A Highly Flexible and Efficient Ugi-Type Multicomponent Synthesis of Versatile N-Fused Aminoimidazoles

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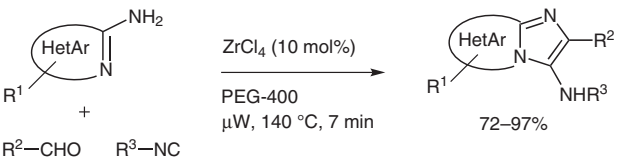
Abstract: A microwave-promoted highly flexible and efficient Ugi-type multicomponent reaction of heterocyclic amidines with aldehydes and isocyanides catalyzed by zirconium(IV) chloride was developed. The general protocol offered the very reliable synthesis of a library of medicinally important, widely versatile N-fused aminoimidazoles in excellent yields. Poorly reactive heterocyclic amidines, functionally and sterically hindered aldehydes, which suffer as troublesome reactants in earlier described methods, were rendered as feasible substrates in this process. The efficient catalysis by $ZrCl_4$ in addition to the effect of microwave irradiation was found crucial for gaining superior flexibility and efficiency of the protocol.

Key words: multicomponent reaction, N-heterocycles, catalysis, zirconium(IV) chloride, microwave

Multicomponent reactions (MCRs)[1] offer the elegant performance of multiple reactions into a sequence in one reaction step without isolating the intermediates, atom-economy, structural complexity of products (structural economy), bond-forming efficiency (bond-forming economy), convergent synthesis, and the feasibility of introducing maximum chemical diversity elements in one chemical event. They are being increasingly tailored and fine tuned for synthesizing various heterocyclic scaffolds that is particularly useful in the preparation of diverse chemical libraries of bioactive molecules. The success of introducing chemical diversity into MCR products leading to the formation of a library exclusively depends on the efficiency of the reaction spanning over versatile reactants. Thus, the development of novel multicomponent process that can be reliable for versatile reactants to provide the high-yielding synthesis of a wide library of drug-like products is of high demand, and is continually augmented.[2]

Nitrogen-fused imidazoles with scaffold versatility in second heterocyclic ring have gained immense attention because of their wide range of pharmaceutical activities,[3] such as antibacterial,[3d] antiviral,[3e] antifungal[3f] and anti-inflammatory[3g] agents, selective CDK inhibitors,[3h] GABA receptor agonists,[3i] bradykinin B2 receptor antagonists,[3j] and calcium channel blockers.[3k] These classes of heterocycles are represented by launched drugs in market like zolimidine (antiulcer), zolpidem (hypnotic), and alpidem (anxiolytic). To access such medicinally important N-fused imidazoles, several MCR methods[4,5] in addition to the multi-step synthesis,[6a] one-pot multi-reactions,[6b] and two-component reactions,[7] have been endeavored. MCR approaches, especially the Ugi-type multicomponent reaction, which was simultaneously first discovered by Bienaymé,[4j] Groebke,[4k] and Blackburn[4l] et al. in 1998, have attracted attention because of their appealing attributes. But their inflexibility spanning over versatile reactants, especially low-reactive amidines and functional aldehydes is found to be a crucial problem. The less reactive amidines in these reactions reportedly suffer from slow reaction and competing side reactions through nucleophilic attack of protic solvent (like MeOH) and amidine-amine to intermediate Schiff bases.[4a,b,j,5b] Moreover, the MCR products derived from these 2-aminoazines are significant in aspects of pharmacophoric features for bioactivity studies. Likewise, the products resulting from functional aldehydes offer the opportunity of preparing larger compound libraries through diversity oriented synthesis. In addition, the low yields, long reaction times, and the use of expensive Lewis acids, for example, $Sc(OTf)_3$, are the issues of Ugi-type MCR methods, that need to be resolved.

Herein, we present a microwave-promoted robust and much reliable multicomponent protocol catalyzed by zirconium(IV) chloride (Scheme 1). The protocol proved its superior flexibility and efficiency for wide versatile reactants including low reactive amidines, and functional and sterically hindered aldehydes.



Scheme 1 Synthesis of versatile N-fused 3-aminoimidazoles

Recently, we have developed a protocol[4a] of multicomponent synthesis of N-fused imidazoles exploring the efficient catalysis of zirconium(IV) chloride in poly(ethylene glycol). The method worked well for considerably large versatile reactants. Considering the aspect of drug-like properties and the structural significance of the MCR-products derived from the reaction of 2-aminobenzimida-

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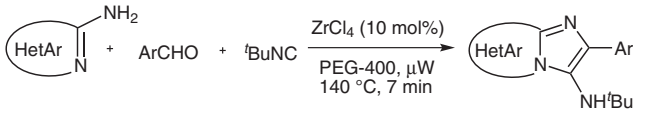
zole, which is a much less reactive amidine, we performed its reaction with 4-chlorobenzaldehyde and *tert*-butyl isocyanide by our developed process. The reaction was found to be slow, and prolonging the reaction for 18 hours produced a mixture of products out of which 23% of the targeted product was isolated. Increasing the reaction temperature from 50 to 100 °C and screening of other solvents such as DMSO and *t*-BuOH did not improve the reaction. To the best of our knowledge, there is no report of use of this amidine in the Ugi-type MCR. The reactions were then performed following some reported efficient methods, for example, catalysis by perchloric acid[4f] in MeOH, $Sc(OTf)_3$[4h] in CH_2Cl_2–MeOH, and catalysis by $MgCl_2$[4c] in MeOH under microwave irradiation (160 °C). Although, $Sc(OTf)_3$-catalyzed process improved the yield of the product (36%) in 48 hours, the other two methods disfavored the desired MCR, and the formation of many side reaction products were observed in all the three methods. In addition, the reaction of 4-formylphenylboronic acid and 4-formylbenzoic acid, which are important for follow up chemistry leading to diversity oriented synthesis, when attempted in our described method, exhibited a low reaction rate, and side products started to form after 15 hours. We then considered developing a robust method to gain the wider flexibility for these low reactive heterocyclic amidine and functional aldehydes, and additionally the method could be general to provide a convenient high-yielding synthesis of a library of versatile N-fused imidazoles. As microwave irradiation is continually being proved as a convenient method of heating to offer enhanced chemical activation as revealed in many areas including cycloaddition reactions[8] we surmised that the efficient catalysis by zirconium(IV) chloride, as explored in our earlier developed method,[4a] in combination with microwave irradiation could be beneficial.

