RESEARCH ARTICLE

Synthesis, Characterization and Study Biological Activity of Five and Seven Heterocyclic Compounds

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ABSTRACT

The compound 3-((1-(naphthalene-2-yl) ethylidene) amino)-2-thioxo-imidazolidin–4-one [II] was prepared from the cyclization of 2-(1-(naphthalen-2-yl) ethylidene) hydrazine-1-carbothioamide [I] with ethyl α-chloroacetate in the presence of fused CH_3COONa. The new 2-thioxo-imidazlidin-4-one derivatives containing heterocyclic unit, five, and seven-member ring were successfully formed, such as imidazoline-4-one, tetrazole, thiazolidin-4-one, and 1,3-oxazepinerings. The synthesized derivatives were characterized by their fourier-transform infrared spectroscopy (FTIR), ^{1}H-NMR, mass spectra, and CHN-S. Furthermore, the synthesized compounds have been screened for their antibacterial activity against *E.col (G-), Staph. Aureus (G+), and Bacillus cereus(G+)*, and compared to Ampicillin, Amoxicillin, and Lincomycin as antibiotic standards.

Keywords: 2-thioxo-imidazolidine-4-ones, 1,3-oxazepine, Antibacterial activities, Cycloaddition reaction, Imidazolidin-4-one, Tetrazole, Thiazolidin-4-one.

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INTRODUCTION

In the recent years, there has been considerable interest in the chemistry of 2-thioxo-imidazolidin-4-one and its derivatives because it has a broad range of biological and pharmacological properties such as antidiabetic activity, anti-microbial activity, anti-fungal, anti-inflammatory, antitumor, anti-HIV activity.[1-4] Imidazol-4-ones can also be regarded as cyclic amine and used by way of antimicrobial, anticancer, antioxidant, anti-inflammatory, antifungal, and potent anticonvulsant agents. Also, imidazole-4-one derivatives are widely used as intermediates in the synthesis of organic target compounds including pharmaceuticals, dyes, photographic chemicals.[5-7] Tetrazole derivatives attracted interest because of their individual structure and their uses as antibiotics, antiallergics, or in the synthesis of growth hormone Leukotriene D4 (LTD4).[8,9] It is well known that thiazolidin-4-one derivatives possess a wide range of pharmacological activities, and some of them considered as central nervous system potential agents.[10-12] Finally, the presence of 1,3-oxazepine, which constitutes a non-homologous seven member ring, that contains O-in position-1 and N-in position-3 in different structures leads to diversified applications in different areas such as in the medical field. In particular, their apoptosis proteins (IAPs) inhibitor activity, which led to using them in the treatment of cancer. Studies on the synthesis and biological activity of 1,3-oxazepine derivatives developed by many scientists around the globe are reported in the literature.[13-18] Prompted by these observations, we synthesized and characterized new compounds containing imidazolidin-4-one, tetrazole, thiazolidin-4-one, and 1, 3-oxazepine units in the same molecule of 2-thioxo-imidazolidin-4-one and investigate their antibacteiral activity so some of them could be used as drugs in the future.

EXPERIMENTAL

Material

The chemicals were purchased from Sigma-Aldrich, Fluke, and GCC Chemicals company. The FTIR spectrums were recorded using potassium bromide discs on Shimadzo (Ir prestige-21) Fourier Transform Infrared Spectrometer. ^{1}HNMR spectra were recorded on Bruker, Ultra Shield (300)MHz, Switzerland (Gazi University-Turkey). Elemental analysis was carried out using an EuroEA Elemental Analyzer, and the mass spectrum was recorded using Agilent 6490 Triple Quadrupole LC/MS (Q)-TOF Mass spectrometer (Gazi University-Turkey). Purities of derivatives compounds were checked with (Silica gel TLC)-Merck. The antibacterial activity was performed in the Center for Market Research and Consumer Protection, University of Baghdad.

