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Synthesis of Imidazo[1,2-a]pyridine derivatives as an antimicrobial agents

Mayur. J. Joshi, Vaishali. M. Goswami, Jalpa. R. Pandya and Hitendra. S. Joshi*

Chemical Research Laboratory, Department of Chemistry, Saurashtra University, Rajkot-360005, India

* E-mail address: drhsjoshi49@gmail.com

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Abstract: A series of bioactive entities containing heterocyclic ring system namely pyrazoline and imidazolinone attached to Imidazo[1,2-a]pyridine ring was synthesized. The products have been assayed for their biological activity against Gram positive, Gram negative bacteria and fungi strains. Some of the derivatives showed moderate to good activity at concentration of 40µg/ml. The structures of the synthesized compounds have been elucidated by IR, ¹H NMR, Mass spectral data and elemental analysis.

Keywords: Imidazo[1,2-a]pyridine, Pyrazoline, Imidazolinone, antimicrobial activity.

1. Introduction:

The nitrogen-bridgehead fused heterocycles containing an imidazole ring are pharmacologically important molecules due to its versatility of biological activity. Major parasites have become a threat for mankind and have developed resistant against currently available drugs. Therefore there is an urgent need to develop novel derivatives with good antimicrobial activity. The aim of our research is to focus on the introduction of chemical diversity in the molecular frame work to synthesize therapeutic active molecules of different composition.

considerable interest from the pharmaceutical industry and its structure has been studied for various pharmacological characteristics like antifungal [1], antiviral [2,3], antibacterial agents [4,5] etc. Imidazo[1,2-a]pyridines have shown more selective pharmacological importance as sedative-hypnotic agent (Zolpidem) as well anxiolytic agent (Alpidem) [6]. Various synthetic methods have been intended for the preparation of imidazo[1,2-a]pyridine.

Pyrazolines are an important class of heterocyclic compounds containing two nitrogen atoms in the five membered ring. Pyrazoline derivatives are the electron rich nitrogen heterocycles which play an important role in the diverse biological activities. These

Imidazo[1,2-a]pyridine have received

heterocyclic compounds widely occur in nature in the form of alkaloids, vitamins, pigments and as constituents of plant and animal cell. [7]. Pyrazoline and imidazolinone derivatives have drawn considerable attention of the chemists due to their good pharmacological activities like anticovulsant [8], antimicrobial [9], anti-inflammatory [10], antibacterial [11,12], etc. Considering these findings, synthesis of some new pyrazoline as well as imidazolinone derivatives bearing imidazo[1,2-*a*]pyridine nucleus was carried out and evaluated for antimicrobial activity.

2. Results and Discussion:

The synthesis of pyrazolines (**3a-3l**) and imidazolinones (**5a-5l**) was performed by following the steps shown in the reaction (scheme-1). The required compound **1** has been synthesized by following the literature methods. The chalcone intermediates (**2a-2l**) were synthesized using Claisen condensation reaction of 2-(4-chlorophenyl)imidazo[1,2-*a*]pyridine-3-carbaldehyde (**1**) with various acetophenones in presence of catalytic amount of alkali. The compound (**3a-3l**) was synthesized by the heterocyclization of **2a-2l** with hydrazine hydrate in presence of glacial acetic acid. The imidazolinone derivatives (**5a-5l**) were synthesized from key intermediate azalactone (**4**) by reaction with various aryl amines and basic catalyst such as pyridine. Synthesis of azalactones was carried out by Erlen-Meyer synthesis from 2-(4-chlorophenyl)imidazo[1,2-*a*]pyridine-3-carbaldehyde (**1**) with hippuric acid, in presence of sodium acetate and acetic anhydride. The structures of all the synthesized compounds were assigned on the basis of IR, ¹H NMR, Mass spectral data and elemental analysis.

3. EXPERIMENTAL:

Melting points were determined on electro

thermal apparatus using open capillaries and are uncorrected. Thin-layer chromatography was accomplished on 0.2-mm pre coated plates of silica gel 60G F254 (Merck, St. Louis, MO, USA). Visualization was made with UV light (254 and 365nm) or with an iodine vapour. IR spectra were recorded on a FTIR-8400 spectrophotometer (Shimadzu, Kyoto, Japan), using DRS probe. ¹H NMR spectra were recorded on a Bruker AVANCE II (400 MHz) spectrometer (Bruker, Rheinstetten, Germany), in CDCl₃. Chemical shifts are expressed in δ ppm downfield from TMS as an internal standard. Mass spectra were determined using direct inlet probe on a GCMS-QP 2010 mass spectrometer (Shimadzu, Kyoto, Japan). Elemental analysis was performed on a EuroVector EA 3000 elemental analyzer. Solvents were evaporated with a Laborota 4000 efficient rotary evaporator (Heidolph, Germany). All reagents were purchased from Fluka (New Delhi, India), Sigma Aldrich (New Delhi, India), Merck (St. Louis, MO, USA) and Rankem (New Delhi, India) and used without further purification.

3.1 Synthesis of 2-(4-chlorophenyl)imidazo[1,2-*a*]pyridine-3-carbaldehyde (**1**).

To a solution of 2-(4-chlorophenyl)imidazo[1,2-*a*]pyridine (0.01 mol) in DMF (25 mL) phosphorus oxychloride (0.02 mol) was added drop wise at room temperature with constant stirring. The resulting mixture was heated up to 80 °C for 5 h. After completion of reaction monitored by TLC, the solvent was evaporated to dryness in vacuo, the mass obtained was neutralized with saturated solution of NaHCO₃, filtered, washed with water and crystallized from methanol to give pure compound **1** [13]. Yield 64 % ; mp 196 °C.

3.2 General procedure for synthesis of (2*E*)-3-[2-(4-Chlorophenyl)imidazo[1,2-*a*]pyridine-3-yl]-1-arylprop-2-en-1-one (**2a-2l**).