In an initial experiment, the reaction of 2-aminobenzimidazole was carried out with 4-chlorobenzaldehyde and *tert*-butyl isocyanide catalyzed by $ZrCl_4$ (10 mol%) in PEG-400 as solvent under microwave irradiation at 140 °C (Biotage Initiator™ 60) for 5 minutes. Although, it afforded the desired MCR product, its complete isolation by both chromatographic purification and crystallization was problematic because of its high polarity and association with PEG. The reaction was then performed in *t*-BuOH. To our delight, the direct crystallization of the product from the reaction mixture without workup and chromatographic purification afforded *N*-*tert*-butyl-2-(4-chlorophenyl)-1*H*-imidazo[1,2-*a*]benzimidazol-3-amine in 75% yield (Table 1, entry 1). Inspired by the success of the reaction with 2-aminobenzimidazole, we tested the efficiency of the protocol for 4-formylphenylboronic acid and 4-formylbenzoic acid. Gratifyingly, the reaction of these functional aldehydes with 2-aminopyridine and *tert*-butyl isocyanide in PEG-400 provided the desired products in 82 and 92% isolated yield, respectively (Table 2, entries 1 and 2). Isolation of these products by crystallization without workup and chromatographic purification resulted in considerable loss in yields. We then focused on flexibility and efficiency of the protocol, as a general process, for other versatile heterocyclic-2-amidines, aldehydes, and isocyanides. The reaction of 2-aminopyridine with 2-thiophenecarboxaldehyde and cyclohexyl isocyanide was carried out in this microwave-promoted method. Very interestingly, the extraction of the resultant reaction mixture with ethyl acetate, washing with water, and the evaporation of the solvent provided a mixture of only the product, *N*-cyclohexyl-2-(2-thiophenyl)imidazo[1,2-*a*]pyridin-3-amine and poly(ethylene glycol) as revealed by ^{1}H NMR spectroscopy. The reaction conversion as determined by ^{1}H NMR was quantitative, and quantitative ^{1}H NMR calculation showed 99.6% yield. The column chromatographic filtration of the reaction mixture on silica gel afforded the analytically pure product in 97% isolated yield (Table 2, entry 11).

Table 1 Synthesis of Versatile N-Fused 3-Aminoimidazoles Spanning Diverse Heterocyclic Amidines



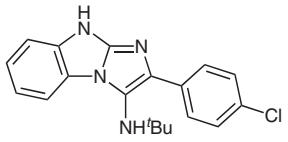
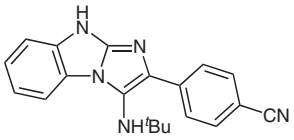
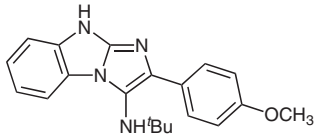
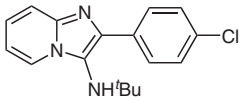
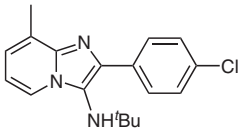
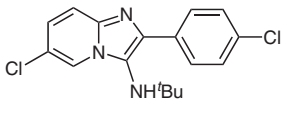
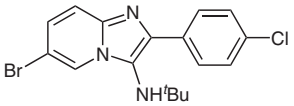
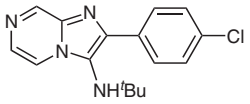
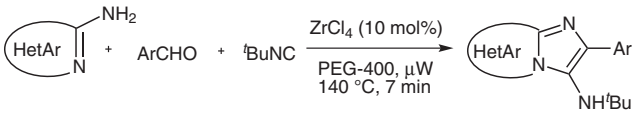
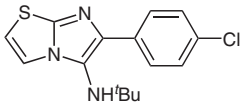
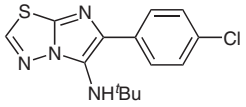
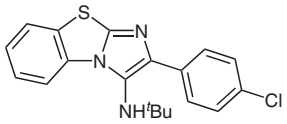
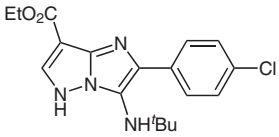
Entry	Product	Yield (%)[a]
1		75[b]
2		74[b]
3		72[b]
4		91
5		92
6		92
7		82
8		94

Table 1 Synthesis of Versatile N-Fused 3-Aminoimidazoles Spanning Diverse Heterocyclic Amidines (continued)



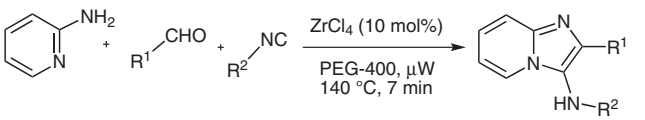
Entry	Product	Yield (%)[a]
9		90
10		82[c]
11		82
12		88

[a] Isolated yield.
[b] Reaction was performed in *t*-BuOH at 140 °C for 5 min.
[c] Reaction was performed at 140 °C for 3 min.

The scope of this process was broad and covers a wide range of heterocyclic 2-azines, aldehydes, and isocyanides affording, in all cases, the products in excellent yields. Heterocyclic azine includes 2-aminobenzimidazole, 2-aminopyridine, 2-aminopyrazine, 2-aminothiazole, 2-aminothiadiazole, 2-aminobenzthiazole, and 3-amino-1*H*-pyrazole (Table 1). Less reactive amidines like aminothiazole and aminothiadiazole were reported[4j,5b] to suffer from a slower reaction and competing reactions through nucleophilic attack of protic solvent (like MeOH) and amidine-amine to intermediate Schiff bases. Significantly, the reaction of these amidines (Table 1, entries 9–11) afforded also excellent yields. The less reactive amidine, 2-aminobenzimidazole, which gave in previous methods maximally 23% yield, provided in this new process the corresponding products in 72–75% isolated yields (Table 1, entries 1–3). These MCR products represent the compounds of significant drug-like properties for our investigation of targeted bioactivity studies.