General Synthetic Procedures

All compounds [I-VIII$_{a-c}$]were synthesized depending on Scheme 1:

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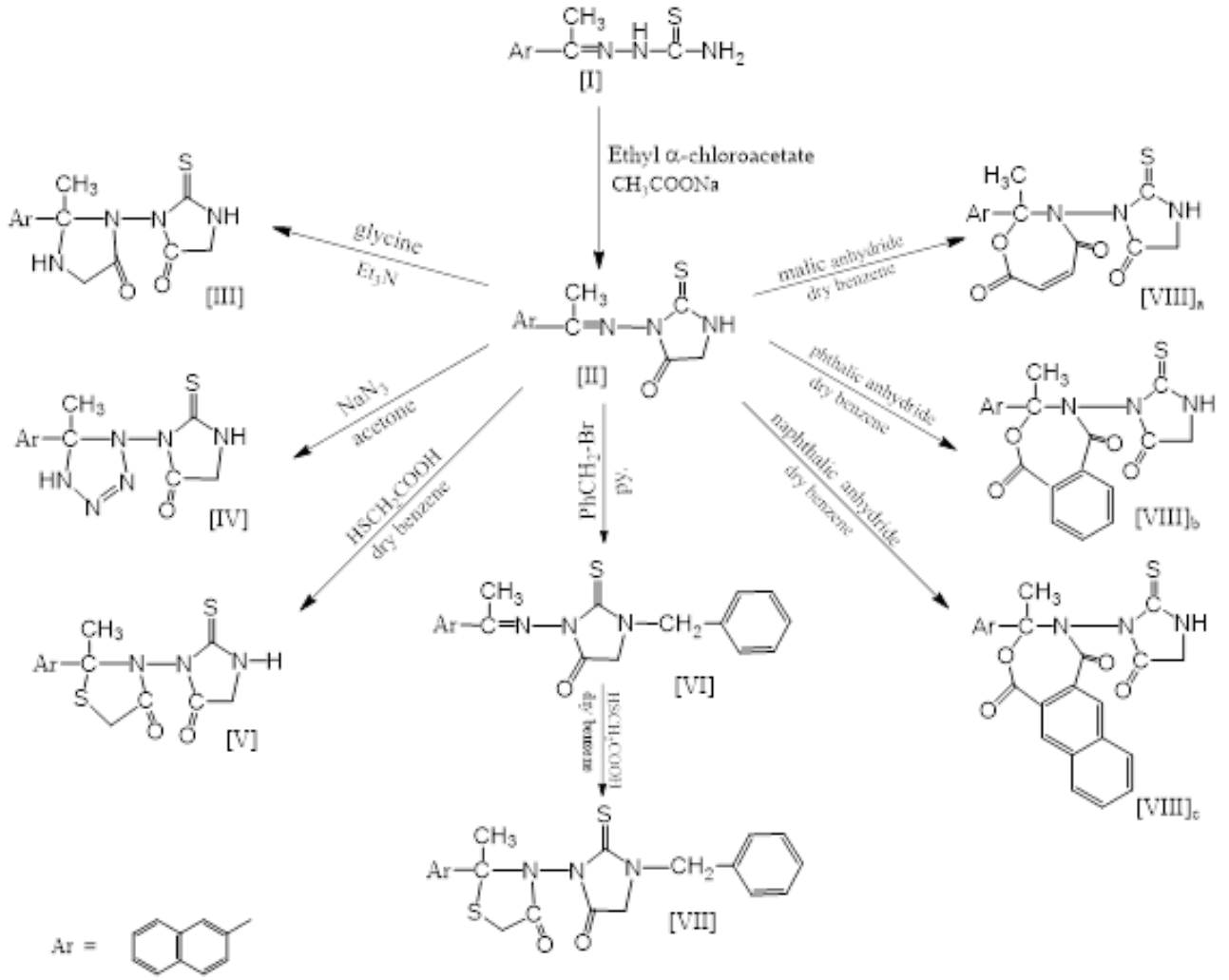


Scheme 1: The synthetic route for target derivatives[I]-[VIII]$_{a-c}$

Preparation of 2-(1-(naphthalen-2-yl) ethylidene) hydrazine-1- carbothioamide [I]

This compound [I]was prepared following the procedure described by Lit. [19]. yield 82%, m.p158^{0}C.

Synthesis of 3-((1-(naphthalen-2-yl) ethylidene)amino)-2-thioxo-imidazolidin–4-one [II]

A mixture of compound [I] (2.43g,0.01mol), ethyl-α chloroacetate (0.01mol) and fused acetate (0.03mole) in (20mL) C_2H_5OH was refluxed for 4hrs,2 then poured into ice-water. The resulting pale beige solid was filtered off, washed with cold water, dried and recrystallized by ethanol to give derivative [II]. Yield 80%, m.p 201-203^{0}C. FTIR (υ,cm^{-1}): 3138 (NH), 3061 (C-H arom.), 2852 (CH aliph.), 1707 (C=O), 1614 (C=N), 1573-1556 (C=C aromatic), and 1242(C=S). ^{1}HNMR(δ ppm): 2.08(s,3H, CH_3), 3.89 (s, 2H, CH_2CO), 7.51-8.80 (m, 7H, Ar-H), 12.01(s,1H, NH), tautomeric with SH in the 2-thioxo-imidazolidin-4-one ring.