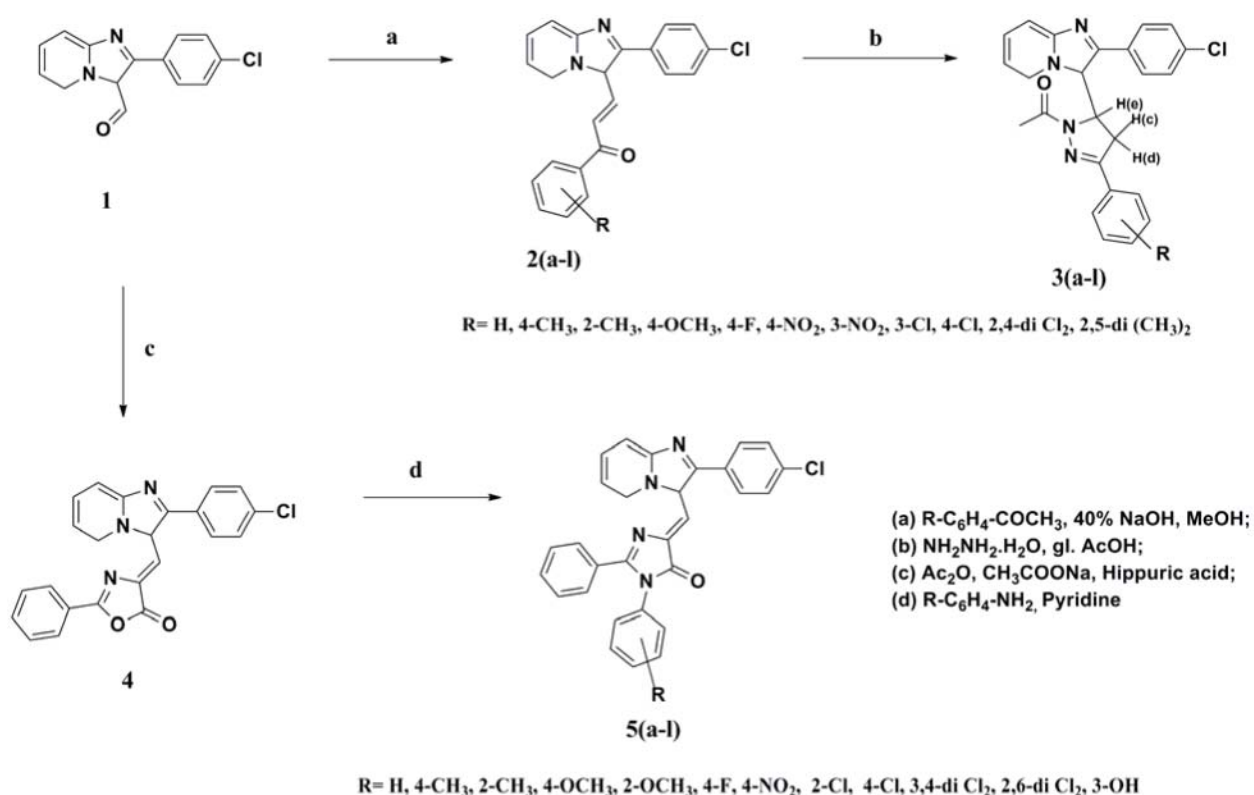
The mixture of 2-(4-chlorophenyl)imidazo[1,2-*a*]pyridine-3-carbaldehyde (**1**) (0.01 mol) and substituted acetophenone (0.01 mol) in ethanol (25 mL) in presence of catalytic amount of 40% KOH was stirred at room temperature for 24 h. Synthesis of the above chalcones were carried out by the well know Claisen-Schmidt reaction. The resulting solution was poured on to crushed ice, thus the solid separated was filtered, washed with water, dried in vacuo and crystallized from ethanol to give analytically pure product.

3.3 General procedure for the synthesis of 3-(1-Acetyl-3-aryl-4,5-dihydro-1*H*-pyrazol-5-yl)-2-(4-chlorophenyl)imidazo[1,2-*a*]pyridines (3a-3l).

The mixture of (2*E*)-3-[2-(4-chlorophenyl)imidazo[1,2-*a*]pyridine-3-yl]-1-phenylprop-2-en-1-one (0.01 mol) and hydrazine hydrate (0.01 mol) in glacial acetic acid (25 mL) was refluxed for 8 h. After completion of reaction monitored by TLC, water was added to the reaction mass and neutralized with saturated solution of NaHCO₃. Thus solid separated was filtered, washed with water and hexane and crystallized from ethanol to give pure product (**3a**).

By following the same procedure as compound **3a** other compounds were synthesized and other physical data reported in Table-1

3.4 General procedure for synthesis of



Scheme 1 : Synthesis of imidazo[1,2-*a*]pyridine having pyrazoline and imidazolinone linkers

Scheme-I Synthetic route of pyrazolines and imidazolines having Imidazo[1,2-*a*]pyridine nucleus

Table-I: Physical Data of 3-(1-Acetyl-3-aryl-4,5-dihydro-1*H*-pyrazol-5-yl)-2-(4-chlorophenyl)imidazo[1,2-*a*]pyridines (**3a-3l**) and (5*Z*)-5-[[2-(4-Chlorophenyl)imidazo[1,2-*a*]pyridine-3-yl]methylene}-3-aryl-2-phenyl-3,5-dihydro-4*H*-imidazol-4-ones (**5a-5l**).

Sr. No.	Compound	Substitution R	Molecular Formula	Molecular Weight	Yield %
1	3a	C ₆ H ₅ -	C ₂₄ H ₁₉ ClN ₄ O	416	62
2	3b	4-CH ₃ -C ₆ H ₄ -	C ₂₅ H ₂₁ ClN ₄ O	430	65
3	3c	2-CH ₃ -C ₆ H ₄ -	C ₂₅ H ₂₁ ClN ₄ O	430	58
4	3d	4-OCH ₃ -C ₆ H ₄ -	C ₂₅ H ₂₁ ClN ₄ O ₂	446	65
5	3e	4-F-C ₆ H ₄ -	C ₂₄ H ₁₈ ClFN ₄ O	434	64
6	3f	4-NO ₂ -C ₆ H ₄ -	C ₂₄ H ₁₈ ClN ₅ O ₃	461	59
7	3g	3-NO ₂ -C ₆ H ₄ -	C ₂₄ H ₁₈ ClN ₅ O ₃	461	57
8	3h	3-Cl-C ₆ H ₄ -	C ₂₄ H ₁₈ Cl ₂ N ₄ O	450	65
9	3i	4-Cl-C ₆ H ₄ -	C ₂₄ H ₁₈ Cl ₂ N ₄ O	450	55
10	3j	2,4-di-Cl-C ₆ H ₃ -	C ₂₄ H ₁₇ Cl ₃ N ₄ O	485	58
11	3k	2,5-di-CH ₃ -C ₆ H ₃ -	C ₂₆ H ₂₃ ClN ₄ O	444	62
12	3l	4-SCH ₃ -C ₆ H ₄ -	C ₂₅ H ₂₁ ClN ₄ OS	462	62
13	5a	C ₆ H ₅ -	C ₂₉ H ₁₉ ClN ₄ O	476	52
14	5b	4-CH ₃ -C ₆ H ₄ -	C ₃₀ H ₂₁ ClN ₄ O	490	63
15	5c	2-CH ₃ -C ₆ H ₄ -	C ₃₀ H ₂₁ ClN ₄ O	490	56
16	5d	4-OCH ₃ -C ₆ H ₄	C ₃₀ H ₂₁ ClN ₄ O ₂	506	64
17	5e	2-OCH ₃ -C ₆ H ₄	C ₃₀ H ₂₁ ClN ₄ O ₂	506	67
18	5f	4-F-C ₆ H ₄ -	C ₂₉ H ₁₈ ClFN ₄ O	433	69
19	5g	4-NO ₂ -C ₆ H ₄ -	C ₂₉ H ₁₈ ClN ₅ O ₃	521	58
20	5h	2-Cl-C ₆ H ₄ -	C ₂₉ H ₁₈ Cl ₂ N ₄ O	510	73
21	5i	4-Cl-C ₆ H ₄ -	C ₂₉ H ₁₈ Cl ₂ N ₄ O	510	62
22	5j	3,4-(Cl) ₂ -C ₆ H ₃	C ₂₉ H ₁₇ Cl ₃ N ₄ O	545	78
23	5k	2,6-(Cl) ₂ -C ₆ H ₃	C ₂₉ H ₁₇ Cl ₃ N ₄ O	545	68
24	5l	3-OH-C ₆ H ₄ -	C ₂₉ H ₁₉ ClN ₄ O ₂	492	59

(4Z)-{[2-(4-Chlorophenyl)imidazo[1,2-a]pyridine-3-yl]methylene}-2-phenyl-1,3-oxazol-5(4H)-one (4).