Aldehydes including electron-rich, electron-poor, sterically hindered and metallocene-derived aromatic, heteroaromatic, and aliphatic aldehydes can be used (Table 2). 4-Formylphenylboronic acid, 4-formylbenzoic acid, and sterically hindered 2,4,6-trimethylbenzaldehyde (Table 2, entries 1–3), which suffered problems to undergo the reaction in our earlier reported method, proceeded well in the new process. The method was quite general for isocyanides, as investigated with *tert*-butyl, cyclohexyl, 4-methoxyphenyl, and 1,1,3,3-tetramethylbutyl isocyanides (Table 2). Significantly, the dealkylation of 1,1,3,3-

Table 2 Synthesis of N-Fused 3-Aminoimidazoles Spanning a Range of Aldehydes and Isocyanides



Entry	Aldehyde R^1	Isocyanide R^2	Yield (%)[a]
1	4-$HCOC_6H_4B(OH)_2$	*t*-Bu	82
2	4-$HCOC_6H_4CO_2H$	*t*-Bu	92
3	2,4,6-$Me_3C_6H_2$	cyclohexyl	88
4	3,4,5-$(MeO)_3C_6H_2$	cyclohexyl	93
5	3-$MeOC_6H_4$	cyclohexyl	96
6	4-$Me_2NC_6H_4$	cyclohexyl	89
7	2-BrC_6H_4	cyclohexyl	90
8	2-naphthyl	cyclohexyl	96
9	2-pyrrolyl	cyclohexyl	95
10	2-furyl	cyclohexyl	93
11	2-thiophenyl	cyclohexyl	97
12	2-pyridyl	cyclohexyl	91
13	ferrocenyl	cyclohexyl	90
14	*n*-C_5H_{11}	*t*-Bu	81
15	4-ClC_6H_4	1,1,3,3-tetramethylbutyl	88
16	4-ClC_6H_4	4-$MeOC_6H_4$	96

[a] Isolated yield.

tetramethylbutyl group of MCR product by TFA can convert it into corresponding primary amine product, which can be useful for further modification to afford more versatile products.[9] Functional groups on aromatic rings of aldehydes and heterocyclic amidines, such as boronic acid, carboxylic acid, ester, methoxy, chloro, bromo, cyano, and *N*,*N*-dimethyl were unaffected by the reaction conditions, and it thus opens the avenue for diversity-oriented preparation of larger focused libraries. The MCR product containing a boronic acid is valuable for further modification via the follow up C–C, C–O, and C–N bond formation by carbon–boron bond cross-coupling processes such as Suzuki, Heck, Sonogashira, and Buchwald–Hartwig couplings and Petasis MCR. Similarly the MCR product containing carboxylic acid can lead to a diverse library via several reactions like Ugi and Passerini reactions.

This multicomponent reaction proceeds consecutively through the formation of imine (or iminium) intermediate from 2-amidine and aldehyde, its [4+1] cycloaddition with the isocyanide, and the prototropic shift resulting in N-fused 3-aminoimidazoles. As observed in our investigations on the reaction of 2-aminobenimidazole, the reported methods of $Sc(OTf)_3$- and $HClO_4$-catalysis, and

$MgCl_2$-catalysis under microwave irradiation (160 °C) failed to provide successfully the corresponding MCR products for this poorly reactive starting compound. Our earlier developed process of $ZrCl_4$-catalysis at conventional heating (50 °C) was also found unsuccessful. On the other hand, the present method involving microwave irradiation (140 °C) and catalysis by $ZrCl_4$ offered the success for this poorly reactive 2-aminoazine. These imply that the efficient Lewis acid-catalysis by $ZrCl_4$, because of its high cationic charge potential (Z^2/r is 22.22 e^2m^{-10}), in addition to the effect of microwave irradiation was found crucial to promote the sufficient activation of low reactive amidines, and functional and sterically hindered aldehydes towards imine formation and subsequent hetero [4+1] cycloaddition in MCR. This effect results in a superior flexibility and efficiency of the protocol for structurally versatile reactants, and provides the MCR-products in excellent yields. To the best of our knowledge, there is no report on both conventional and microwave-promoted heating methods of using these less reactive 2-aminobenzimidazole, 4-formylphenylboronic acid, 4-formylbenzoic acid, and 2,4,6-trimethylbenzaldehyde in Ugi-type multicomponent reactions.

In conclusion, we have developed a highly efficient protocol of microwave-promoted multicomponent reaction catalyzed by zirconium(IV) chloride. The tolerance of the process towards functional moieties such as boronic acid, carboxylic acid, ester, halogens, and nitrile offers the feasibility of follow-up chemistry leading to diversity-oriented synthesis.

The starting materials and solvents were used as received from commercial suppliers without further purification. The ^1H and ^{13}C spectra were recorded on Bruker Avance III 400 and DPX 300 spectrometers using TMS as internal standard. Mass spectra were analyzed on Finnigan MAT LCQ (ESI) and Bruker Daltonics Ultraflex (MALDI). The IR spectra were taken on a Perkin-Elmer spectrometer as KBr pellets for solid and neat for liquid samples. Elemental analyses were done on Elementar Vario EL spectrometer.

N-tert-Butyl-2-(4-chlorophenyl)imidazo[1,2-*a*]pyridin-3-amine (Table 1, Entry 4); Typical Procedure

To a mixture of 2-aminopyridine (94 mg, 1 mmol) and 4-chlorobenzaldehyde (140 mg, 1 mmol) in PEG-400 (1 mL) in a microwave vial were added *tert*-butyl isocyanide (83 mg, 1 mmol) and $ZrCl_4$ (23 mg, 10 mol%). The vessel was sealed with a cap and the mixture was then irradiated in a monomode microwave synthesizer (Biotage Initiator™ 60) at 140 °C for 7 min. After cooling to r.t. in the microwave cavity, the crude mixture was extracted with EtOAc (60 mL) and the EtOAc layer was washed with H_2O (3 × 10 mL). The organic layer was dried (Na_2SO_4), filtered, and concentrated under reduced pressure. The column chromatographic purification of the crude product over silica gel (mesh size: 60–120) with EtOAc–hexane (1:1.5) as eluent afforded *N-tert*-butyl-2-(4-chlorophenyl)imidazo[1,2-*a*]pyridin-3-amine; yield: 273 mg (91%).

All reactions in Tables 1 and 2, except the reactions of 2-aminobenzimidazole (Table 1, entries 1–3) were carried out following this procedure.

Reactions of 2-Aminobenzimidazole (Table 1, Entries 1–3)

The reactions of 2-aminobenzimidazole with aldehydes and *tert*-butyl isocyanide in *t*-BuOH (replacing PEG-400) were conducted following the above-mentioned procedure. The resultant mixture obtained in each case was diluted with H_2O (5 mL), and aq ammonia (10%) was added dropwise till complete precipitation. The solid was filtered, washed subsequently with ice-cold H_2O (3 × 10 mL) and EtOAc–petroleum ether (bp 60–80 °C) (1:1, 3 × 5 mL), and dried under air. The complete removal of solvents was done under vacuum pump.