Synthesis of 2-methyl-2-(naphthalen-2-yl)-2'-thioxo-[1,1'-biimidazolidine]-5,5'-dione [III].

A mixture of derivative [II] (2.83g,0.01mol), glycine (0.01mol) and trimethylamine (1mL) in C_2H_5OH (10mL) was refluxed for 9 hours,[5] the reaction mixture was neutralized with (10%) diluted hydrochloric acid. The resulting yellow solid was filtered off, washed, dried to give a new compound [III], yield 73%, m.p 190-192 ^{0}C. ; FTIR (ν,cm^{-1}): 3207, (NH), 3057 (C-H arom.), 2972-2886 (C-H aliph.), 1720, 1681 (C=O imidazolidin-4-one), 1224 (C=S), and 1234 (C-N); ^{1}H NMR (δ ppm): 2.08 (s,3H, CH_3), 3.35 (s,2H, CH_2-CO), 3.95 (s,2H,CH_2-CO), 7.54-8.38 (m,7H,Ar-H),12.02(s,1H,NH); Ms: m/z 340.1 (10), 341.1 (18.1), 263.09 (100); Elemental analysis: Calcd. for $C_{17}H_{16}N_4O_2S$: C,60.00; H,4.70; N,16.47; S, 9.41; Found: C, 60.34; H, 4.46; N, 16.82; S, 9.76%.

Synthesis of 3-(5-methyl-5-(naphthalen-2-yl)-4,5-dihydro-1H-tetrazol-1-yl)-2-thioxoimidazolidin-4-one [IV].

A mixture of compound [II](2.83g, 0.01 mol) and sodium azide (0.01 mol) in dry acetone (25mL) and refluxed for 3hrs.18 The soild precipitate was filtered washed to give derivative [IV].The resulting beige white solid; yield 44%, m.p212-214^{0}C.; FTIR (ν,cm^{-1}): 3207, (NH), 3057 (C-Harom.), 2972-2886 (C-Haliph.), 1728(C=O, 1224 (C=S), and 1342 (C-N); ^{1}HNMR (δ ppm): 2.47 (s, 3H, CH_3), 3.32 (s,2H, CH_2-CO), 7.55-8.31 (m,7H,Ar-H),12.00(s,1H,NH); Elemental analysis: Calcd.($C_{15}H_{14}N_6OS$):

C, 55.21; H, 4.29; N,25.76; S, 9.81; Found: C,55.83; H, 4.52; N, 25.98; S, 9.96%.

Synthesis of 2-methyl-2-(naphthalen-2-yl)-3-(5–oxo-2-thioxo imidazolidin-1-yl)thiazolidin-4-one [V].

A mixture of compound [II] (2.83g,0.01mol) and thioglycolicacid 0.01mol) was heated with dry benzene (20mL) for 8 hrs[10], cooled and neutralized with solution contaning $NaHCO_3$, the product was off white, filtered off and recrystallized.Yield: 73% m.p = 198-200^{0}C; FTIR (υ,cm^{-1}): 3191(NH), 3052 (C-H arom.), 2967-2916 (C-H aliph.), 1727and 1693 (C=O), 1240 (C=S); ^{1}HNMR (δ ppm): 2.57 (s, 3H, CH_3), 3.90 (s,2H,CH_2-S), 3.24 (s,2H,CH_2-N), 7.55-8.31 (m, 7H, Ar-H); 12.01 (s,1H,NH); Elemental analysis: Calcd. for ($C_{17}H_{15}N_3O_2S_2$): C,57.14; H,4.20; N,11.76; S, 17.92; Found: C, 54.93; H, 4.00; N, 10.98; S, 18.06%.

Synthesis of 1-benzyl-3-((1-(naphthalen-2-yl)ethylidene) amino)-2-thioxo-imidazolidin-4-one [VI].