To a solution of 2-(4-Chlorophenyl)imidazo[1,2-a]pyridine-3-carbaldehyde (**1**) (0.01 mol), acetic anhydride (0.075 mol), hippuric acid (0.025 mol) and sodium acetate (0.03 mol) was added and heated on a water bath for 4-5 h. The resulting solution was poured onto crushed ice, thus the solid separated was isolated and crystallized from dioxane. Yield 59%, mp 176°C.

3.5 General procedure for synthesis of (5Z)-5-{[2-(4-Chlorophenyl)imidazo[1,2-a]pyridine-3-yl]methylene}-3-aryl-2-phenyl-3,5-dihydro-4H-imidazol-4-ones (5a-5l).

The mixture of (4Z)-4-{[2-(4-Chlorophenyl)imidazo[1,2-a]pyridine-3-yl]methylene}-2-phenyl-1,3-oxazol-5(4H)-one (0.01 mol) and aniline (0.01 mol) in dry pyridine (25 mL) was refluxed in an oil bath for 12 h. The reaction mass was poured on to crushed ice and neutralized with 10% HCl solution. The isolated product was then crystallized from dioxane to give pure product (**5a**).

By following the same procedure as compound **5a** other compounds were synthesized and other physical data reported in Table-I.

4. Antimicrobial Activity:

The antimicrobial activity was assayed by using the cup-plate diffusion method by measuring the zone of inhibition in mm. Newly synthesized compounds were screened *in vitro* for their antimicrobial activity against varieties of bacterial strains such as Gram positive *Bacillus megaterium* ATCC 14518, *Staphylococcus aureus* ATCC 25923 and Gram negative *Escherichia coli* ATCC 25922, *Psuedomonas aeruginosa* ATCC 27853 and

fungi *Aspergillus niger* ATCC 9029 at 40µg/ml concentration. Standard drugs like Amoxicillin, Benzyl penicillin, Ciprofloxacin, Erythromycin and Greseofulvin were used for the comparison purpose. The results of the *in vitro* screening are given in (Table II).

To investigate the antimicrobial potency of the newly synthesized compounds, we have used the five different bacteria *B. megaterium*, *S. aureus*, *E. Coli*, *P. aeruginosa* and fungal *Aspergillus niger* microbial culture for evaluating the antimicrobial activity of the tested compounds for primary SAR studies. The antimicrobial activity of the newly synthesized compounds is shown in Table II. We decided to explore different structural variations by introducing a substituted phenyl ring at 1st position of pyrazoline and simultaneously at 2nd position of imidazolinone. We have synthesized compound having unsubstituted phenyl ring at 1st and 2nd position of pyrazoline and imidazolinone respectively. We observed that the compound (**5a**) having a phenyl ring attached to the 2nd position of imidazolinone showed much better antibacterial than the compound (**3a**) having unsubstituted phenyl ring at pyrazoline moiety. But the compound (**3a**) showed more zone of inhibition than compound (**5a**) in the anti fungal microbial plate.

Later on we decided to study both the groups separately by introducing various electron donating and electron withdrawing groups in the phenyl ring.

We observed that when a substituted phenyl ring having an electron donating group was attached to pyrazoline derivative (**3b-3d**) there was a decrease in zone of inhibition in both antibacterial and antifungal plate, but when a substituted phenyl ring having an electron withdrawing group was attached to the pyrazoline (**3e-3i**) there was an increase in the zone of inhibition. Thus it was observed that substituted phenyl

ring having an electron donating group is more potent than the substituted phenyl ring having an electron donating group.

Then we synthesized compounds having di-substitution on the phenyl ring (**3j**, **3k**), where we observed that compound (**3j**) having a substituted phenyl ring with an electron withdrawing group showed less zone of inhibition compared to that of compound (**3k**) having a substituted phenyl ring with electron donating group. The compound (**3k**) showed good zone of inhibition in bacterial and fungal culture plate.

We also studied the effect of position of the group at phenyl ring (**3e-3i**). We observed that the compounds having *para* substitution (**3f**, **3i**) were found to be more active than the compounds having *meta* substitution (**3g**, **3h**). The compound (**3f**) having a 4-nitro substituted phenyl ring was found to be more active in bacterial and fungal plate with good zone of inhibition.

Focusing on the second group having a substituted phenyl ring attached to the 2nd position of imidazolinone ring, we observed that the compounds (**5b-5l**) showed similar pattern as in the pyrazoline ring derivative. The compounds having an electron donating group substitution at the phenyl ring (**5b-5e**) showed less potency than the compounds having an electron withdrawing group substitution at the phenyl ring (**5f-5k**).

The imidazolinone derivatives showed good antifungal activity with good zone of inhibition.

In order to study the effect of number of groups on phenyl ring, we synthesized two compound having di-substitution on the phenyl ring (**5j**, **5k**). The di-substituted phenyl ring attached imidazolinone showed a decrease in the zone of inhibition. The compound **5f** having a 4-Floro

phenyl ring substitution was found to be active in both bacterial and fungal plate with good zone of inhibition.

From the result of antimicrobial data, compounds **3d**, **3f**, **5a**, **5f**, and **5l** were active and compounds **3a**, **3c**, **3e**, **3g**, **3k**, **5b**, **5c**, **5g**, **5i** and **5j** were moderately active against *B. megaterium*. Same as compounds **3e**, **3k**, **5b**, **5c** and **5f** were active, while compounds **3d**, **3h**, **5d**, **5e**, **5h**, **5i**, **5k** and **5l** were moderately active against *S. aureus*. Further compounds **3c**, **3h**, **3g**, **5a** and **5e** were active compounds and compounds **3e**, **3f**, **3i**, **5c**, **5f**, **5h** and **5k** shows moderate activity against *E. coli*. In case of *P. aeruginosa* compounds **3f**, **5c** and **5l** were active and compounds **3g**, **3i**, **3j**, **5d**, **5e**, **5f**, **5i**, **5j** and **5k** were moderately active. Against *A. niger* compounds **3c**, **3f**, **3g**, **3i**, **3k**, **5e**, **5f**, **5g**, **5j** and **5k** were active while compounds **3a**, **3b**, **3h**, **3j**, **3l**, **5d**, **5h**, **5i** and **5l** were moderately active. Remaining compounds did not show promising activity against tested bacteria and fungi.

5. Spectral Data

3-(1-Acetyl-3-phenyl-4,5-dihydro-1H-pyrazol-5-yl)-2-(4-chlorophenyl)imidazo[1,2-a]pyridine (3a).