N-tert-Butyl-2-(4-chlorophenyl)-1*H*-imidazo[1,2-*a*]benzimidazol-3-amine (Table 1, Entry 1)

Light yellow solid; mp 234–236 °C.

IR (KBr): 3309, 2969, 2868, 1629, 1470, 1187, 740 cm^{-1}.

^1H NMR (300 MHz, DMSO-d_6): δ = 1.13 (s, 9 H), 3.58 (br s, 1 H, NH), 4.68 (br s, 1 H, NH), 7.19 (t, *J* = 7.5 Hz, 1 H), 7.28 (t, *J* = 7.5 Hz, 1 H), 7.40–7.47 (m, 3 H), 8.01 (d, *J* = 7.8 Hz, 1 H), 8.17 (d, *J* = 8.4 Hz, 2 H).

^{13}C NMR (100 MHz, DMSO-d_6): δ = 30.3 (3 CH_3), 56.0, 112.5, 119.2, 122.5, 123.1, 125.7, 128.1 (2 CH), 128.7 (2 CH), 129.0, 129.4, 130.52, 130.56, 133.0, 146.3.

MS (MALDI): *m*/*z* = 339 (MH^+).

Anal. Calcd for $C_{19}H_{19}ClN_4$: C, 67.35; H, 5.65; N, 16.54. Found: C, 67.51; H, 5.78; N, 16.49.

N-tert-Butyl-2-(4-cyanophenyl)-1*H*-imidazo[1,2-*a*]benzimidazol-3-amine (Table 1, Entry 2)

Yellow solid; mp >300 °C.

IR (KBr): 3380, 2968, 2221, 1630, 1469, 1196, 851, 743 cm^{-1}.

^1H NMR (400 MHz, DMSO-d_6): δ = 1.05 (s, 9 H), 7.12 (t, *J* = 7.6 Hz, 1 H), 7.22 (t, *J* = 7.6 Hz, 1 H), 7.33 (d, *J* = 8.0 Hz, 1 H), 7.75 (d, *J* = 8.0 Hz, 2 H), 7.95 (d, *J* = 8.0 Hz, 1 H), 8.29 (d, *J* = 8.0 Hz, 2 H).

^{13}C NMR (100 MHz, DMSO-d_6): δ = 30.2 (3 CH_3), 56.4, 107.8, 112.1, 112.8, 119.5, 119.8, 123.6, 124.3, 125.4, 127.3 (2 CH), 132.1 (2 CH), 133.5, 136.5, 141.2, 146.4.

MS (MALDI): *m*/*z* = 330 (MH^+).

Anal. Calcd for $C_{20}H_{19}N_5$: C, 72.93; H, 5.81; N, 21.26. Found: C, 73.07; H, 5.92; N, 21.01.

N-tert-Butyl-2-(4-methoxyphenyl)-1*H*-imidazo[1,2-*a*]benzimidazol-3-amine (Table 1, Entry 3)

Yellow solid; mp >300 °C.

IR (KBr): 3313, 2970, 1610, 1511, 1252, 1039, 833, 740 cm^{-1}.

^1H NMR (400 MHz, DMSO-d_6): δ = 1.02 (s, 9 H), 6.91 (d, *J* = 8.4 Hz, 2 H), 7.05 (t, *J* = 8.0 Hz, 1 H), 7.16 (t, *J* = 7.6 Hz, 1 H), 7.33 (d, *J* = 8.0 Hz, 1 H), 7.89 (d, *J* = 7.6 Hz, 1 H), 7.93 (d, *J* = 8.0 Hz, 2 H).

^{13}C NMR (100 MHz, DMSO-d_6): δ = 30.3 (3 CH_3), 55.4, 55.7, 112.1, 113.2, 113.7 (2 CH), 118.7, 120.9, 122.6, 126.1, 127.7, 128.5 (2 CH), 131.0, 133.5, 146.7, 158.1.

MS (MALDI): *m*/*z* = 335 (MH^+).

Anal. Calcd for $C_{20}H_{22}N_4O$: C, 71.83; H, 6.63; N, 16.75. Found: C, 72.07; H, 6.89; N, 16.59.

N-tert-Butyl-2-(4-chlorophenyl)imidazo[1,2-*a*]pyridin-3-amine (Table 1, Entry 4)

White solid; mp 146–149 °C.

IR (KBr): 3457, 2972, 1635, 1493, 1194, 770 cm^{-1}.

^1H NMR (400 MHz, $CDCl_3$): δ = 1.06 (s, 9 H), 6.78 (t, *J* = 6.8 Hz, 1 H), 7.15 (t, *J* = 8 Hz, 1 H), 7.40 (d, *J* = 8.8 Hz, 2 H), 7.54 (d, *J* = 7.2 Hz, 1 H), 7.92 (d, *J* = 8.8 Hz, 2 H), 8.20 (d, *J* = 6.8 Hz, 1 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 30.3 (3 CH_3), 56.4, 111.5, 117.3, 123.3, 123.4, 124.3, 128.4 (2 CH), 129.3 (2 CH), 133.1, 133.7, 138.3, 142.0.

MS (ESI): *m*/*z* = 300 (MH^+).

Anal. Calcd for $C_{17}H_{18}ClN_3$: C, 68.11; H, 6.05; N, 14.02. Found: C, 68.45; H, 6.29; N, 13.97.

***N-tert*-Butyl-2-(4-chlorophenyl)-8-methylimidazo[1,2-*a*]pyridin-3-amine (Table 1, Entry 5)**
Light yellow solid; mp 147–148 °C.

IR (KBr): 3406, 2972, 1635, 1493, 757 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.03 (s, 9 H), 2.61 (s, 3 H), 3.00 (br s, 1 H, NH), 6.69 (t, *J* = 6.8 Hz, 1 H), 6.93 (d, *J* = 6.8 Hz, 1 H), 7.38 (d, *J* = 6.4 Hz, 2 H), 7.90 (d, *J* = 6.4 Hz, 2 H), 8.06 (d, *J* = 6.8 Hz, 1 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 16.5, 30.3 (3 CH_3), 56.3, 111.4, 121.2, 123.0, 123.8, 127.1, 128.4 (2 CH), 129.5 (2 CH), 132.9, 134.1, 138.0, 142.4.

MS (ESI): *m*/*z* = 314 (MH^+).