A mixture of compound [II](2.83g,0.01mol) and benzyl bromid (0.01mol) in pyridine (20mL) was refluxed for 4hrs, then cooled and acidified with dilute HCl (10%).The pale brown formed was filtered off,dried and recrystallized from methanol to give compound [VI]. Yield : 74% m.p = 208-210°C;FTIR (υ, cm^{-1}): 3057 (C-Harom.), 2970-2777 (C-Haliph.), 1685 (C=N), 1724 (C=O), 1234 (C=S); ^{1}H NMR δ ppm: 2.99 (s,3H,CH_3), 3.05 (s,2H,CH_2-ph), 5.08 (s,2H, CH_2-S), 6.81-8.24 (m,12H, Ar-H).

Synthesis of 3-(3–benzyl-5–oxo-2–thioxoimidazolidin-1-yl)-2-methyl-2-(naphthalene-2-yl)thiazolidin-4-one [VII].

Compound [VI] (3.73g, 0.01mol) and thioglycolicacid (0. 01 mol) was heated under reflux in dry benzene (15mL) for 8hrs., then neutralized with $NaHCO_3$ solution, filtered off and dried to give compound [VII]. Yield : 61% m.p = 170-172 ^{0}C; FTIR (υ,cm^{-1}): 3095 (C-Harom.), 2974-2920 (C-Haliph.), 1707,1670 (C=O), 1242(C=S); ^{1}H-NMR δ ppm: 2.71 (s,3H,CH_3), 3.89(s,2H, CH_2-ph), 4.07 (s,2H, CH_2-S), 7.57-8.68 (m,12H, Ar-H); Elemental analysis: Calcd. for $C_{24}H_{21}N_3O_2S_2$: C,64.42; H,4.69; N,9.39; S, 14.31; Found: C, 64.92; H, 4.21; N, 9.81; S, 14.58%.

Synthesis of 1,3-oxazepine derivatives [VIII]a-c

To a stirring solution of compound [II] (2.83g,0.01 mole) in dry benzene,different acid anhydrides (malic anhydride, or phthalic anhydride,or naphthalic anhydride) (0.01 mole) (20mL) were added for 6 hrs.[15]. The resulting solid was filtered off, dried and recrystallized from appropriate solvent to obtained 1,3-oxazipenes $[VIII]_{a-c}$.

- *2-methyl-2-(naphthalen-2-yl)-3-(5-oxo-2-thioxoimidazolidin-1-yl)-2,3-dihydro-1,3-oxazepine-4,7-dione [VIII]$_a$; Yield :*

80%, m.p = 153-155 ^{0}C; FTIR(υ,cm^{-1}): 3150 (N-H), 3059 (C-Harom.), 2972-2855 (C-Haliph.), 1776,1745 (C=O) lactone and lactam of oxazepine ring, 1705 (C=O imidazolidin-4-one ring), 1238(C=S); Ms: m/z = 381.0 (5), 379.9 (7), 283 (15) 282.07(100); Elemental analysis: Calcd. for ($C_{19}H_{15}N_3O_4S$): C,59.83; H,3.96; N,11.02; S, 8.41; Found: C, 60.02; H, 4.11; N, 10.82; S, 8.98%.

- *3-methyl-3-(naphthalen-2-yl)-4-(5-oxo-2-thioxoimidazolidin-1-yl)-3, 4-dihydrobenzo [e] [1,3] oxazepine-1, 5-dione [VIII]$_b$; yield :*

77% m.p = 171-173 ^{0}C; FTIR (ν,cm^{-1}): 3164 (N-H),3054 (C-Harom.), 2973-2869 (C-Haliph.), 1768,1746 (C=O) lactone and lactam of oxazepine ring,1708 (C=O imidazolidin-4-one ring), 1244(C=S); ^{1}H-NMR δ ppm: 12.00 (s,1H, NH), 8.31-6.73 (m,11H, Ar-H), 3.33 (s,2H,CH_2-CO), 2.98 (s,3H,CH_3); Elemental analysis: Calcd. for ($C_{23}H_{17}N_3O_4S$): C,64.03; H,3.97; N,9.74; S, 7.43; Found: C, 64.72; H, 4.57; N, 9.84; S, 7.83%.