Yield 62 %; mp 156-158°C; IR (KBr): 3015, 1655, 1591, 1509, 1473, 1170, 785 cm⁻¹ ¹H NMR (400 MHz CDCl₃): δ 7.55 (d, 2H, Ar-H_{b,b'}, J = 2.37 Hz), 7.49 (m, 5H, Ar-H), 7.46 (d, 2H, Ar-H_{a,a'}, J = 1.95 Hz), 6.93-8.27 (m, 4H, imidazo[1,2-a]pyridine-H), 5.8 (dd, 1H, -CHe), 3.99 (dd, 1H, -CHc, J = 17.80 Hz), 3.90 (s, 3H, -CH₃), 3.33 (dd, 1H, -CHd, J = 17.80 Hz), 2.32 (s, 3H, -COCH₃). MS: *m/z* = 416[M⁺]. Anal. Calcd. For C₂₄H₁₉ClN₄O: C, 69.48; H, 4.62; N, 13.50 % Found: C, 69.52; H, 4.66; N, 13.55%.

3-(1-Acetyl-3-(4-methylphenyl)-4,5-dihydro-1H-pyrazol-5-yl)-2-(4-chlorophenyl)imidazo[1,2-a]pyridine (3b).

Yield 65 %; mp 186°C; IR (KBr): 3021, 2975,

Table-II: Antimicrobial activity results of 3-(1-Acetyl-3-aryl-4,5-dihydro-1*H*-pyrazol-5-yl)-2-(4-chlorophenyl)imidazo[1,2-*a*]pyridines (**3a-3l**) and (5*Z*)-5- {[2-(4-Chlorophenyl)imidazo[1,2-*a*]pyridine-3-yl]methylene}-3-aryl-2-phenyl-3,5-dihydro-4*H*-imidazol-4-ones (**5a-5l**).

Compound	R	Zones of inhibition in mm				
		Antibacterial activity				Antifungal activity
		<i>B. megaterium</i>	<i>S. aureus</i>	<i>E. coli</i>	<i>P. aeruginosa</i>	<i>A. niger</i>
3a	C ₆ H ₅ -	15	11	12	13	17
3b	4-CH ₃ -C ₆ H ₄ -	10	12	10	11	16
3c	2-CH ₃ -C ₆ H ₄ -	15	11	18	10	19
3d	2,5-di-CH ₃ --C ₆ H ₃ -	17	20	10	12	22
3e	4-OCH ₃ -C ₆ H ₄ -	19	17	13	12	12
3f	2,4-di-Cl-C ₆ H ₃ -	11	12	14	16	15
3g	4-Cl-C ₆ H ₄ -	12	17	15	15	18
3h	3-Cl-C ₆ H ₄ -	13	16	18	08	14
3i	4-SCH ₃ -C ₆ H ₄ -	09	10	13	11	16
3j	4-F-C ₆ H ₄ -	16	18	14	13	17
3k	3-NO ₂ -C ₆ H ₄ -	17	12	20	16	18
3l	4-NO ₂ -C ₆ H ₄ -	19	10	16	21	21
5a	C ₆ H ₅ -	18	12	18	13	12
5b	4-Cl-C ₆ H ₄ -	15	14	10	16	15
5c	4-NO ₂ -C ₆ H ₄ -	14	09	11	13	20
5d	2-CH ₃ -C ₆ H ₄ -	16	18	16	19	13
5e	4-CH ₃ -C ₆ H ₄ -	14	20	12	11	11
5f	2-OCH ₃ -C ₆ H ₄	13	14	21	17	19
5g	4-OCH ₃ -C ₆ H ₄	11	16	13	16	15
5h	4-F-C ₆ H ₄ -	18	20	14	14	20
5i	2-Cl-C ₆ H ₄ -	09	16	17	12	17
5j	3,4-(Cl) ₂ -C ₆ H ₃	17	11	10	14	19
5k	2,6-(Cl) ₂ -C ₆ H ₃	11	16	16	16	18
5l	3-OH-C ₆ H ₄ -	19	15	13	19	15
Amoxicillin	-	25	25	20	22	00
Benzyl penicillin	-	18	19	21	21	00
Ciprofloxacin	-	20	15	22	16	00
Erythromycin	-	22	21	19	23	00
Greseofulvin	-	00	00	00	00	26

1645, 1583, 1480, 1395, 1153, 810, 788 cm^{-1} . ^1H NMR (400 MHz CDCl_3): δ , 7.73 (d, 2H, Ar-H, $J = 3.05$ Hz), 7.58 (d, 2H, Ar-Hb,b', $J = 2.37$ Hz), 7.48 (d, 2H, Ar-Ha,a', $J = 1.95$ Hz), 7.18 (d, 2H, Ar-H, $J = 2.23$ Hz), 7.10-8.25 (m, 4H, imidazo[1,2-a]pyridine-H), 5.77 (dd, 1H, -CHe), 3.95 (dd, 1H, -CHc, $J = 17.80$ Hz), 3.35 (dd, 1H, -CHd, $J = 17.80$ Hz), 2.38 (s, 3H, -COCH₃), 2.36 (s, 3H, Ar-CH₃). MS: $m/z = 430[\text{M}^+]$. Anal. Calcd. For $\text{C}_{25}\text{H}_{21}\text{ClN}_4\text{O}$: C, 70.01; H, 4.93; N, 13.06 % Found: C, 69.98; H, 4.91; N, 13.09%.

3-(1-Acetyl-3-(2-methylphenyl)-4,5-dihydro-1H-pyrazol-5-yl)-2-(4-chlorophenyl)imidazo[1,2-a]pyridine (3c).

Yield 58 %; mp 146°C; IR (KBr): 3010, 2969, 1659, 1595, 1474, 1392, 1090, 781, 770 cm^{-1} . ^1H NMR (400 MHz CDCl_3): δ , 7.58 (d, 2H, Ar-Hb,b', $J = 2.37$ Hz), 7.52 (m, 4H, Ar-H), 7.44 (d, 2H, Ar-Ha,a', $J = 1.95$ Hz), 6.95-8.27 (m, 4H, imidazo[1,2-a]pyridine-H), 5.76 (dd, 1H, -CHe), 4.10 (dd, 1H, -CHc, $J = 17.80$ Hz), 3.30 (dd, 1H, -CHd, $J = 17.80$ Hz), 2.35 (s, 3H, -COCH₃), 2.25 (s, 3H, Ar-CH₃); MS: $m/z = 430[\text{M}^+]$. Anal. Calcd. For $\text{C}_{25}\text{H}_{21}\text{ClN}_4\text{O}$: C, 70.01; H, 4.93; N, 13.06 % Found: C, 69.98; H, 4.91; N, 13.09%.

3-(1-Acetyl-3-(4-methoxyphenyl)-4,5-dihydro-1H-pyrazol-5-yl)-2-(4-chlorophenyl)imidazo[1,2-a]pyridine (3d).

