

vibration bands were discovered and compared to those in the literature. NMR spectra of the derivatives were recorded at Shahid Beheshti University. Chemistry Department, Iran.

Using DMSO-d<sub>6</sub> as the solvent, carbon spectra (<sup>13</sup>C NMR) and proton spectra (<sup>1</sup>H-NMR) were acquired on a Bruker spectrometer at 75 MHz and 300 MHz, respectively. An electro-thermal device (VOL 15 V. Watts 45 W) was used to determine the melting points. The data were uncorrected and represented in °C melting point instrument in open capillanes. Thin-layer chromatography (TLC) on silica gel plates (stationary phase) using specific solvents (mobile phase) and iodine for spot visibility allowed for the observation of the progress of the chemical processes.

### **Preparation of the Compound [M] 2-(1H-benzo[d]imidazol-2-yl)-3-(4-formylphenyl) acrylonitrile**

The compound (M) was prepared by dissolving (0.5gm, 0.0032mol) of benzimidazole derivative add 30ml absolute ethanol and 2ml of 10%NaOH then add the terephthaldehyde (0.4288gm ,0.0032mol) and let the reaction escalate for 12hours [15]. resulting solution was Brown powder, melting point > 175 °C decamp, the physical properties of this compound is listed in Table (1). FTIR (cm<sup>-1</sup>) was 1550 (C=C aroma), 1598(C=C) alkene, 2985(CH Aliph.),3040 (CH aroma),2887(CH aldehyde), 3284(NH),1693(C=O aldehyde), 2243(CN nitrile) . <sup>1</sup>HNMR (δ ppm) were 6.48 (s,1H, CH=C-CN), 7.76-7.49 (m, 4H, Ar-H),10.00(s, 1H, NH), 12.37(H-C=O aldehyde). <sup>13</sup>CNMR (δ ppm) were 152.14(CN-C=CH),147.27(CN-C=CH),182.31 (H-C=O),143.76(C=N endocyclic),121.16(C≡N) and 122.07-132.27. signals of aromatic carbon of ring.

### **Preparation of the Compound [M1] 2-(1H-benzo[d]imidazol-2-yl)-3-(4-((E)-((1,5-dimethyl-3-oxo-2-phenyl-2,3-dihydro-1H-pyrazol-4-yl) imino) methyl) phenyl) acrylonitrile**

The compound (M1) was prepared by dissolving (0.7gm, 0.0026mol) from M compound add 30ml absolute ethanol and three drops of glacial acetic acid, was added to it then (0.5278gm ,0.0026mol) of 4-amino antipyrine the reaction goes up for 15hours [16]. resulting solution was dark brown, melting point 158-156°C, The physical properties of this compound is listed in Table (1). FTIR (cm<sup>-1</sup>) was 1639 (N-C=O.), 1490 (C=C aroma), 1581(C=N imine),1560(C=C) alkene 2200(CN nitrile),3100(CH)alkene, 3066(CH)aroma, 2989-2929(CH Aliph.), 3417(NH), 1178(C-N). <sup>1</sup>HNMR (δ ppm) were 1.41(s,3H,CH<sub>3</sub>),1.89 (s, 3H, N-CH<sub>3</sub>),6.95(s,1H,CH=C-CN),8.67(CH=N imine ), 10.67 (s, 1H, NH) <sup>13</sup>CNMR (δ ppm) were

27.13(CH<sub>3</sub>),29.12(CH<sub>3</sub>-N),157.87(CN=CH),148.06(CN-C=CH),169.64 (C=O),154.77(C=N endocyclic),150.22(C-N=CH),111.55(C≡N),141.69-143.74(C=C-CH<sub>3</sub> endocyclic) and 112.27-130.27. signals of aromatic carbon of ring.

**Preparation of the Compound [M1a] (E)-2-(1H-benzo[d]imidazol-2-yl)-3-(4-(1-(4-bromophenyl)-3-(1,5-dimethyl-3-oxo-2-phenyl-2,3-dihydro-1H-pyrazol-4-yl)-4-oxo-1,3-diazetid-2-yl) phenyl) acrylonitrile**

The compound (M1a) was prepared by dissolving (0.504gm, 0.0011mol) from M1 compound add 30ml absolute ethanol was added to it then (0.2178gm ,0.0011) of 4-bromo phenyl isocyanate the reaction goes up for 16hours [17]. resulting solution was brown, melting point 126-124°, The physical properties of this compound is listed in Table (1). FTIR (cm<sup>-1</sup>) was 1703(C=O azetidine), 1643(C=O Lactam),1544 (C=C aroma), and 1591(C=C)alkene,3116(CH)alkene, 3070(CH)aroma, 3311(NH),740(C-Br),2200(C≡N), <sup>1</sup>HNMR (δ ppm) were 1.78(s,3H,C-CH<sub>3</sub>),1.93(s, 3H, N-CH<sub>3</sub>),6.49(s,1H,CH=C-CN), 11.88 (s, 1H, NH),7.32-7.71(Ar-H),5.32(CH azetidine ring), <sup>13</sup>CNMR (δ ppm) were 25.21(C-CH<sub>3</sub>),29.26(CH<sub>3</sub>-N), 76.27(CH azetidine ring),172.56(C=O azetidine ring),169.17(C=O lactam ),150.74(C-CN=C ),145.42(CN-C=C),152.14 (C=N endocyclic ),142.63(C=C-N ),140.27(N-C=C ),118.65(C≡N,) and 121.54-130.36. signals of aromatic carbon of ring.

**Preparation of the Compound [M1b] (E)-2-(1H-benzo[d]imidazol-2-yl)-3-(4-(1-(1,5-dimethyl-3-oxo-2-phenyl-2,3-dihydro-1H-pyrazol-4-yl)-3-(4-methoxyphenyl)-4-oxo-1,3-diazetid-2-yl) phenyl) acrylonitrile**

The compound (M1b) was prepared by dissolving (0.504gm, 0.0011mol) from M1 compound add 30ml absolute ethanol was added to it then (0.1639gm ,0.0011) of 4-methoxy phenyl isocyanate the reaction goes up for 16hours. resulting solution was black, melting point 95-93°, The physical properties of this compound is listed in Table (1). FTIR (cm<sup>-1</sup>) was 1701(C=O azetidine ring) ,1639(C=O lactam), 1546 (C=C aroma), and,1610(C=C) alkene,1546(C=C aroma) 2220(C-N),3142(CH)alkene, 3061(CH)aroma, 2985-2837(CH Aliph.),3294(NH).