- *3-methyl-3-(naphthalen-2-yl)-4-(5-oxo-2-thioxoimidazolidin-1-yl)-3, 4-dihydro naphtho [2,3-e] [1,3]oxazepine-1,5-dione [VIII]$_c$; yield :*

84% m.p = 189-191 ^{0}C; FTIR (ν,cm^{-1}): 3136 (N-H),3061 (C-H arom.), 2971-2908 (C-H aliph.), 1770,1737 (C=O lactone and lactam of oxazepine ring), 1705 (C=O imidazolidin-4-one ring), 1232(C=S); ^{1}H NMR (DMSO-d6) δ ppm: 12.04 (s, 1H, NH), 8.31-7.55 (m,13H, Ar-H), 3.90 (s,2H, CH_2-CO), 2.57 (s, 3H, CH_3); (s,3H, CH_3); Elemental analysis: Calcd. for $C_{27}H_{19}N_3O_4S$: C,67.35; H,3.98; N,8.73; S, 6.66; Found: C, 67.92; H, 4.07; N, 8.94; S, 6.83%.

RESULTS AND DISCUSSION

The new 2-thioxo-imidazolidin -4-one derivative [II] was synthesized by reaction starting the corresponding compound[I] with ethyl α-chloroacetate. The reaction proceeds via nucleophilic attack of the more nucleophilic NH_2 group of thiosemicarbazone[I] upon the ethyl α-chloroacetate to give [A], the cyclization takes place by intermolecular nucleophilic substitution to form intermediate [B], which is undergoing rapid proton transfer and loss ethanol to give the desired 2-thioxo-imidazolidin-4-one [II]. The suggesting mechanism of this reaction may be outlined as follows, in the Scheme 2:

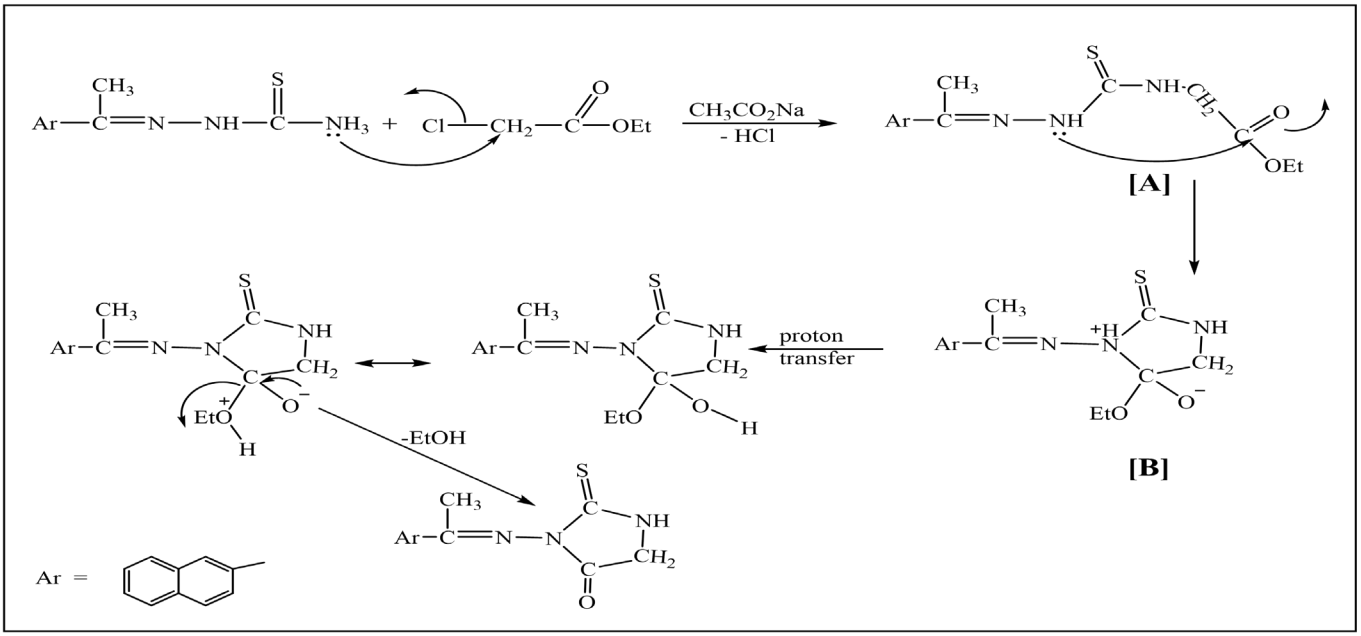
The new imidazolidin-4-one derivative [III] was synthesized by the reaction of compound [II] with glycine in the presence of triethylamine in ethanol. The suggested mechanism [18] to obtain the desired product is outlined below, Scheme 3:

The new tetrazole derivative[IV] was synthesized from the reaction of Schiff bases[II] (by one step) with sodium azide in dry acetone.