Yield 65 %; mp 223-225°C; IR (KBr): 3016, 1645, 1593, 1503, 1221, 1107, 781 cm^{-1} . ^1H NMR (400 MHz CDCl_3): δ , 7.93 (d, 2H, Ar-H, $J = 3.07$ Hz), 7.55 (d, 2H, Ar-Hb,b', $J = 2.37$ Hz), 7.46 (d, 2H, Ar-Ha,a', $J = 1.95$ Hz), 6.93-8.27 (m, 4H, imidazo[1,2-a]pyridine-H), 6.7 (d, 2H, Ar-H, $J = 2.20$ Hz), 5.80 (dd, 1H, -CHe), 3.99 (dd, 1H, -CHc, $J = 17.80$ Hz), 3.90 (s, 3H, -OCH₃), 3.33 (dd, 1H, -CHd, $J = 17.80$ Hz), 2.32 (s, 3H, -COCH₃), 2.25 (s, 3H, -CH₃); MS: $m/z = 446[\text{M}^+]$. Anal. Calcd. For $\text{C}_{25}\text{H}_{21}\text{ClN}_4\text{O}_2$: C, 67.49; H, 4.76; N, 12.59% Found: C, 67.52; H, 4.79; N, 12.62%.

3-(1-Acetyl-3-(4-fluorophenyl)-4,5-dihydro-1H-pyrazol-5-yl)-2-(4-chlorophenyl)imidazo[1,2-a]pyridine (3e).

Yield 64 %, mp 211-213 °C; IR (KBr): 3010, 1643, 1610, 1510, 1163, 810, 790 cm^{-1} . ^1H NMR (400 MHz CDCl_3): δ , 7.52 (d, 2H, Ar-Hb,b', $J = 2.37$ Hz), 7.50 (d, 2H, Ar-Ha,a', $J = 1.95$ Hz), 7.44 (d, 2H, Ar-H, $J = 2.90$ Hz), 7.0 (m, 2H, Ar-H, $J = 2.20$ Hz), 6.89-8.30 (m, 4H, imidazo[1,2-a]pyridine-H), 5.8 (dd, 1H, -CHe), 4.18 (dd, 1H, -CHc, $J = 17.80$ Hz), 3.40 (dd, 1H, -CHd, $J = 17.80$ Hz), 2.35 (s, 3H, -COCH₃), 2.43 (s, 3H, -CH₃). MS: $m/z = 434[\text{M}^+]$. Anal. Calcd. For $\text{C}_{24}\text{H}_{18}\text{ClFN}_4\text{O}$: C, 66.59; H, 4.19; N, 12.94 % Found: C, 66.62; H, 4.23; N, 12.96%.

3-(1-Acetyl-3-(4-nitrophenyl)-4,5-dihydro-1H-pyrazol-5-yl)-2-(4-chlorophenyl)imidazo[1,2-a]pyridine (3f).

Yield 59 %; mp 167-169 °C; IR (KBr): 3005, 1649, 1581, 1535, 1350, 1105, 795 cm^{-1} . ^1H NMR (400 MHz CDCl_3): δ , 8.10 (d, 2H, Ar-H, $J = 3.05$ Hz), 7.9 (d, 2H, Ar-H, $J = 2.30$ Hz), 7.55 (d, 2H, Ar-Hb,b', $J = 2.37$ Hz), 7.40 (d, 2H, Ar-Ha,a', $J = 1.95$ Hz), 7.0-8.32 (m, 4H, imidazo[1,2-a]pyridine-H), 5.76 (dd, 1H, -CHe), 4.05 (dd, 1H, -CHc, $J = 17.80$ Hz), 3.35 (dd, 1H, -CHd, $J = 17.80$ Hz), 2.40 (s, 3H, -COCH₃), 2.45 (s, 3H, -CH₃). MS: $m/z = 461[\text{M}^+]$. Anal. Calcd. For $\text{C}_{24}\text{H}_{18}\text{ClN}_5\text{O}_3$: C, 62.68; H, 3.95; N, 15.23 % Found: C, 62.71; H, 3.99; N, 15.27%.

3-(1-Acetyl-3-(3-nitrophenyl)-4,5-dihydro-1H-pyrazol-5-yl)-2-(4-chlorophenyl)imidazo[1,2-a]pyridine (3g).

Yield 57 %; mp 172-174°C; IR (KBr): 3005, 1649, 1581, 1535, 1350, 795, 700 cm^{-1} . ^1H NMR (400 MHz CDCl_3): δ , 8.30 (t, 1H, Ar-H, $J = 1.60$ Hz), 8.47 (m, 1H, Ar-H, $J = 8.0$ Hz), 8.25 (q, 1H, Ar-H, $J = 7.85$ Hz), 7.64 (t, 1H, Ar-H, $J = 8.0$ Hz), 7.50 (d, 2H, Ar-Hb,b', $J = 2.37$ Hz), 7.40 (d, 2H, Ar-Ha,a', $J = 1.95$ Hz), 7.1-8.35 (m, 4H, imidazo[1,2-a]pyridine-H), 5.74 (dd, 1H, -CHe), 4.10 (dd, 1H, -CHc, $J = 17.80$ Hz).

Hz), 3.40 (dd, 1H, -CHd, $J = 17.80$ Hz), 2.38 (s, 3H, -COCH₃), 2.47 (s, 3H, -CH₃). MS: $m/z = 461[M^+]$. Anal. Calcd. For C₂₄H₁₈ClN₅O₃: C, 62.68; H, 3.95; N, 15.23 % Found: C, 62.71; H, 3.99; N, 15.27%.

3-(1-Acetyl-3-(3-chlorophenyl)-4,5-dihydro-1H-pyrazol-5-yl)-2-(4-chlorophenyl)imidazo[1,2-a]pyridine (3h).

Yield 65 %; mp 149-151 °C; IR (KBr): 3012, 1652, 1601, 1478, 1118, 797, 750 cm⁻¹. ¹H NMR (400 MHz CDCl₃): δ , 7.52 (d, 2H, Ar-Hb,b', $J = 2.37$ Hz), 7.50 (m, 3H, Ar-H), 7.46 (d, 2H, Ar-Ha,a', $J = 1.95$ Hz), 6.90-8.25 (m, 4H, imidazo[1,2-a]pyridine-H), 6.67 (dd, 1H, Ar-H, $J = 2.20$ Hz), 5.83 (dd, 1H, -CHe), 4.05 (dd, 1H, -CHc, $J = 17.80$ Hz), 3.33 (dd, 1H, -CHd, $J = 17.80$ Hz), 2.38 (s, 3H, -COCH₃), 2.36 (s, 3H, -CH₃). MS: $m/z = 450[M^+]$. Anal. Calcd. For C₂₄H₁₈Cl₂N₄O: C, 64.15; H, 4.04; N, 12.47 % Found: C, 64.19; H, 4.08; N, 12.51%.

3-(1-Acetyl-3-(4-chlorophenyl)-4,5-dihydro-1H-pyrazol-5-yl)-2-(4-chlorophenyl)imidazo[1,2-a]pyridine (3i).

Yield 55 %; mp 180-182 °C; IR (KBr): 3027, 1663, 1580, 1460, 1097, 773 cm⁻¹. ¹H NMR (400 MHz CDCl₃): δ , 7.8 (d, 2H, Ar-H, $J = 3.09$ Hz), 7.58 (d, 2H, Ar-Hb,b', $J = 2.37$ Hz), 7.48 (d, 2H, Ar-Ha,a', $J = 1.95$ Hz), 7.41 (d, 2H, Ar-H, $J = 2.10$ Hz), 7.10-8.25 (m, 4H, imidazo[1,2-a]pyridine-H), 5.79 (dd, 1H, -CHe), 3.95 (dd, 1H, -CHc, $J = 17.80$ Hz), 3.35 (dd, 1H, -CHd, $J = 17.80$ Hz), 2.38 (s, 3H, -COCH₃), 2.36 (s, 3H, -CH₃). MS: $m/z = 450[M^+]$. Anal. Calcd. For C₂₄H₁₈Cl₂N₄O: C, 64.15; H, 4.04; N, 12.47 % Found: C, 64.19; H, 4.08; N, 12.51%.