Anal. Calcd for $C_{18}H_{20}ClN_3$: C, 68.89; H, 6.42; N, 13.39. Found: C, 69.17; H, 6.68; N, 13.32.

***N-tert*-Butyl-6-chloro-2-(4-chlorophenyl)imidazo[1,2-*a*]pyridin-3-amine (Table 1, Entry 6)**
White solid; mp 192–194 °C.

IR (KBr): 3451, 2970, 1635, 1496, 779 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.05 (s, 9 H), 3.00 (br s, 1 H, NH), 7.11 (d, *J* = 7.2, 2.4 Hz, 1 H), 7.40 (d, *J* = 6.8 Hz, 2 H), 7.47 (d, *J* = 8.8 Hz, 1 H), 7.86 (d, *J* = 6.8 Hz, 2 H), 8.23 (s, 1 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 30.3 (3 CH_3), 56.6, 117.8, 120.1, 121.3, 123.9, 125.7, 128.5 (2 CH), 129.3 (2 CH), 133.2, 133.5, 139.5, 140.3.

MS (ESI): *m*/*z* = 334 (MH^+).

Anal. Calcd for $C_{17}H_{17}Cl_2N_3$: C, 61.09; H, 5.13; N, 12.57. Found: C, 60.96; H, 5.29; N, 12.62.

6-Bromo-*N-tert*-butyl-2-(4-chlorophenyl)imidazo[1,2-*a*]pyridin-3-amine (Table 1, Entry 7)
Greenish yellow solid; mp 174–176 °C.

IR (KBr): 3291, 2966, 2922, 2857, 1488, 1402, 1207, 1093, 835, 797, 765 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.04 (s, 9 H), 7.20 (d, *J* = 9.6 Hz, 1 H), 7.38–7.43 (m, 3 H), 7.45 (*J* = 8.4 Hz, 2 H), 8.31 (s, 1 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 30.3 (3 CH_3), 56.6, 106.5, 118.0, 123.6, 127.7, 128.5 (2 CH), 129.3 (2 CH), 133.1, 133.5, 139.3, 140.4.

MS (ESI): *m*/*z* = 378 (MH^+).

Anal. Calcd for $C_{17}H_{17}BrClN_3$: C, 53.92; H, 4.52; N, 11.10. Found: C, 54.12; H, 4.68; N, 11.06.

***N-tert*-Butyl-2-(4-chlorophenyl)imidazo[1,2-*a*]pyrazin-3-amine (Table 1, Entry 8)**
Light yellow solid; mp 150–152 °C.

IR (KBr): 3425, 2972, 1646, 1493, 757 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.07 (s, 9 H), 7.43 (d, *J* = 6.8 Hz, 2 H), 7.86 (d, *J* = 4.4 Hz, 1 H), 7.92 (d, *J* = 6.8 Hz, 2 H), 8.10 (d, *J* = 6 Hz, 1 H), 8.99 (s, 1 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 30.4 (3 CH_3), 57.0, 116.2, 124.9, 128.6 (2 CH), 128.7, 129.0, 129.4 (2 CH), 131.3, 132.7, 134.1, 137.3, 141.1, 143.4.

MS (ESI): *m*/*z* = 301 (MH^+).

Anal. Calcd for $C_{16}H_{17}ClN_4$: C, 63.89; H, 5.70; N, 18.63. Found: C, 63.65; H, 5.88; N, 18.36.

***N-tert*-Butyl-6-(4-chlorophenyl)imidazo[2,1-*b*]thiazol-5-amine (Table 1, Entry 9)**
Cream solid; mp 167–168 °C.

IR (KBr): 3429, 2959, 1636, 1487, 651 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.08 (s, 9 H), 6.74 (d, *J* = 4.4, 1 H), 7.33–7.36 (m, 3 H), 7.89 (d, *J* = 6.8 Hz, 2 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 30.2 (3 CH_3), 55.8, 111.7, 117.7, 125.4, 128.3 (2 CH), 128.4 (2 CH), 132.3, 133.7, 139.1, 145.7.

MS (ESI): *m*/*z* = 306 (MH^+).

Anal. Calcd for $C_{15}H_{16}ClN_3S$: C, 58.91; H, 5.27; N, 13.74; S, 10.48. Found: C, 59.22; H, 5.20; N, 13.92; S, 10.29.

***N-tert*-Butyl-6-(4-chlorophenyl)imidazo[2,1-*b*][1,3,4]thiadiazol-5-amine (Table 1, Entry 10)**
White solid; mp 127–130 °C.

IR (KBr): 3349, 2960, 1664, 1602, 1493, 797 cm^{-1}.

^{1}H NMR (400 MHz, DMSO-d_6): δ = 1.06 (s, 9 H), 4.53 (s, 1 H), 7.40 (d, *J* = 8.4 Hz, 2 H), 8.17 (d, *J* = 8.4 Hz, 2 H), 9.12 (s, 1 H).

^{13}C NMR (100 MHz, DMSO-d_6): δ = 30.4 (3 CH_3), 55.4, 127.6, 128.3 (2 CH), 128.4 (2 CH), 131.2, 134.4, 137.4, 140.6, 149.3.

MS (ESI): *m*/*z* = 307 (MH^+).

Anal. Calcd for $C_{14}H_{15}ClN_4S$: C, 54.81; H, 4.93; N, 18.26; S, 10.45. Found: C, 54.92; H, 5.22; N, 18.14; S, 10.23.

***N-tert*-Butyl-2-(4-chlorophenyl)imidazo[2,1-*b*]benzothiazol-3-amine (Table 1, Entry 11)**
Light yellow solid; mp 171–174 °C.

IR (KBr): 3337, 2958, 1673, 1491, 757 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.06 (s, 9 H), 3.01 (br s, 1 H, NH), 7.28–7.32 (m, 1 H), 7.37 (d, *J* = 6.4 Hz, 2 H), 7.64–7.66 (m, 1 H), 7.65 (d, *J* = 7.6 Hz, 1 H), 7.74 (d, *J* = 6.4 Hz, 2 H), 8.30 (d, *J* = 8.2 Hz, 1 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 29.9 (3 CH_3), 56.6, 114.4, 124.0, 124.3, 125.3, 128.2, 128.4 (2CH), 128.9 (2CH), 130.3, 130.7, 132.7, 133.6, 133.7, 140.0, 144.2.

MS (ESI): *m*/*z* = 356 (MH^+).