### **Preparation of the Compound [M2] N'-((E)-4-(2-(1H-benzo[d]imidazol-2-yl)-2-cyanovinyl) benzylidene) benzohydrazid**

The compound (M2) was prepared by dissolving (0.3563gm, 0.0013mol) from M compound add 25ml absolute ethanol Add three drops of glacial acetic acid, was added to it then (0.1781gm ,0.0013mol) from Nicotinic hydrazide the reaction goes up for 17hours. resulting solution was dark brown, melting point >223- decomp□, The physical properties of this compound is listed in Table (1). FTIR (cm<sup>-1</sup>) was 1670(C=O.amide), 1411 (C=C aroma), and,1530 (C=C) alkene 2200(C-N),1556 (C=N Schiff's base), 3057(CH)aroma, 3286(NH)amide ,3415(NH)Imidazole. <sup>1</sup>HNMR (δ ppm) were 6.68(s,1H, CH=C-CN), 7.64-7.23 (m, 4H, Ar-H),8.53(CH=N), 11.33 (s, 1H, O=C-NH amide),11.95(s,1H, NH) Imidazole. <sup>13</sup>CNMR (δ ppm) were 168.12(O=C-NH amide), 159.06(C=N endocyclic),151.25(C=N pyridine ring), 156.03(C=N Schiff's base),145.97 (CH=C-CN),143.04 (CH=C-CN),116.63(CN nitrile) and 121.04-130.25 signals of aromatic carbon of ring.

### **Preparation of the Compound [M2a] N-(2-(4-(2-(1H-benzo[d]imidazol-2-yl)-2-cyanovinyl) phenyl)-3-(4-bromo phenyl)-4-oxo-1,3-diazetid-1-yl) isonicotinamide**

The compound (M2a) was prepared by dissolving (0.215gm, 0.0005mol) from M2 compound add 25ml absolute ethanol, was added to it then (0.099gm ,0.0005mol) from 4-bramo phenyl iso cyanate the reaction goes up for 16hours. resulting solution was Light brown, melting point 175-173□, The physical properties of this compound is listed in Table (1). FTIR (cm<sup>-1</sup>) was 1701(C=O azetidine) , 1670(C=O amide ) 1550 (C=C aroma), and,1589(C=C) alkene 2220(CN nitrile ), 3055(CH)aroma, 3282(NH)amide ,3417 (NH ) Imidazole <sup>1</sup>HNMR (δ ppm) were 6.96(s,1H,CH=C-CN), 7.98-7.52 (m, 4H, Ar-H),5.36(CH-N azetidine ring ), 11.36 (s, 1H, O=C-NH amide ),11.76(s,1H,NH)Imidazole. <sup>13</sup>CNMR (δ ppm) were171.75 (C=O azetidine ring), 168.06(C=O amide), 158.04(C=N endocyclic) ,152.71(C=N pyridine ring), 150.97 (CH=C-CN),147.97 (CH=C-CN),117.65(CN nitrile),73.38(CH-N azetidine ring), and 121.04-131.42 signals of aromatic carbon of ring.

### **Preparation of the Compound [M2b] N-(2-(4-(2-(1H-benzo[d]imidazol-2-yl)-2-cyanovinyl) phenyl)-3-(4-methoxyphenyl)-4-oxo-1,3-diazetid-1-yl) isonicotinamide**

The compound (M2b) was prepared by dissolving (0.21gm, 0.00054mol) from M2 compound Add 25ml absolute ethanol, are added to it then (0.0801gm ,0.00054mol) from 4-methoxy phenyl iso cyanate the reaction goes up for 15hours. resulting solution was light yellow, melting point 75-73 $^{\circ}$ C, The physical properties of this compound is listed in Table (1). FTIR ( $\text{cm}^{-1}$ ) was 1701(C=O azetidine ring), 1610(C=O amide) 1448 (C=C aroma), and,1541(C=C) alkene 2220(CN nitrile), 3051(CH)aroma, 3126(NH)amide ,3319(NH)Imidazole, 3051(CH aroma),2918-2839(CH aliph).  $^1\text{H}$ NMR ( $\delta$  ppm) were 3.39(s,3H, OCH<sub>3</sub>),5.13(s,1H, CH azetidine ring), 6.00(s,1H, CH=C-CN), 7.41-7.69 (m, 4H, Ar-H), 11.36 (s, 1H, O=C-NH amide) ,11.85(s,1H, NH) Imidazole.  $^{13}\text{C}$ NMR ( $\delta$  ppm) were 57.38(OCH<sub>3</sub>),73.38(CH azetidine ring), 116.69(CN nitrile),171.77(C=O azetidine ring), 168.38(C=O amide), 158.04(C=N endocyclic),154.27(C=N pyridine ring), 148.12 (CH=C-CN carbon nitrile),131.45 (CH=C-CN),117.65(C-N),73.38(CH-N Quadruple ring), and 121.04-131.26 signals of aromatic carbon of ring .

**Table 1. Physical characteristics of prepared compounds**

Comp. No	M.Wt g/mol	Color	m.p $^{\circ}$ C	Yield %	R <sub>f</sub> E\B
M	273	Brown powder	>175 decamp	77%	0.81
M1	458	dark brown	158-156 $^{\circ}$ C	85%	0.83
M1a	663	Brown	126-124 $^{\circ}$ C	91%	0.95
M1b	607	Black	95-93 $^{\circ}$ C	59%	0.87
M2	392	dark brown	>223 $^{\circ}$ C decomp	90%	0.92
M2a	590	Light brown	175-173 $^{\circ}$ C	92%	0.90
M2b	541	dark yellow	75-73 $^{\circ}$ C	66%	0.91

B /E= Ethanol/Benzene (3:2)

## 2.2. Antibacterial Agent

The Mueller-Hinton agar culture medium was made following the guidelines of the Indian business Biomarker Laboratories by dissolving 38 grams of the medium in 1 liter of distilled water in a glass flask. The solution was boiled in a water bath till the agar was entirely dissolved. The culture media was subsequently sterilized in an autoclave at 15 psi and 121°C for 15 minutes. The solution was thereafter put onto sterilized glass Petri plates and allowed to cool at a rate of 15-20 ml per dish. The plates were then incubated for 24 hours at a temperature of 37°C.

Solutions were formulated for select compounds to assess their biological efficacy against two bacterial strains, using doses of 0.125, 0.25, 0.5, and 1 µg/ml for each drug, dissolved in 5 ml of the solvent (DMSO). The bacteria were inoculated onto the surface of the culture medium (Mueller-Hinton Agar) utilizing a loopful, and 4 holes, each with a 9 mm diameter, were created in the plates using a cork borer sanitized with alcohol. The precaution was taken to maintain an appropriate spacing between each hole to prevent the overlap of inhibition zones. The generated solutions were administered into these wells at a volume of 0.1 ml utilizing a micropipette and incubated at 37°C for 24 hours. The diameter of the inhibitory zone of the compounds was later measured utilizing a millimeter ruler.