3-(1-Acetyl-3-(2,4-dichlorophenyl)-4,5-dihydro-1H-pyrazol-5-yl)-2-(4-chlorophenyl)imidazo[1,2-a]pyridine (3j).

Yield 58 %; mp 198-200 °C; IR (KBr): 3019, 1658, 1591, 1481, 1083, 785, 770 cm⁻¹. ¹H NMR (400 MHz CDCl₃): δ , 7.86 (d, 1H, Ar-H, $J = 2.25$ Hz), 7.55 (d, 2H, Ar-Hb,b', $J = 2.37$ Hz),

7.52 (d, 1H, Ar-H, $J = 8.30$ Hz), 7.46 (d, 2H, Ar-Ha,a', $J = 1.95$ Hz), 7.32 (dd, 1H, Ar-H, $J = 8.35$ Hz), 6.90-8.27 (m, 4H, imidazo[1,2-a]pyridine-H), 5.78 (dd, 1H, -CHe), 4.10 (dd, 1H, -CHc, $J = 17.80$ Hz), 3.45 (dd, 1H, -CHd, $J = 17.80$ Hz), 2.37 (s, 3H, -COCH₃), 2.25 (s, 3H, -CH₃). MS: $m/z = 485[M^+]$. Anal. Calcd. For C₂₄H₁₇Cl₃N₄O: C, 59.58; H, 3.54; N, 11.58% Found: C, 59.62; H, 3.58; N, 11.59%.

3-(1-Acetyl-3-(2,5-dimethylphenyl)-4,5-dihydro-1H-pyrazol-5-yl)-2-(4-chlorophenyl)imidazo[1,2-a]pyridine (3k).

Yield 62 %; mp 152-154 °C; IR (KBr): 3023, 1649, 1605, 1487, 1124, 798, 760, 695 cm⁻¹. ¹H NMR (400 MHz CDCl₃): δ , 7.8 (d, 1H, Ar-H), 7.52 (d, 2H, Ar-Hb,b', $J = 2.37$ Hz), 7.50 (d, 2H, Ar-Ha,a', $J = 1.95$ Hz), 7.15 (d, 2H, Ar-H, $J = 8.0$ Hz), 7.05-8.30 (m, 4H, imidazo[1,2-a]pyridine-H), 5.81 (dd, 1H, -CHe), 4.05 (dd, 1H, -CHc, $J = 17.80$ Hz), 3.40 (dd, 1H, -CHd, $J = 17.80$ Hz), 2.35 (s, 3H, -COCH₃), 2.32 (s, 3H, Ar-CH₃), 2.21 (s, 3H, Ar-CH₃). MS: $m/z = 444[M^+]$. Anal. Calcd. For C₂₆H₂₃ClN₄O: C, 70.50; H, 5.23; N, 12.65 % Found: C, 70.53; H, 5.28; N, 12.69%.

3-(1-Acetyl-3-(4-(methylthio)phenyl)-4,5-dihydro-1H-pyrazol-5-yl)-2-(4-chlorophenyl)imidazo[1,2-a]pyridine (3l).

Yield 62 %; mp 177-179 °C; IR (KBr): 3056, 2850, 1645, 1588, 1491, 1084, 773, 550 cm⁻¹. ¹H NMR (400 MHz CDCl₃): δ , 7.6 (d, 2H, Ar-H, $J = 3.0$ Hz), 7.58 (d, 2H, Ar-Hb,b', $J = 2.37$ Hz), 7.48 (d, 2H, Ar-Ha,a', $J = 1.95$ Hz), 7.36 (d, 2H, Ar-H, $J = 2.01$ Hz), 6.96-8.30 (m, 4H, imidazo[1,2-a]pyridine-H), 5.78 (dd, 1H, -CHe), 3.98 (dd, 1H, -CHc, $J = 17.80$ Hz), 3.40 (dd, 1H, -CHd, $J = 17.80$ Hz), 2.32 (s, 3H, -COCH₃), 2.47 (s, 3H, -CH₃). MS: $m/z = 462[M^+]$. Anal. Calcd. For C₂₅H₂₁ClN₄OS: C, 65.14 H, 4.59; N, 12.15 % Found: C, 65.18; H, 4.63; N, 12.18%.

(5Z)-5-{[2-(4-Chlorophenyl)imidazo[1,2-a]

pyridine-3-yl]methylene}-3-phenyl-2-phenyl-3,5-dihydro-4H-imidazol-4-one (**5a**).

Yield 52 %; mp 175-177 °C; IR (KBr): 3016, 1640, 1593, 1503, 1107, 785 cm⁻¹. ¹H NMR (400 MHz CDCl₃): δ, 8.7 (s, 1H, -CHc), 7.33-7.66 (m, 5H, Ar-H), 7.28-7.50 (m, 5H, Ar-H), 7.02-7.3(m, 4H, imidazo[1,2-a]pyrdine), 6.89-6.93 (d, 2H, Ar-Hb,b', J = 2.37 Hz), 6.58-6.62 (d, 2H, Ar-Ha,a', J = 1.95 Hz). MS: *m/z* = 476[M⁺]. Anal. Calcd. For C₂₉H₁₉ClN₄O: C, 73.34; H, 4.03; N, 11.80 % Found: C, 73.35; H, 4.05; N, 11.85%.

(5Z)-5-{{[2-(4-Chlorophenyl)imidazo[1,2-a]pyridine-3-yl]methylene}-3-(4-methylphenyl)-2-phenyl-3,5-dihydro-4H-imidazol-4-one (**5b**).

Yield 63 %; mp 134-136°C; IR (KBr): 3021, 2975, 1640, 1585, 1485, 1392, 1155, 815, 790 cm⁻¹. ¹H NMR (400 MHz CDCl₃): δ, 8.67 (s, 1H, -CHc), 7.38-7.70 (m, 5H, Ar-H), 7.1 (d, 2H, Ar-H, J = 2.65 Hz), 7.0 (d, 2H, Ar-H, J = 2.24 Hz), 7.10-7.39 (m, 4H, imidazo[1,2-a]pyrdine), 6.89 (d, 2H, Ar-Hb,b', J = 2.37 Hz), 6.60 (d, 2H, Ar-Ha,a', J = 1.95 Hz), 2.27 (s, 1H, Ar-CH₃). MS: *m/z* = 490[M⁺]. Anal. Calcd. For C₃₀H₂₁ClN₄O: C, 73.69; H, 4.33; N, 11.46 % Found: C, 73.73; H, 4.36; N, 11.50 %.

(5Z)-5-{{[2-(4-Chlorophenyl)imidazo[1,2-a]pyridine-3-yl]methylene}-3-(2-methylphenyl)-2-phenyl-3, 5-dihydro-4H-imidazol-4-one (**5c**).