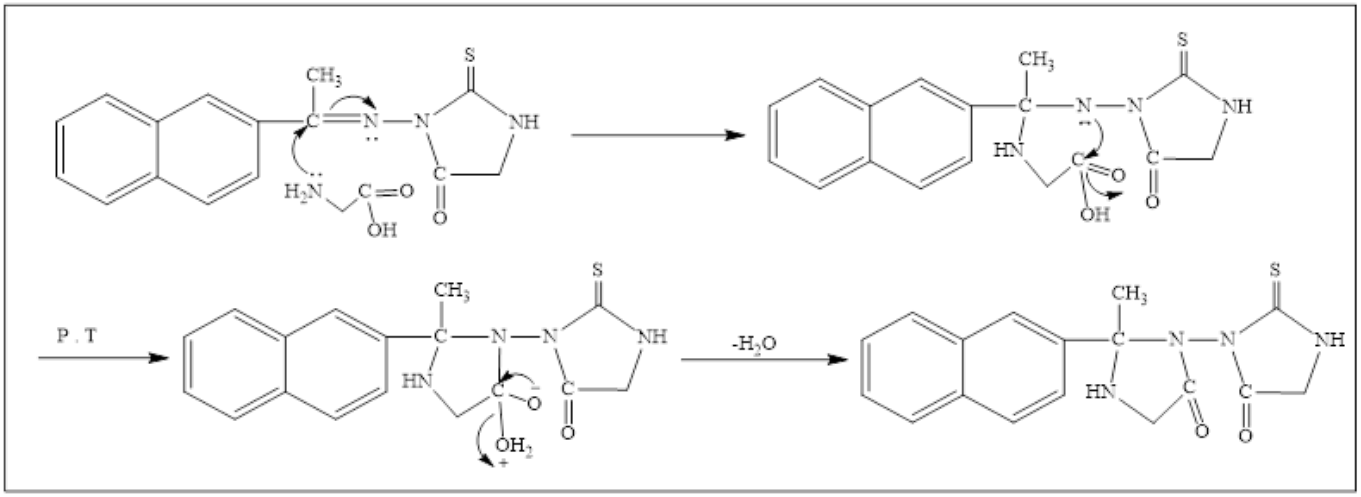
The new thiazolidin-4-one compounds [V] and [VII] were synthesized from the reaction of compounds[II] or [VI] with $SHCH_2COOH$ in dry benzene.

The new 1,3-oxazepine $[VIII]_{a-c}$ were synthesized by the cycloaddition reaction of compound[II] with different acid anhydrides (malic anhydride, phthalic anhydride and, naphthalic anhydride) in dry benzene. The mechanism involves the addition of one σ-carbonyl (C =O) to π-bond imine group (N=C) to give 4-membered cyclic and 5-membered cyclic ring of anhydride in the same transition state, which opens into different anhydride to a given seven-membered cyclic ring 1, 3-oxazepine-4, 7-dione. The mechanism of this reaction may be outlined as follows in the Scheme 4:

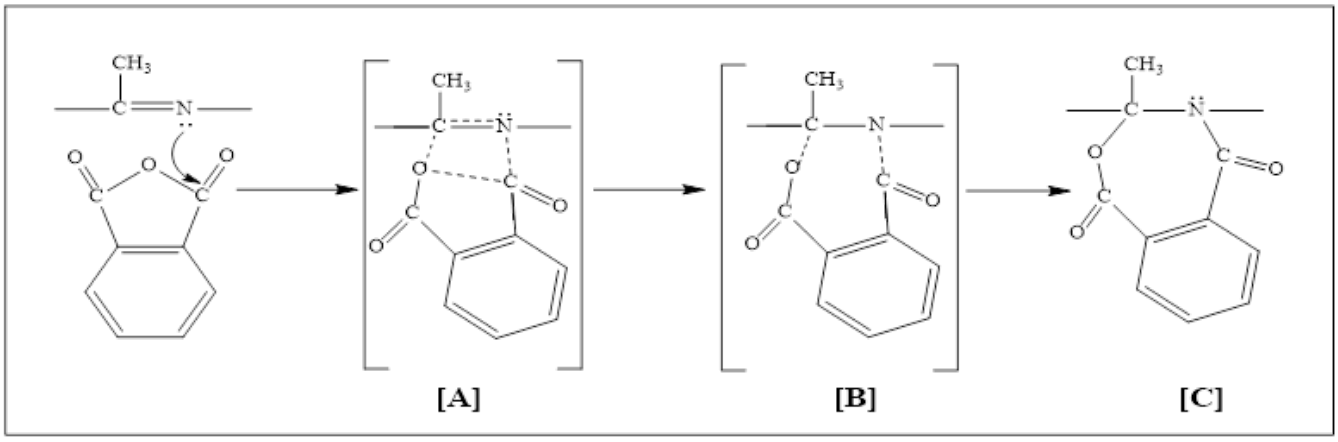
The structure of the compounds were characterized by spectral data (FTIR, ^{1}HNMR and Mass spectrometry) and