## 3. RESULTS AND DISCUSSION

1,3-Diazetidone derivatives were synthesized for the current investigation, and they were then characterized spectrally using FTIR, H-NMR, and <sup>13</sup>C-NMR spectra for some of them. Other analyses included Antibacterial assessment and melting points.

### 3.1. Spectral Investigation

The compounds were synthesized according to the chemical procedures outlined in Scheme 1. By the of 2-(1H-benzo[d]imidazol-2-yl)acetonitrile with terephthalaldehyde presence of 10%NaOH and absolute ethanol to form a compound [M] The compound (M) was observed by FT-IR spectroscopy, where the spectrum of the compound showed absorption bands. 1550 (C=C aroma), 1598(C=C) alkene, 2985(CH Aliph.),3040 (CH aroma),2887(CH aldehyde), 3284(NH),1693(C=O aldehyde), 2243(CN nitrile) . <sup>1</sup>HNMR (δ ppm) were 6.48 (s,1H, CH=C-CN), 7.76-7.49 (m, 4H, Ar.-H),10.00(s, 1H, NH), 12.37(H-C=O aldehyde). <sup>13</sup>CNMR (δ ppm) were 152.14(CN-C=CH),147.27(CN-C=CH),182.31 (H-C=O),143.76(C=N endocyclic),121.16(C≡N) and 122.07-132.27. signals of aromatic carbon of ring.

This research used a new derivative of Schiff base to form an imidazole derivative which reacted with 4-aminoantipyrine to form [M1] compound . Where we notice in the infrared

spectrum(FTIR) the disappearance of the aldehyde group and the formation of the imine group, where the lactam group appears  $1639\text{cm}^{-1}$  (N-C=O amide) and  $1581$  (Schiff base).  $^1\text{H}$ NMR ( $\delta$  ppm) were  $1.41$ (s,3H,CH<sub>3</sub>),  $1.89$  (s, 3H, N-CH<sub>3</sub>),  $6.95$ (s,1H,CH=C-CN),  $8.67$ (CH=N),  $10.67$  (s, 1H, NH)  $^{13}\text{C}$ NMR ( $\delta$  ppm) were  $152.14$ (CN-C=CH),  $147.27$ (CN-C=CH),  $182.31$  (H-C=O),  $143.76$ (C=N endocyclic), and  $122.07$ - $132.27$ . signals of aromatic carbon of ring.

While the compound M1a was identified in the FTIR spectrum upon the addition of 4-bromo phenyl iso cyanate it showed a azetidine ring and the disappearance of the Schiff base, as the spectrum gave a group  $1703$  (C=O azetidine),  $1643$ (C=O Lactam),  $3311$ (NH),  $740$ (C-Br),  $^1\text{H}$ NMR ( $\delta$  ppm) were  $1.78$ (s,3H,C-CH<sub>3</sub>),  $1.93$ (s, 3H, N-CH<sub>3</sub>),  $6.49$ (s,1H,CH=C-CN),  $11.88$  (s, 1H, NH),  $7.32$ - $7.71$ (Ar.-H),  $5.32$ (CH azetidine ring),  $^{13}\text{C}$ NMR ( $\delta$  ppm) were  $25.21$ (C-CH<sub>3</sub>),  $29.26$ (CH<sub>3</sub>-N),  $76.27$ (CH azetidine ring),  $172.56$ (C=O azetidine ring),  $169.17$ (C=O lactam),  $150.74$ (C-CN=C),  $145.42$ (CN-C=C),  $152.14$  (C=N pentagram),  $142.63$ (C=C-N),  $140.27$ (N-C=C), and  $121.54$ - $130.36$  signals of aromatic carbon of ring

The compound M1b was identified in the FTIR spectrum upon the addition of 4-methoxyphenyl iso cyanate, it showed a azetidine ring and the disappearance of the Schiff base, as the spectrum gave a group  $1701$ (N-C=O) azetidine ring,  $1639$ (N-C=O) lactam,  $3294$ (NH) Returns to the imidazole

The M2 compound was observed in the FTIR spectrum where the spectrum showed absorption bands at the frequency  $1670$ (N-C=O) Back to the amide group.  $1565$ (C=N) Schiff base,  $3286$ (NH) amide,  $3415$ (NH imidazole) Returns to the imidazole five-ring.  $1670$ (N-C=O) amide.  $^1\text{H}$ NMR ( $\delta$  ppm) were  $6.68$ (s,1H, CH=C-CN),  $7.64$ - $7.23$  (m, 4H, Ar-H),  $8.53$ (CH=N),  $11.33$  (s, 1H, O=C-NH amide),  $11.95$ (s,1H, NH) Imidazole.  $^{13}\text{C}$ NMR ( $\delta$  ppm) were  $^{13}\text{C}$ NMR ( $\delta$  ppm) were  $168.12$ (O=C-NH amide),  $159.06$ (C=N endocyclic),  $151.25$ (C=N pyridine ring),  $156.03$ (C=N Schiff's bases), and  $121.04$ - $130.25$  signals of aromatic carbon of ring.

Note in the compound M2a the disappearance of the Schiff base and the formation of a tetracyclic ring upon the addition of 4-bromophenyl azocyanate and imidazole hardness, as the FTIR spectrum gave bands group  $1701$ (N-C=O) tetra lactam,  $1670$ (N-C=O) amide,  $1550$  (C=C aroma), and  $1589$ (C=C) alkene  $2220$ (C-N),  $3061$ (CH) aroma,  $2985$ - $2835$ (CH Aliph.),  $3055$ (CH aroma),  $3417$ (NH) Returns to the imidazole,  $3282$ (NH) amide.  $^1\text{H}$ NMR ( $\delta$  ppm) were  $6.96$ (s,1H, CH=C-CN),  $7.98$ - $7.52$  (m, 4H, Ar.-H),  $5.36$ (CH-N azetidine ring),  $11.36$  (s, 1H, O=C-NH amide),  $11.76$ (s,1H, NH) Imidazole.  $^{13}\text{C}$ NMR ( $\delta$  ppm) were  $171.75$  (O=C-N azetidine ring),  $168.06$ (O=C-N amide),  $158.04$ (C=N endocyclic),  $152.71$ (C=N

pyridine ring), 150.97 (CH=C-CN),147.97 (CH=C-CN),117.65(C-N),73.38(CH-N azetidine ring), and 121.04-131.42 signals of aromatic carbon of ring