Yield 56 %; mp 147-150°C; IR (KBr): 3010, 2975, 1645, 1590, 1470, 1395, 1085, 784, 769 cm⁻¹. ¹H NMR (400 MHz CDCl₃): δ 8.7 (s, 1H, -CHc), 7.40-7.67 (m, 5H, Ar-H), 7.10-7.30 (m, 4H, imidazo[1,2-a]pyrdine), 7.06-7.72 (m, 4H, Ar-H), 6.90 (d, 2H, Ar-Hb,b', J = 2.37 Hz), 6.58 (d, 2H, Ar-Ha,a', J = 1.95 Hz), 2.12 (s, 1H, Ar-CH₃). MS: *m/z* = 490[M⁺]. Anal. Calcd. For C₃₀H₂₁ClN₄O: C, 73.69; H, 4.33; N, 11.46 % Found: C, 73.73; H, 4.36; N, 11.50%.

(5Z)-5-{{[2-(4-Chlorophenyl)imidazo[1,2-a]pyridine-3-yl]methylene}-3(4methoxyphenyl)-2-phenyl-3, 5-dihydro-4H-imidazol-4-one (**5d**).

Yield 64 %; mp 195-197 °C; IR (KBr): 3319, 3029, 1665, 1587, 1093, 796 cm⁻¹. ¹H NMR (400 MHz CDCl₃): δ, 8.67 (s, 1H, -CHc), 7.35-7.60 (m, 5H, Ar-H), 7.05 (d, 2H, Ar-H, J = 2.68 Hz), 6.90 (d, 2H, Ar-H, J = 2.30 Hz), 7.0-7.35 (m, 4H, imidazo[1,2-a]pyrdine), 6.90 (d, 2H, Ar-Hb,b', J = 2.37 Hz), 6.60 (d, 2H, Ar-Ha,a', J = 1.95 Hz), 3.72 (s, 3H, Ar-OCH₃). MS: *m/z* = 506[M⁺]. Anal. Calcd. For C₃₀H₂₁ClN₄O₂: C, 73.36; H, 4.19; N, 11.10 % Found: C, 73.39; H, 4.25; N, 11.15 %.

(5Z)-5-{{[2-(4-Chlorophenyl)imidazo[1,2-a]pyridine-3-yl]methylene}-3-(2-methoxyphenyl)-2-phenyl-3, 5-dihydro-4H-imidazol-4-one (**5e**).

Yield 67 %; mp 198-200 °C; IR (KBr): 3020, 1659, 1595, 1510, 1220, 1110, 780 cm⁻¹. ¹H NMR (400 MHz CDCl₃): δ, 8.67 (s, 1H, -CHc), 7.38-7.60 (m, 5H, Ar-H), 7.10 (d, 2H, Ar-Hb,b', J = 2.37 Hz), 7.03-7.28 (m, 4H, imidazo[1,2-a]pyrdine), 6.88-7.20 (m, 4H, Ar-H), 6.60 (d, 2H, Ar-Ha,a', J = 1.95 Hz), 3.93 (s, 3H, Ar-OCH₃). MS: *m/z* = 506[M⁺]. Anal. Calcd. For C₃₀H₂₁ClN₄O₂: C, 73.36; H, 4.19; N, 11.10 % Found: C, 73.39; H, 4.25; N, 11.15 %.

(5Z)-5-{{[2-(4-Chlorophenyl)imidazo[1,2-a]pyridine-3-yl]methylene}-3-(4-fluorophenyl)-2-phenyl-3, 5-dihydro-4H-imidazol-4-one (**5f**).

Yield 69 %; mp 182-185 °C; IR (KBr): 3010, 1643, 1610, 1510, 1163, 790, 680 cm⁻¹. ¹H NMR (400 MHz CDCl₃): δ, 8.68 (s, 1H, -CHc), 7.35-7.60 (m, 5H, Ar-H), 7.2 (d, 2H, Ar-H, J = 2.65 Hz), 7.06 (d, 2H, Ar-H, J = 3.05 Hz), 6.99-7.30 (m, 4H, imidazo[1,2-a]pyrdine), 6.89 (d, 2H, Ar-Hb,b', J = 2.37 Hz), 6.60 (d, 2H, Ar-Ha,a', J = 1.95 Hz). MS: *m/z* = 433[M⁺]. Anal. Calcd. For C₂₉H₁₈ClFN₄O: C, 70.66; H, 3.68; N, 11.37 % Found: C, 70.70; H, 3.70; N, 11.40 %.

(5Z)-5-{{[2-(4-Chlorophenyl)imidazo[1,2-a]pyridine-3-yl]methylene}-3-(4-nitrophenyl)-2-phenyl-3, 5-dihydro-4H-imidazol-4-one (**5g**).

Yield 58 %; mp 154-155 °C; IR (KBr): 3015, 1650, 1585, 1540, 1105, 810, 790 cm⁻¹. ¹H NMR

(400 MHz CDCl₃): δ ; 8.73 (s, 1H, -CHc), 8.2 (d, 2H, Ar-H, J = 3.0 Hz), 7.6 (d, 2H, Ar-H, J = 2.64 Hz), 7.40-7.75 (m, 5H, Ar-H), 7.10-7.35 (m, 4H, imidazo[1,2-a]pyridine), 6.89 (d, 2H, Ar-Hb,b', J = 2.37 Hz), 6.59 (d, 2H, Ar-Ha,a', J = 1.95 Hz). MS: m/z = 521[M⁺]. Anal. Calcd. For C₂₉H₁₈ClN₅O₃: C, 66.99; H, 3.49; N, 13.47 % Found: C, 67.02; H, 3.52; N, 13.51%.

(5Z)-5-{[2-(4-Chlorophenyl)imidazo[1,2-a]pyridine-3-yl]methylene}-3-(2-chlorophenyl)-2-phenyl-3,5-dihydro-4H-imidazol-4-one (**5h**).

Yield 73 %; mp 167-170°C; IR (KBr): 3012, 1652, 1601, 1478, 1118, 780, 750 cm⁻¹. ¹H NMR (400 MHz CDCl₃): δ ; 8.75 (s, 1H, -CHc), 7.34-7.70 (m, 5H, Ar-H), 7.15-7.50 (m, 4H, Ar-H), 7.03-7.30 (m, 4H, imidazo[1,2-a]pyridine), 6.93 (d, 2H, Ar-Hb,b', J = 2.37 Hz), 6.68 (d, 2H, Ar-Ha,a', J = 1.95 Hz). MS: m/z = 510[M⁺]. Anal. Calcd. For C₂₉H₁₈Cl₂N₄O: C, 68.38; H, 3.56; N, 11.00 % Found: C, 68.42; H, 3.58; N, 11.05%.

(5Z)-5-{[2-(4-Chlorophenyl)imidazo[1,2-a]pyridine-3-yl]methylene}-3-(4-chlorophenyl)-2-phenyl-3,5-dihydro-4H-imidazol-4-one (**5i**).