Scheme 2



Scheme 3



Scheme 4

Table 1: Antibacterial activity of the compounds [II]-[VIII]a-c

Comp.No.	*E.Coli (G-)*	*Staph.aurus (G+)*	*Bacillus subtilis(G+)*
[II]	++	++	++
[III]	+++	++	++
[IV]	+	-	-
[V]	++	+++	++
[VII]	++	++	++
$[VIII]_a$	+	++	+++
$[VIII]_b$	++	+++	++
$[VIII]_c$	++	++	+++
Ampicillin	_	+	_
Amoxicilin	_	+++	_
Lincomycin	_	++	_
DimethylSulfoxie	_	_	_

Key to symbols: Highly active = + + +(mor than)15 mm.
Moderately active = + +(11-15) mm and slightly active = + (5-10) mm.

(C.H.N.S). These data give a piece of good evidence for the formation of the suggested structure to these compounds.

All of the deivatives[II]–$[VIII]_c$ have been screened for their biologcail activities, using three types of bacteria; *E.Coli(G-)*, *Staph.aureus(G+)* and *Bascillus cereus (G+)*, and compared to Ampicillin, Amoxicillin and Lincomycin as antibiotic standards. Most of these compounds show good to moderate activity toward these bacteria.

Biological Activity

Heterocyclic compounds are well known for their antibacterial, antifungal, and chemotherapeutic agents. In this work, the antibacterial activity of the compounds was examined (in vitro) antibacterial activity against *E.col (G-), Staph. Aureus (G+),* and *Bascillus cereus (G+)*, according to the agar diffusion method,[20] and compared to Ampicillin, Amoxicillin, and Lincomycin as antibiotic standards.[21]

All the derivatives exhibit the highest or low biological activity against bacteria. Compounds [III], [V], and $[VIII]_{b,c}$ showed good inhibition against of the three types of the bacteria; this could be related to the presence of imidazolidin-4-one, thiazolidin-4-one, 1,3-oxazepine rings.

CONCLUSION

The study aimed to synthesize 2-thioxo-imidazolidin-4-one derivatives. All the compounds[II-$VIII_c$] were then biologically examined for in-vitro antibacterial activities.