As for the M2b compound, it gave a spectrum when the Schiff base derivative was reacted with 4-methoxyphenyl azocyanate, where he noticed the disappearance of the Schiff base and the formation of a azetidine ring, where the carbonyl group of the azetidine ring appeared at the frequency group 1701(C=O azetidine ring), 1610(C=O amide) 1448 (C=C aroma), and,1541(C=C) alkene 2220(CN nitrile), 3051(CH)aroma, 3126(NH)amide, 3319(NH)Imidazole, 3051(CH aroma),2918-2839(CH aliph). <sup>1</sup>HNMR ( $\delta$  ppm) were 3.39(s,3H, OCH<sub>3</sub>),5.13(s,1H, CH azetidine ring), 6.00(s,1H, CH=C-CN), 7.41-7.69 (m, 4H, Ar.-H), 11.36 (s, 1H, O=C-NH amide) ,11.85(s,1H, NH) Imidazole. <sup>13</sup>CNMR ( $\delta$  ppm) were 57.38(OCH<sub>3</sub>),73.38(CH azetidine ring), 116.69(CN nitrile),171.77(C=O azetidine ring), 168.38(C=O amide), 158.04(C=N endocyclic),154.27(C=N pyridine ring), 148.12 (CH=C-CN carbon nitrile),131.45 (CH=C-CN),117.65(C-N),73.38(CH-N Quadruple ring), and 121.04-131.26 signals of aromatic carbon of ring .