Yield 62 %; mp 137-139°C; IR (KBr): 3027, 1663, 1580, 1460, 1097, 773 cm⁻¹. ¹H NMR (400 MHz CDCl₃): δ ; 8.72 (s, 1H, -CHc), 7.8 (d, 2H, Ar-H, J = 2.60 Hz), 7.40-7.72 (m, 5H, Ar-H), 7.22 (d, 2H, Ar-H, J = 2.50 Hz), 7.02-7.33 (m, 4H, imidazo[1,2-a]pyridine), 6.91 (d, 2H, Ar-Hb,b', J = 2.37 Hz), 6.59 (d, 2H, Ar-Ha,a', J = 1.95 Hz). MS: m/z = 510[M⁺]. Anal. Calcd. For C₂₉H₁₈Cl₂N₄O: C, 68.38; H, 3.56; N, 11.00 % Found: C, 68.41; H, 3.58; N, 11.03%.

(5Z)-5-{[2-(4-Chlorophenyl)imidazo[1,2-a]pyridine-3-yl]methylene}-3-(3,4-dichlorophenyl)-2-phenyl-3,5-dihydro-4H-imidazol-4-one (**5j**).

Yield 78 %; mp 178°C; IR (KBr): 3015, 1645, 1585, 1485, 1080, 780, 749 cm⁻¹. ¹H NMR (400 MHz CDCl₃): δ ; 8.73 (s, 1H, -CHc), 7.9 (s, 1H, Ar-H, J = 2.8 Hz), 7.69 (d, 1H, Ar-H, J = 9.0 Hz), 7.47 (d, 1H, Ar-H, J = 9.0 Hz), 7.36-7.68 (m,

5H, Ar-H), 7.03-7.29 (m, 4H, imidazo[1,2-a]pyridine), 6.88 (d, 2H, Ar-Hb,b', J = 2.37 Hz), 6.59 (d, 2H, Ar-Ha,a', J = 1.95 Hz). MS: m/z = 545[M⁺]. Anal. Calcd. For C₂₉H₁₇Cl₃N₄O: C, 64.05; H, 3.15; N, 10.30 % Found: C, 64.10; H, 3.20; N, 10.35 %.

(5Z)-5-{[2-(4-Chlorophenyl)imidazo[1,2-a]pyridine-3-yl]methylene}-3-(2,6-dichlorophenyl)-2-phenyl-3,5-dihydro-4H-imidazol-4-one (**5k**).

Yield 68 %; mp 188-190°C; IR (KBr): 3019, 1655, 1585, 1480, 1083, 785, 749 cm⁻¹. ¹H NMR (400 MHz CDCl₃): δ ; 8.73 (s, 1H, -CHc), 7.36-7.68 (m, 5H, Ar-H), 7.33-7.56 (m, 3H, Ar-H), 7.03-7.29 (m, 4H, imidazo[1,2-a]pyridine), 6.88 (d, 2H, Ar-Hb,b', J = 2.37 Hz), 6.59 (d, 2H, Ar-Ha,a', J = 1.95 Hz). MS: m/z = 545[M⁺]. Anal. Calcd. For C₂₉H₁₇Cl₃N₄O: C, 64.05; H, 3.15; N, 10.30 % Found: C, 64.10; H, 3.20; N, 10.35 %.

(5Z)-5-{[2-(4-Chlorophenyl)imidazo[1,2-a]pyridine-3-yl]methylene}-3-(3-hydroxyphenyl)-2-phenyl-3,5-dihydro-4H-imidazol-4-one (**5l**).

Yield 59 %; mp 191°C; IR (KBr): 3060, 3025, 1650, 1580, 1480, 1080, 789, 750 cm⁻¹. ¹H NMR (400 MHz CDCl₃): δ ; 9.86 (s, 1H, Ar-H), 8.69 (s, 1H, -CHc), 7.35-7.7 (m, 5H, Ar-H), 7.02-7.35 (m, 4H, imidazo[1,2-a]pyridine), 6.96 (s, 1H, Ar-H), 6.95-7.20 (m, 3H, Ar-H), 6.80 (d, 2H, Ar-Hb,b', J = 2.37 Hz), 6.60 (d, 2H, Ar-Ha,a', J = 1.95 Hz). MS: m/z = 492[M⁺]. Anal. Calcd. For C₂₉H₁₉ClN₄O₂: C, 70.95; H, 3.90; N, 11.41 % Found: C, 70.98; H, 3.95; N, 11.46 %.

6. Conclusion

In the present study, we have described synthesis of imidazo [1,2-a] pyridine that possess good yield and exhibited potent antibacterial activities against *B. megaterium*, *S. aureus*, *E. coli* & *P. aeruginosa* and antifungal activity against *A. niger*. From SAR study it was found that in pyrazoline derivatives phenyl ring substituted with electron-withdrawing groups like nitro,

chloro, fluoro (**3e**, **3f**, **3g**, **3i**) showed good activity compared to those in which the phenyl ring substituted with electron donating groups like methoxy (**3d**) while compounds with electron donating substitutions like 2-methyl and 2, 5-dimethyl (**3c**, **3j**) were found to be active against fungi strain *A. niger*. In imidazolinone derivatives phenyl ring substituted electron-withdrawing groups like fluoro, hydroxyl (**5f**, **5l**) showed good activity compared to those in which the phenyl ring substituted with electron donating groups like methoxy, methyl (**5b**, **5c**, **5d**) while compounds with electron withdrawing substitutions like nitro, dichloro, fluoro (**5f**, **5j**, **5k**) were found to be active against fungi strain *A. niger*.

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References:

1. Y. Rival, G. Grassy, A. Taudou, R. Ecalle, Eur J Med Chem., **1991**, 26, 13-18.
2. A. Gueiffier, S. Mavel, J. Balzarini, J.P. Chapat, J Med Chem., **1998**, 41, 5108-5112.
3. M. Lhassani, O. Chavignon, A. Gueiffier, Eur J Med Chem., **1999**, 34, 271-274.
4. Y. Rival, G. Grassy, G. Michel, Chem Pharma Bull., **1992**, 40, 1170-1176.
5. J.C. Teulade, G. Grassy, J.P. Girard, J.P. Chapat, Eur J. Med Chem., **1978**, 13, 271.
6. R.B. Lacerda, K.F. de Lima, L.L da Silva, C.N. Romeiro, A.M Freag, Bioorg Med Chem., **2009**, 17, 74-84.
7. M.Yusuf, P. Jain, Arabian Journal of Chemistry **2011**, doi:10.1016/j.arabjc.2011.09.013
8. A. Sudhir, P.C. Dandiya, Proc Dec Conf Ind Pharmacal Soc., **1977**, Abs. No. 88.
9. J. Panda, S.V. Srinivas, M.E. Rao, J Indian Chem Soc., **2002**, 79, 770-771.
10. F.F. Barsoum, H.M. Hosni, A.S. Girgis, Bioorg Med Chem., **2006**, 14, 4466-4476.
11. P. Desaea, A. Nunrich, M. Carderny, G. Devaux, Eur J Med Chem., **1990**, 25, 285-290.
12. K.C. Mathur, R. Sahay, J Indian Chem Soc., **1990**, 67, 856-860.
13. M.J. Joshi, P.B. Vekariya, B.L. Dodiya, R.M. Ghetiya, H.S. Joshi, J Heterocyclic Chem., **2012**, 49, 130-134.