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REFERENCES

1. Unlusoy, M. C., Kazak, C., Bayro, O., Verspohl, E. J., Ertan, R., & Dundar, O. B. (2013). Synthesis and antidiabetic activity of 2, 4-thiazolidindione, imidazolidinedione and 2-thioxo-imidazolidine-4-one derivatives bearing 6-methyl chromonyl pharmacophore. Journal of enzyme inhibition and medicinal chemistry, 28(6), 1205-1210.
2. Nasser, A., Idhayadhulla, A., Kumar, R. S., & Selvin, J. (2010). Synthesis of Some 2-Thioxo-imidazolidin-4-one Derivatives and its Antimicrobial Activity. Journal of Chemistry, 7(4), 1320-1325.
3. Majouga, A. G., Beloglazkina, E. K., Yudina, A. V., Mironov, A. V., & Zyk, N. V. (2015). Oxidative dehydrogenation of 5-(pyridine-2-yl-methyl)-2-thioxo-4-imidazolidinones in complexation reaction with copper (II) chloride. Inorganic Chemistry Communications, 51, 114-117.
4. Comber, R. N., Reynolds, R. C., Friedrich, J. D., Manguikian, R. A., Buckheit Jr, R. W., Truss, J. W., ... & Secrist III, J. A. (1992). 5, 5-Disubstituted hydantoins: syntheses and anti-HIV activity. Journal of medicinal chemistry, 35(19), 3567-3572.
5. Joshi, H., Upadhyay, P., Karia, D., & Baxi, A. J. (2003). Synthesis of some novel imidazolinones as potent anticonvulsant agents. European journal of medicinal chemistry, 38(9), 837-840.
6. El-Hady, H.A. and Abubshait, S.A. (2017). Synthesis and anticancer evaluation of imidazolinone and benzoxazole derivatives, Arabian Journal of Chemistry, 10(2): S3725-S3731.
7. Mohamed, M.S., Mahmoud, R.K., Sayed, A.I., El-Araby, M.E. (2012). Antiproliferative Properties of Vinyl Dipeptides: Synthesis and MCF-7 Cell Line Testing, Journal of Medicinal Chemistry, 2(4): 24-29.
8. Mishra, B.B. and Tiwari, K.V. (2015). Ionic Liquids-Prompted Synthesis of Biologically Relevant Five-and Six-Membered Heterocyclic Skeletons, 1st Ed. New York, Chapter 17,437–493.
9. Kun, S., Bokor, É., Sipos, Á., Docsa, T., Somsák, L. (2018) .Synthesis of New C-and N-β-d-Glucopyranosyl Derivatives of Imidazole, 1,2,3-Triazole and Tetrazole, and Their Evaluation as Inhibitors of Glycogen Phosphorylase, Molecules, 15(23):666.
10. Liaras, K., Fesatidou, M. and Geronikaki, A. (2018). Thiazoles and Thiazolidinones as COX/LOX Inhibitors, Molecules, 23(3): 685.
11. Kumar, D., Kumar, V., Mundlia, J., Pradhan, D., Malik, S. (2015). Thiazolidin-4-one Derivatives as Central Nervous System Potential Agents, Central Nervous System Agents Medicinal Chemistry 23.
12. Manjal, S.K., Kaur, R., Bhatia, R., Kumar, K., Singh, V., Shankar, R., Kaur, R., Rawal, R.K. (2017). Synthetic and medicinal perspective of thiazolidinones: A review, Bioorganic Chemistry 75: 406-423.
13. Th. Ali, S. and Th. Ghanim, H. (2016). Synthesis and characterization of heterocyclic compounds from amine derivative, International Journal of ChemTech Research, 9(9): 360-367.

14. Mukhlus, A. A., Al-Rawi, M. S., Al-Dujaili, A. H., & Tomma, J. H. (2017). Synthesis And Characterization Of New Oxazepines Derived From D-Erythroascorbic Acid. Ibn AL-Haitham Journal For Pure and Applied Science, 25(2).
15. Obaid, E. K. (2017). Synthesis and Characterization of New Seven Membered Ring Oxazepane Derivatives by Cyclization of Imine With Succinic Anhydride. Journal of University of Babylon, 25(2), 718-727.
16. Sammor, M. S., Hussein, A. Q., Awwadi, F. F., & El-Abadelah, M. M. (2018). One-pot synthesis of novel 3, 10-dihydro-2H-1, 3-oxazepino [7, 6-b] indoles via 1, 4-dipolar cycloaddition reaction. Tetrahedron, 74(1), 42-48.
17. Al-Rawi, M. S., Hassan, H. A., Hassan, D. F., & Abdullah, R. M. (2013). Synthesis and anti-bacterial study of novel compounds with bis (four-, five-, and seven-membered) heterocyclic rings. International Journal for Sciences and Technology, 143(1729), 1-14.
18. Al-Rawi, M. S., Hussei, D. F., Al-Taie, A. F., Al-Halbosiy, M. M., & Hameed, B. A. (2018, May). Cytotoxic effects of new synthesis heterocyclic derivatives of Amoxicillin on some cancer cell lines. In Journal of Physics: Conference Series (Vol. 1003, No. 1, p. 012012). IOP Publishing.
19. Singh, H. L., Sharma, M., & Varshney, A. K. (1999). Synthesis and characterization of some tin (II) complexes with semicarbazones and thiosemicarbazones of heterocyclic ketones. Synthesis and reactivity in inorganic and metal-organic chemistry, 29(5), 817-826.
20. Bhosale, J. D., Dabur, R., Jadhav, G. P., & Bendre, R. S. (2018). Facile syntheses and molecular-docking of novel substituted 3, 4-dimethyl-1H-pyrrole-2-carboxamide/carbohydrazide analogues with antimicrobial and antifungal properties. Molecules, 23(4), 875.
21. Aiube, Z. H., Al-rawi, M. S., & Ebrahem, A. K. (2017). Solvent-Free One-Pot Multicomponent, Synthesis, Characterization and Anti-bacterial activity, of some 2substituted-3-cyano-Pyridine Derivatives. Ibn AL-Haitham Journal For Pure and Applied Science, 28(2), 126-135.