### SCHEME 1. Preparation of 1,3-Diazetidene-2-one derivatives

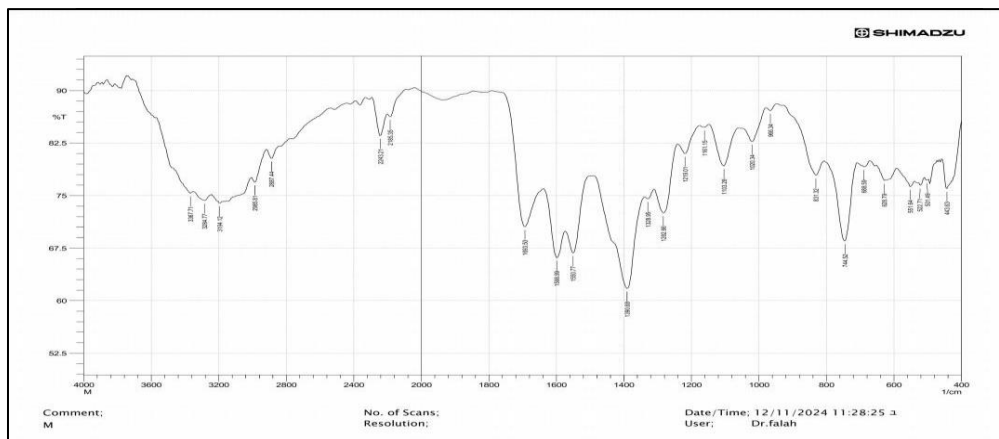


FIGURE 1. FT-IR of compound M

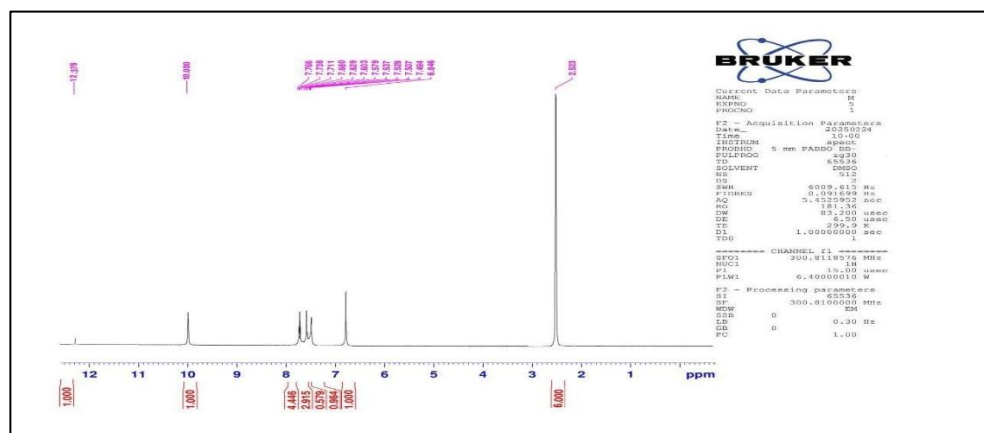


FIGURE 2. <sup>1</sup>H-NMR Spectra of M

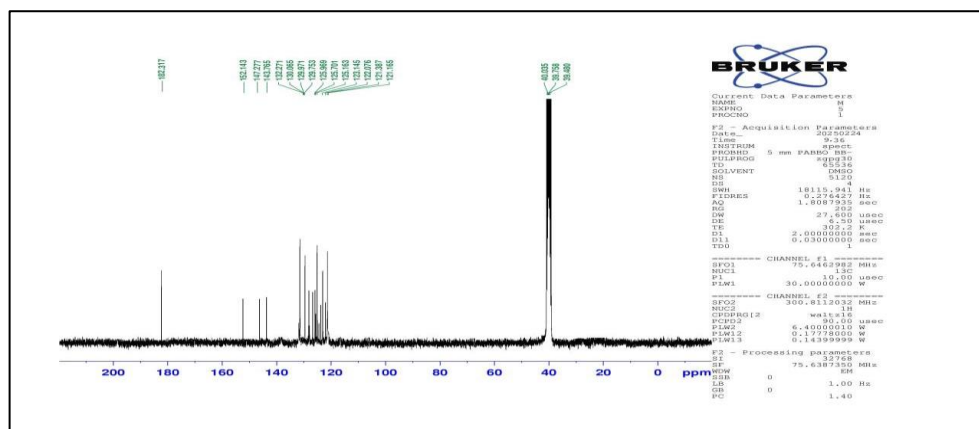


FIGURE 3. <sup>13</sup>C-NMR Spectra of M

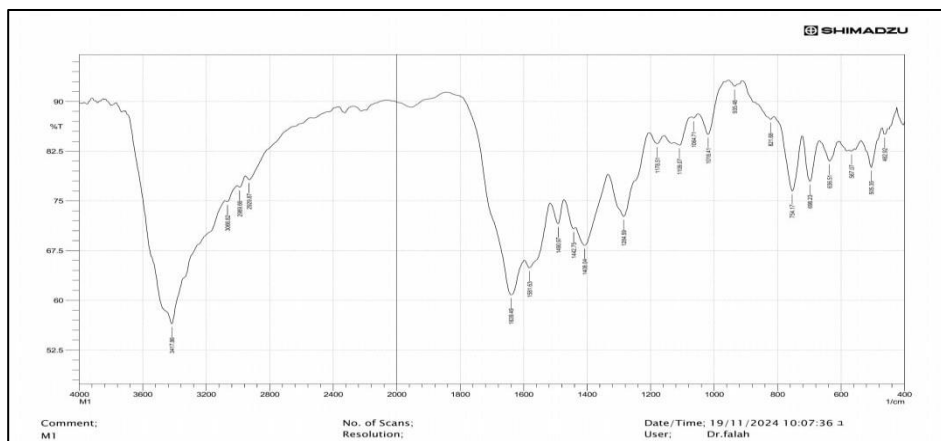


FIGURE 4. FT-IR of compound M1

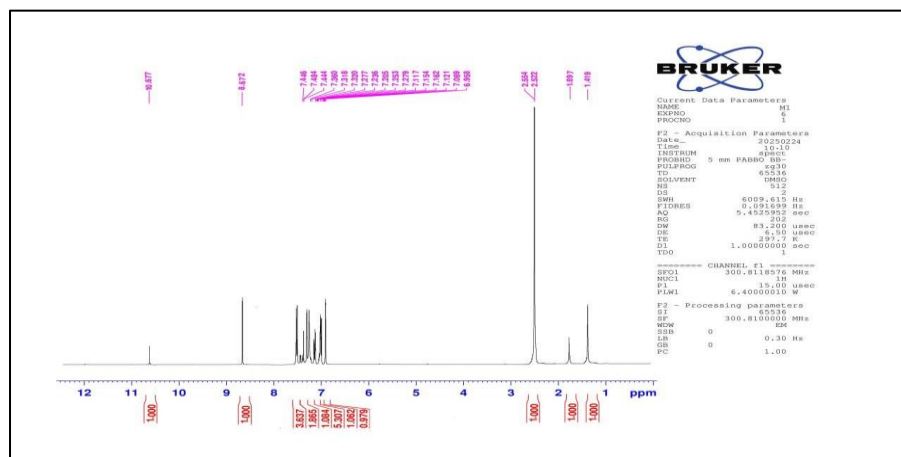


FIGURE 5. <sup>1</sup>H-NMR Spectra of M1

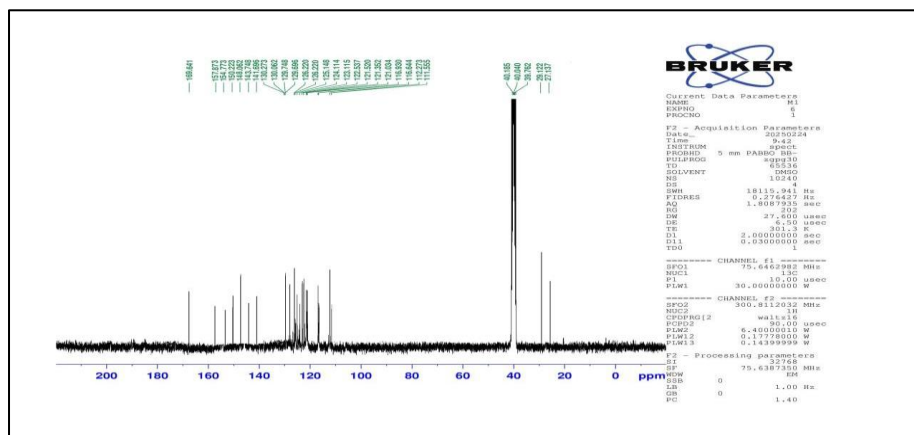


FIGURE 6. <sup>13</sup>C-NMR Spectra of M1