Anal. Calcd for $C_{19}H_{18}ClN_3S$: C, 64.12; H, 5.10; N, 11.81; S, 9.01. Found: C, 64.31; H, 5.38; N, 11.44; S, 8.62.

Ethyl 3-(*tert*-Butylamino)-2-(4-chlorophenyl)-5*H*-imidazo[1,2-*b*]pyrazole-7-carboxylate (Table 1, Entry 12)
Yellow solid; mp 181–183 °C.

IR (KBr): 3431, 2961, 1623, 1480, 704 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.13 (s, 9 H), 1.62 (m, 3 H), 3.00 (br s, 1 H, NH), 7.38 (d, *J* = 8 Hz, 2 H), 7.76 (d, *J* = 8 Hz, 2 H), 7.98 (s, 3 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 14.5, 30.1 (3 CH_3), 56.3, 59.8, 91.3, 122.7, 123.1, 127.7 (2 CH), 129.3 (2 CH), 131.9, 133.5, 138.7, 144.0, 163.9.

MS (ESI): *m*/*z* = 361 (MH^+).

Anal. Calcd for $C_{18}H_{21}ClN_4O_2$: C, 59.91; H, 5.87; N, 15.53. Found: C, 59.75; H, 6.11; N, 15.66.

4-(3-(*tert*-Butylamino)imidazo[1,2-*a*]pyridin-2-yl)phenylboronic Acid (Table 2, Entry 1)
Yellow solid; mp 188–190 °C.

IR (KBr): 3567, 3442, 2961, 2868, 1772, 1609, 1017, 751 cm^{-1}.

^1H NMR (300 MHz, DMSO-d_6): δ = 1.00 (s, 9 H), 4.66 (br s, 1 H, NH), 6.88 (t, *J* = 6.6 Hz, 1 H), 7.20 (t, *J* = 6.9 Hz, 1 H), 7.47 (d, *J* = 9.0 Hz, 1 H), 7.82 (d, *J* = 7.8 Hz, 2 H), 8.01 (s, 2 H, 2 OH), 8.08 (d, *J* = 7.8 Hz, 2 H), 8.41 (d, *J* = 6.6 Hz, 1 H).

^{13}C NMR (75 MHz, DMSO-d_6): δ = 30.4 (3 CH_3), 56.1, 111.4, 116.9, 124.5 (2 CH, 1 C), 126.9 (2 CH), 134.1 (2 CH), 137.2, 138.2, 141.3.

MS (ESI): *m*/*z* = 310 (MH^+).

Anal. Calcd for $C_{17}H_{20}BN_3O_2$: C, 66.04; H, 6.52; N, 13.59. Found: C, 66.21; H, 6.72; N, 13.45.

4-(3-(*tert*-Butylamino)imidazo[1,2-*a*]pyridin-2-yl)benzoic Acid (Table 2, Entry 2)
Yellow solid; mp >300 °C.

IR (KBr): 3567, 2967, 2868, 1717, 1603, 1412, 1219, 771 cm^{-1}.

^1H NMR (400 MHz, DMSO-d_6): δ = 0.75 (s, 9 H), 7.04 (t, *J* = 6.8 Hz, 1 H), 7.43 (t, *J* = 8.0 Hz, 1 H), 7.52 (d, *J* = 8.8 Hz, 1 H), 7.80 (d, *J* = 8.4 Hz, 2 H), 8.01 (d, *J* = 8.0 Hz, 2 H), 8.48 (d, *J* = 7.2 Hz, 1 H).

^{13}C NMR (100 MHz, DMSO-d_6): δ = 30.2 (3 CH_3), 56.8, 114.2, 115.1, 125.9, 126.2, 128.4 (2 CH), 129.8 (2 CH), 130.0, 130.3, 130.9, 135.2, 139.2, 167.4.

MS (MALDI): *m*/*z* = 310 (MH^+).

Anal. Calcd for $C_{18}H_{19}N_3O_2$: C, 69.88; H, 6.19; N, 13.58. Found: C, 69.52; H, 6.52; N, 13.79.

***N*-Cyclohexyl-2-(2,4,6-trimethylphenyl)imidazo[1,2-*a*]pyridin-3-amine (Table 2, Entry 3)**
Buff white solid; mp 166–168 °C.

IR (KBr): 3362, 2929, 2857, 1607, 1076, 746 cm^{-1}.

^1H NMR (400 MHz, $CDCl_3$): δ = 1.01–1.13 (m, 5 H), 1.48–1.53 (m, 1 H), 1.59–1.61 (m, 2 H), 1.68–1.71 (m, 2 H), 2.08 (s, 6 H), 2.33 (s, 3 H), 2.70–2.73 (m, 1 H), 6.79 (t, *J* = 6.8 Hz, 1 H), 6.92 (s, 2 H), 7.11 (t, *J* = 6.8 Hz, 1 H), 7.52 (d, *J* = 8.8 Hz, 1 H), 8.11 (d, *J* = 6.8 Hz, 1 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 20.1 (2 CH_3), 21.2, 24.6 (2 CH_2), 25.6, 33.9 (2 CH_2), 56.4, 111.1, 117.4, 122.6, 122.7, 125.7, 128.0 (2 CH), 130.2, 136.2, 137.3, 137.5 (2 C), 141.3.

MS (ESI): *m*/*z* = 334 (MH^+).

Anal. Calcd for $C_{22}H_{27}N_3$: C, 79.24; H, 8.16; N, 12.60. Found: C, 79.52; H, 8.02; N, 12.46.

***N*-Cyclohexyl-2-(3,4,5-trimethoxyphenyl)imidazo[1,2-*a*]pyridin-3-amine (Table 2, Entry 4)**
Dark orange-brown solid; mp 162–164 °C.

IR (KBr): 3306, 2929, 2853, 1505, 1234, 1127, 1007, 751 cm^{-1}.

^1H NMR (300 MHz, $CDCl_3$): δ = 1.14–1.29 (m, 5 H), 1.61–1.84 (m, 5 H), 3.03 (m, 2 H), 3.90 (s, 3 H), 3.95 (s, 6 H), 6.77 (t, *J* = 6.0 Hz, 1 H), 7.12 (t, *J* = 6.0 Hz, 1 H), 7.40 (s, 2 H), 7.52 (d, *J* = 9.0 Hz, 1 H), 8.07 (d, *J* = 6.0 Hz, 1 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 25.3 (2 CH_2), 26.2, 34.8 (2 CH_2), 56.7 (2 CH_3), 57.4, 61.4, 104.7 (2CH), 112.1, 117.8, 123.0, 124.4, 124.9, 130.7, 137.0, 137.9, 142.0, 153.8 (2 C).