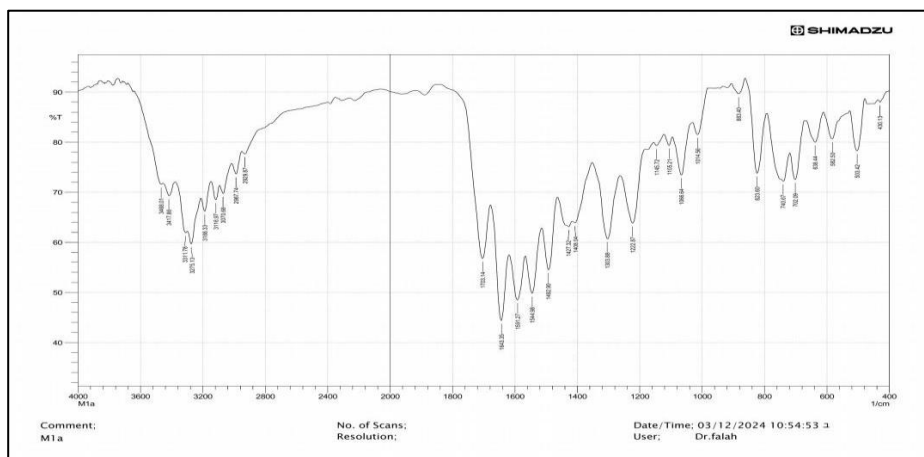


FIGURE 7. FT-IR of compound M1a



FIGURE 10. FT-IR of compound M1b

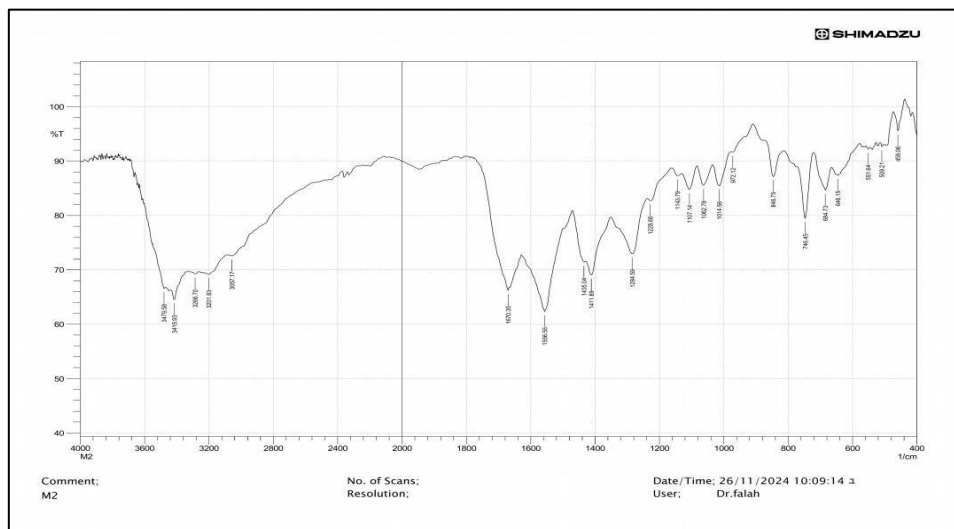


FIGURE 13. FT-IR of compound M2

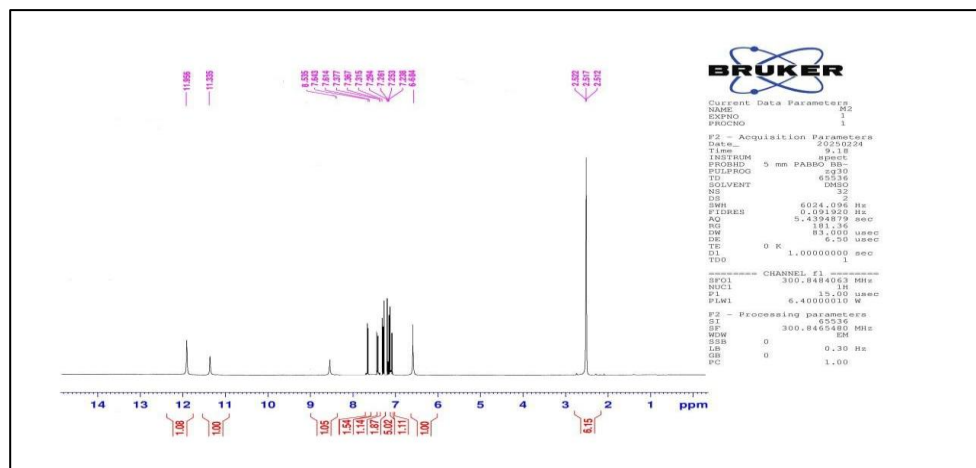


FIGURE 14. <sup>1</sup>H-NMR Spectra of M2

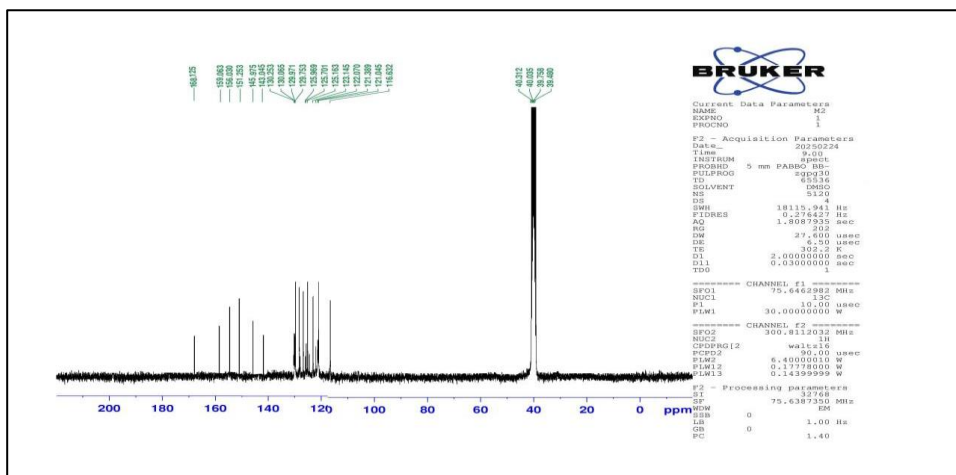


FIGURE 15. <sup>13</sup>C-NMR Spectra of M2

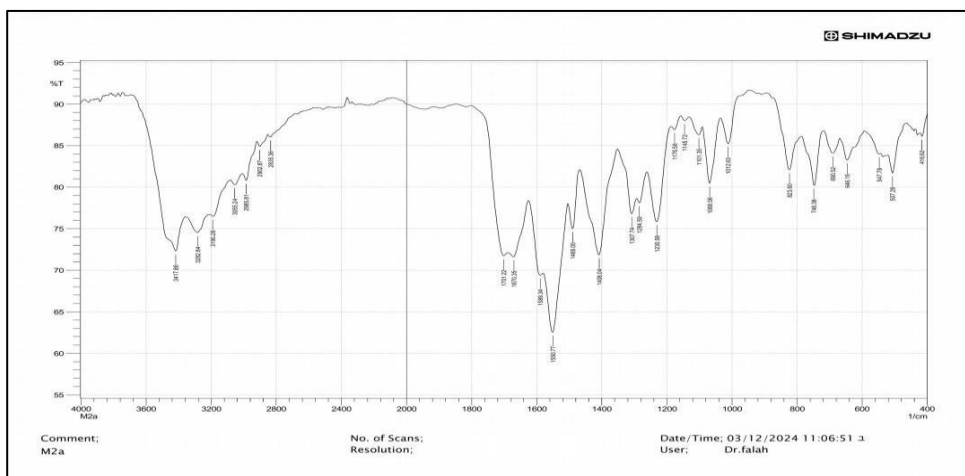


FIGURE 16. FT-IR of compound M2a

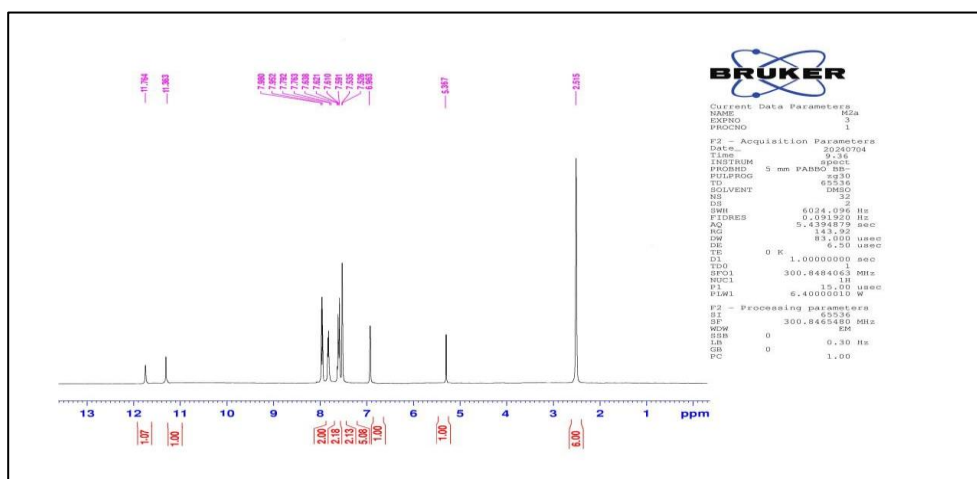
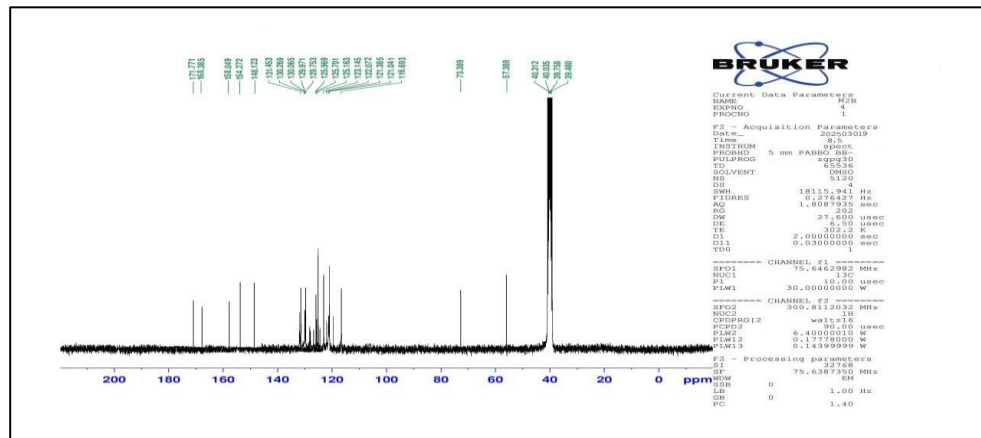


FIGURE 17. <sup>1</sup>H-NMR Spectra of M2a



FIGURE 15.  $^{13}\text{C}$ -NMR Spectra of M2b

## 4. Biological activity:

### 4.1. Antibacterial activity

The biological activity of all the prepared compounds was studied at the Al-Amin Center for Advanced Biotechnology and Research, Holy Shrine of Imam Ali.

The microbiological activity of the prepared compounds was presented against two types of isolated pathogenic bacteria, the Gram-negative bacteria *Acinetobacter baumannii* and the Gram-positive bacteria *Staphylococcus aureus*, as it is believed that the selected bacteria are the most dangerous and deadly. After biological presentation, the prepared compounds showed superior effectiveness against the bacterial strains. The effectiveness depended on the concentration as shown in Table (2). The compounds (M1a) gave the highest inhibition against the Gram-positive bacteria *Staphylococcus aureus* by 26 mm compared to the prepared compounds. The highest and most important inhibition was also observed against the Gram-negative bacteria *Acinetobacter baumannii*. The compound M1 inhibited 23 mm. This effect is attributed to the compounds containing more heteroatoms that have electron density in azetidine ring.

**Table 2. Antibacterial Activity of Synthetic Compounds**

Mate	Con. ( $\mu\text{g. mL}$ )	<i>A. B</i>	<i>Staph.</i>
M	1	21	24

	0.5	16	17
	0.25	12	13
	0.125	0	10
M1	1	23	24
	0.5	15	18
	0.25	11	13
	0.125	0	11
M1a	1	22	26
	0.5	18	20
	0.25	14	16
	0.125	11	11
M2	1	21	28
	0.5	15	22
	0.25	10	18
	0.125	0	13
M2a	1	26	29
	0.5	19	21
	0.25	14	16
	0.125	0	12

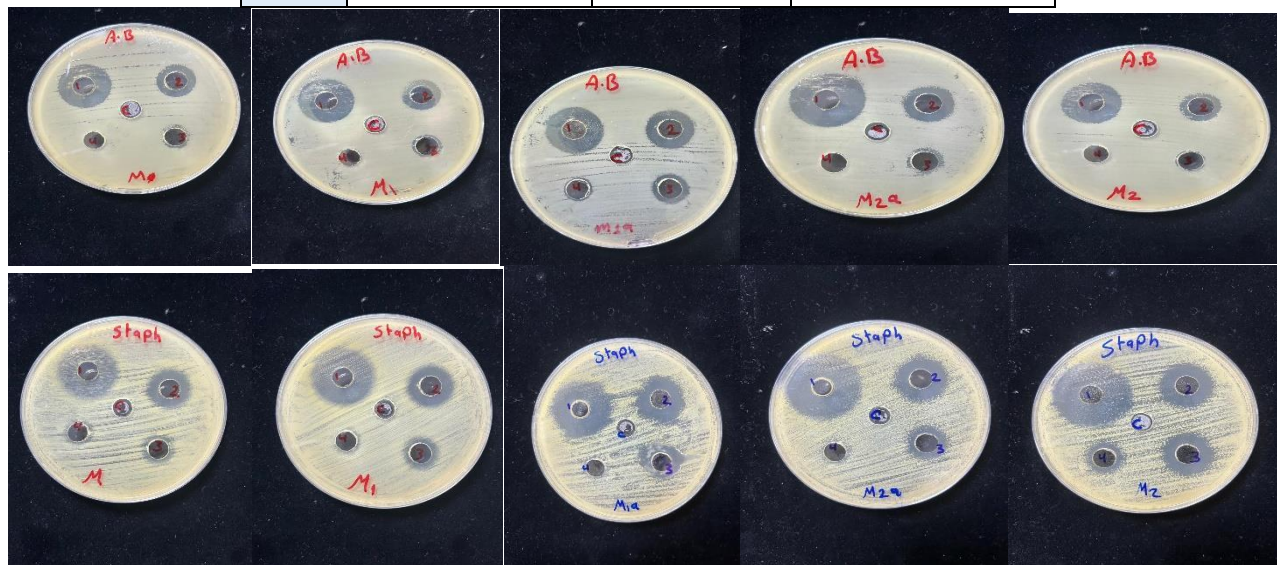
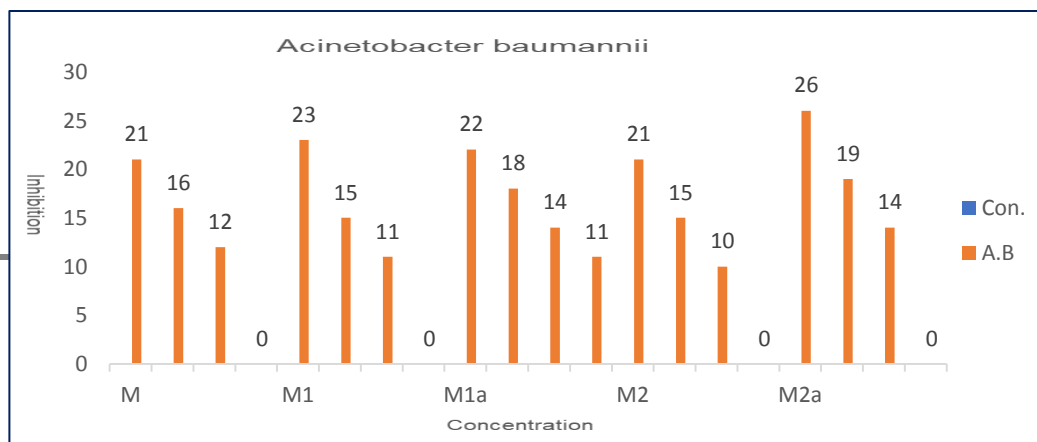
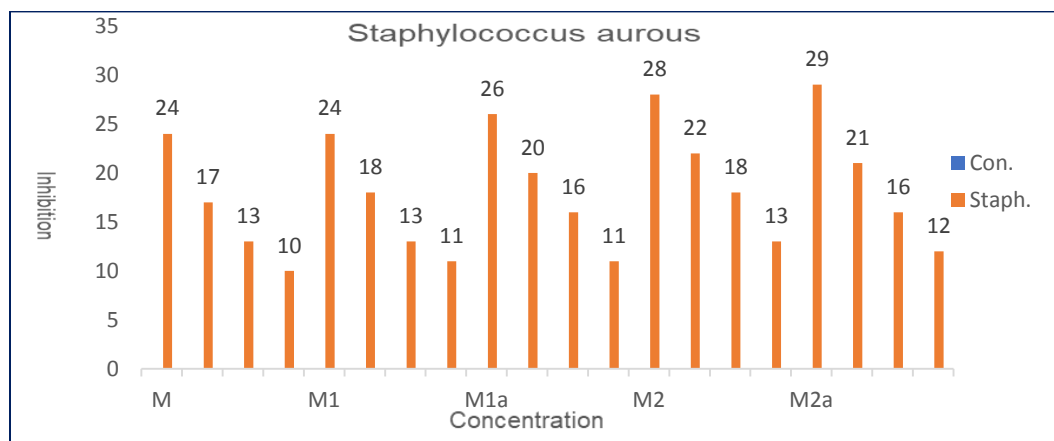