MS (ESI): *m*/*z* = 382 (MH^+).

Anal. Calcd for $C_{22}H_{27}N_3O_3$: C, 69.27; H, 7.13; N, 11.02. Found: C, 69.41; H, 7.35; N, 11.36.

***N*-Cyclohexyl-2-(3-methoxyphenyl)imidazo[1,2-*a*]pyridin-3-amine (Table 2, Entry 5)**
Light yellow solid; mp 153–155 °C.

IR (KBr): 3317, 2928, 2853, 1454, 1260, 1046, 872, 751 cm^{-1}.

^1H NMR (400 MHz, $CDCl_3$): δ = 1.14–1.45 (m, 5 H), 1.58–1.93 (m, 5 H), 2.94–3.00 (m, 2 H), 3.89 (s, 3 H), 6.78 (t, *J* = 6.8 Hz, 1 H), 6.88 (d, *J* = 8.0 Hz, 1 H), 7.13 (t, *J* = 7.6 Hz, 1 H), 7.35 (t, *J* = 7.6 Hz, 1 H), 7.54 (d, *J* = 8.8 Hz, 1 H), 7.60 (d, *J* = 7.6 Hz, 1 H), 7.64 (s, 1 H), 8.11 (d, *J* = 6.8 Hz, 1 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 24.7 (2 CH_2), 25.7, 34.1 (2 CH_2), 55.3, 56.9, 111.6, 112.1, 113.6, 117.2, 119.4, 122.7, 123.9, 125.1, 129.4, 135.7, 136.2, 141.4, 159.8.

MS (ESI): *m*/*z* = 322.2 (MH^+).

Anal. Calcd for $C_{20}H_{23}N_3O$: C, 74.74; H, 7.21; N, 13.07. Found: C, 74.89; H, 7.37; N, 12.86.

***N*-Cyclohexyl-2-[4-(dimethylamino)phenyl]imidazo[1,2-*a*]pyridin-3-amine (Table 2, Entry 6)**
Reddish brown solid; mp 170-171 °C.

IR (KBr): 3306, 2926, 2851, 1613, 1513, 1087, 822, 752, 626 cm^{-1}.

^1H NMR (400 MHz, $CDCl_3$): δ = 1.15–1.23 (m, 5 H), 1.58–1.59 (m, 1 H), 1.69–1.71 (m, 2 H), 1.81–1.84 (m, 2 H), 2.99–3.01 (m, 1 H), 3.01 (s, 6 H), 6.77–6.81 (m, 3 H), 7.13 (t, *J* = 8.0 Hz, 1 H), 7.60 (d, *J* = 8.8 Hz, 1 H), 7.95 (d, *J* = 7.2 Hz, 2 H), 8.14 (d, *J* = 6.8 Hz, 1 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 24.8 (2 CH_2), 25.7, 34.1 (2 CH_2), 40.4 (2 C), 56.8, 111.2, 112.3 (2 CH), 116.8, 122.5, 123.4, 123.5, 127.8 (2 CH), 134.0, 137.0, 141.3, 149.7.

MS (ESI): *m*/*z* = 335 (MH^+).

Anal. Calcd for $C_{21}H_{26}N_4$: C, 75.41; H, 7.84; N, 16.75. Found: C, 75.53; H, 8.11; N, 16.36.

***N*-Cyclohexyl-2-(2-bromophenyl)imidazo[1,2-*a*]pyridin-3-amine (Table 2, Entry 7)**
Dark brown solid; mp 140–142 °C.

IR (KBr): 3272, 2928, 2852, 1664, 1505, 1349, 1024, 751 cm^{-1}.

^1H NMR (400 MHz, $CDCl_3$): δ = 0.98–1.14 (m, 5 H), 1.47–1.72 (m, 5 H), 2.63–2.74 (m, 1 H), 3.29 (br s, 1 H), 6.85 (t, *J* = 6.8 Hz, 1 H), 7.19 (t, *J* = 6.8 Hz, 1 H), 7.27 (t, *J* = 8.0 Hz, 1 H), 7.42 (t, *J* = 8.8 Hz, 1 H), 7.56–7.68 (m, 3 H), 8.17 (d, *J* = 6.8 Hz, 1 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 24.5 (2 CH_2), 25.6, 33.8 (2 CH_2), 56.3, 111.8, 117.4, 122.9, 122.9, 124.1, 125.9, 127.4, 129.5, 132.6, 132.77, 135.6, 141.0.

MS (MALDI): *m*/*z* = 370 (MH^+).

Anal. Calcd for $C_{19}H_{20}BrN_3$: C, 61.63; H, 5.44; N, 11.35. Found: C, 61.84; H, 5.36; N, 11.63.

***N*-Cyclohexyl-2-(naphthalen-2-yl)imidazo[1,2-*a*]pyridin-3-amine (Table 2, Entry 8)**
White solid; mp 138–140 °C.

IR (KBr): 3306, 2927, 2851, 1630, 1602, 1086, 752 cm^{-1}.

^1H NMR (400 MHz, $CDCl_3$): δ = 1.15–1.21 (m, 3 H), 1.25–1.36 (m, 2 H), 1.54–1.56 (m, 1 H), 1.66–1.73 (m, 2 H), 1.83–1.86 (m, 2 H), 2.96–3.03 (m, 1 H), 6.80 (t, *J* = 6.8 Hz, 1 H), 7.15 (t, *J* = 8.0 Hz, 1 H), 7.46–7.52 (m, 2 H), 7.62 (d, *J* = 8.8 Hz, 1 H), 7.83 (m, 1 H), 7.89 (d, *J* = 8.8 Hz, 1 H), 7.93–7.96 (m, 1 H), 8.15 (d, *J* = 5.6 Hz, 1 H), 8.23 (d, *J* = 8.8 Hz, 1 H), 8.57 (s, 1 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 24.8 (2 CH_2), 25.6, 34.1 (2 CH_2), 56.9, 112.0, 116.7, 122.8, 124.3, 124.7, 124.9, 125.4, 125.9 (1 CH, 1 C), 126.1, 127.6, 128.0, 128.4, 130.8, 131.0, 132.7, 133.5, 135.5, 141.1.

MS (ESI): m/z = 342 (MH^+).