FIGURE: 20. Antibacterial evaluation of prepared compounds



**FIGURE 21: Antibacterial Evaluation of prepared compounds against***Acinetobacter baumannii***FIGURE 22: Antibacterial Evaluation of prepared compounds against***Staphylococcus Aurous***References**

1. Khitam T. A., (2017), Preparation Some New Heterocyclic Compounds Derived from Schiff Bases and Evaluation its Biological Activity. *Int. J. Sci. Res.*, 6 (5):1567-1573.
2. S.A. Dalia, F. Afsan, M.S. Hossain, M.N. Khan, C. Zakaria, M.-E. Zahan, M. Ali, (2018), A short review on chemistry of Schiff base metal complexes and their catalytic application, *International Journal of Chemical Studies*, 6, 2859-2867.
3. G. Nagesh, B. Mruthyunjayaswamy, (2015), Synthesis, characterization and biological relevance of some metal (II) complexes with oxygen, nitrogen and oxygen (ONO) donor Schiff base ligand derived from thiazole and 2-hydroxy-1-naphthaldehyde, *Journal of Molecular Structure*, 1085, 198-206.
4. M. Ahmed, M.A. Qadir, M.I. Shafiq, M. Mudassar, Z.Q. Samra, A. Hameed, (2019), Synthesis, characterization, biological activities and molecular modeling of Schiff bases of benzene sulfonamides bearing curcumin scaffold, *Arabian journal of chemistry*, 12, 41-53.

5. B.S. Creaven, E. Czeglédi, M. Devereux, É.A. Enyedy, A.F.-A. Kia, D. Karcz, A. Kellett, S. McClean, N.V. Nagy, A. Noble, (2010), Biological activity and coordination modes of copper (II) complexes of Schiff base-derived coumarin ligands, *Dalton Transactions*, 39, 10854-10865.
6. S.K. Bharti, S.K. Patel, G. Nath, R. Tilak, S.K. Singh, (2010), Synthesis, characterization, DNA cleavage and in vitro antimicrobial activities of copper (II) complexes of Schiff bases containing a 2, 4-disubstituted thiazole, *Transition Metal Chemistry*, 35, 917-925.
7. Hossain, M., & Nanda, A. K., (2018), A review on heterocyclic: Synthesis and their application in medicinal chemistry of imidazole moiety. *Science*, 6(5), 83- 94.
8. Gaybullayevna S. G., (2022), HETEROCYCLIC COMPOUNDS THAT ARE IMPORTANT IN MEDICINE //TA'LIM VA RIVOJLANISH TAHLILI ONLAYN ILMIIY JURNALI. – T. 2. – №. 4. – C. 209-213
9. Kayumovna D. M., Gaybullayevna S. G., (2022), CHEMICAL PROCESSES IN THE SYNTHESIS OF BIOLOGICALLY ACTIVE IMPORTANT COMPOUNDS //TA'LIM VA RIVOJLANISH TAHLILI ONLAYN ILMIIY JURNALI. – T. 2. – №. 4. – C. 248-252.
10. Sadullayeva G. G., Rakhmatov S. B., (2022), AMPEROMETRIC METHOD OF ANALYSIS AND ITS ADVANTAGES OVER OTHER METHODS //INTERNATIONAL JOURNAL OF RESEARCH IN COMMERCE, IT, ENGINEERING AND SOCIAL SCIENCES ISSN: 2349-7793.
11. Sadullayeva G. G., Karimova S. A., (2022), ERITMALAR KONSENTRATSIYASINI IFODALASH BO'YICHA MASALALAR YECHISH USULLARI //Oriental renaissance: Innovative, educational, natural and social sciences, 909-915.
12. SAFAROVA N., (2021), Application of Interactive Methods in Medical Education: Clustering Technique in Teaching of Heterocyclic Compounds //Proceedings of the 37th International Business Information Management Association (IBIMA) , 30-31.
13. Ashish, B., Pandeya, S., (2011), Various approaches for synthesis of imidazole derivatives. *Int. J. Res. Ayurveda and Pharmacy*, 2(4): 1124-29
14. Vessally, E.; Soleimani-Amiri, S, Hosseinian, A, Edjlalid, L, Bekhradnia, A.; (2017), New protocols to access imidazole and their ring fused analogues: synthesis from N-propagylamines, *RSC Adv.*, 7, 7079.
15. Leena, S., Ajaykumar, R., N., (2021). Novel Methods of Knoevenagel Condensation, *Journal of Scientific Research*, 65(8), 38-41.

16. Mohsein, H. F., Jaffer, N. D., Hassen, H. S., & Kadhim, A. A. (2022). Synthesis, Characterization and Anticancer Assessment of New Nitrogen-Cyclic Compounds. *Egyptian Journal of Chemistry*, 65(3), 571-579.
17. Al-Sultani, K. T., & Al-Lami, N. (2021). Antimicrobial activity of new synthesized aza-beta lactam and tetrazole derivatives bearing imidazole [2, 1-b] benzothiazole moiety. *Egyptian Journal of Chemistry*, 64(6), 2953-2961.