Anal. Calcd for $C_{23}H_{23}N_3$: C, 80.90; H, 6.79; N, 12.31. Found: C, 81.01; H, 6.91; N, 12.08.

***N*-Cyclohexyl-2-(1*H*-pyrrol-2-yl)imidazo[1,2-*a*]pyridin-3-amine (Table 2, Entry 9)**
Greenish black solid; mp 166–167 °C.

IR (KBr): 3391, 2928, 2851, 1607, 1273, 750 cm^{-1}.

^1H NMR (400 MHz, $CDCl_3$): δ = 1.16–1.39 (m, 5 H), 1.63–1.67 (m, 1 H), 1.73–1.76 (m, 2 H), 1.88–1.91 (m, 2 H), 3.06–3.15 (m, 2 H), 6.33 (q, J = 2.4 Hz, 1 H), 6.61–6.62 (m, 1 H), 6.78 (t, J = 6.8 Hz, 1 H), 6.87–6.88 (m, 1 H), 7.11 (t, J = 6.8 Hz, 1 H), 7.46 (d, J = 9.2 Hz, 1 H), 8.10 (d, J = 6.8 Hz, 1 H), 10.35 (br s, 1 H, NH).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 24.8 (2 CH_2), 25.7, 34.3 (2 CH_2), 56.7, 105.7, 109.5, 111.5, 116.3, 118.1, 122.5, 122.6, 123.8, 126.0, 131.4, 141.4.

MS (ESI): m/z = 281 (MH^+).

Anal. Calcd for $C_{17}H_{20}N_4$: C, 72.83; H, 7.19; N, 19.98. Found: C, 72.95; H, 7.24; N, 19.81.

***N*-Cyclohexyl-2-(furan-2-yl)imidazo[1,2-*a*]pyridin-3-amine (Table 2, Entry 10)**
Creamish-yellow solid; mp 121–122 °C.

IR (KBr): 3286, 2930, 2854, 1667, 1536, 1349, 752, 737 cm^{-1}.

^1H NMR (400 MHz, $CDCl_3$): δ = 1.11–1.41 (m, 5 H), 1.59–1.75 (m, 3 H), 1.88–1.95 (m, 2 H), 2.95–2.99 (m, 1 H), 6.52–6.53 (m, 1 H), 6.78 (t, J = 6.8 Hz, 1 H), 6.88 (d, J = 3.2 Hz, 1 H), 7.12 (t, J = 8.0 Hz, 1 H), 7.48–7.50 (m, 2 H), 8.06 (d, J = 6.8 Hz, 1 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 25.0 (2 CH_2), 25.7, 34.1 (2 CH_2), 57.0, 106.5, 111.5, 111.7, 117.1, 122.8, 124.1, 141.4, 141.7, 142.7, 150.2, 160.3.

MS (ESI): m/z = 282 (MH^+).

Anal. Calcd for $C_{17}H_{19}N_3O$: C, 72.57; H, 6.81; N, 14.94. Found: C, 72.41; H, 6.98; N, 14.81.

***N*-Cyclohexyl-2-(thiophen-2-yl)imidazo[1,2-*a*]pyridin-3-amine (Table 2, Entry 11)**
Greenish grey solid; mp 165–166 °C.

IR (KBr): 3294, 2927, 2852, 1630, 1579, 1448, 1337, 1084, 751 cm^{-1}.

^1H NMR (400 MHz, $CDCl_3$): δ = 1.12–1.28 (m, 3 H), 1.30–1.43 (m, 2 H), 1.61–1.66 (m, 1 H), 1.73–1.76 (m, 2 H), 1.87–1.90 (m, 2 H), 3.08–3.14 (m, 2 H), 6.81 (t, J = 6.8 Hz, 1 H), 7.13–7.18 (m, 2 H), 7.34 (d, J = 5.2 Hz, 1 H), 7.57 (d, J = 8.8 Hz, 1 H), 7.67 (d, J = 3.6 Hz, 1 H), 8.12 (d, J = 6.8 Hz, 1 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 24.7 (2 CH_2), 25.7, 34.2 (2 CH_2), 57.0, 111.7, 117.0, 122.7, 123.9, 124.3, 124.6, 127.6, 132.6, 137.0, 141.6 (2 C).

MS (ESI): m/z = 298 (MH^+).

Anal. Calcd for $C_{17}H_{19}N_3S$: C, 68.65; H, 6.44; N, 14.13; S; 10.78. Found: C, 68.78; H, 6.67; N, 14.05; S, 10.50.

***N*-Cyclohexyl-2-(pyridin-2-yl)imidazo[1,2-*a*]pyridin-3-amine (Table 2, Entry 12)**
Greenish grey solid; mp 110–111 °C.

IR (KBr): 3292, 2928, 2852, 1593, 744 cm^{-1}.

^1H NMR (400 MHz, $CDCl_3$): δ = 1.20–1.43 (m, 5 H), 1.54–1.66 (m, 1 H), 1.71–1.74 (m, 2 H), 1.88–1.96 (m, 2 H), 3.04–3.15 (m, 1 H), 6.27 (br s, 1 H, NH), 6.76 (t, J = 6.8 Hz, 1 H), 7.07–7.15 (m, 2 H), 7.53 (d, J = 9.2 Hz, 1 H), 7.75 (t, J = 8 Hz, 1 H), 7.98 (d, J = 6.8 Hz, 1 H), 8.17 (d, J = 8 Hz, 1 H), 8.56 (d, J = 4.8 Hz, 1 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 24.9 (2 CH_2), 25.7, 34.0 (2 CH_2), 55.4, 111.6, 117.8, 120.1, 121.0, 123.0, 123.2, 130.1, 131.1, 136.4, 140.7, 148.3, 155.0.

MS (MALDI): m/z = 292 (M^+).

Anal. Calcd for $C_{18}H_{20}N_4$: C, 73.94; H, 6.89; N, 19.16. Found: C, 73.78; H, 7.21; N, 19.01.

***N*-Cyclohexyl-2-(ferrocenyl)imidazo[1,2-*a*]pyridin-3-amine (Table 2, Entry 13)**
Brownish black solid; mp 168–170 °C.

IR (KBr): 3400, 2923, 2857, 1621, 1384, 1259, 1049, 749 cm^{-1}.

^1H NMR (400 MHz, $CDCl_3$): δ = 1.28–1.37 (m, 5 H), 1.66–1.68 (m, 1 H), 1.78–1.80 (m, 2 H), 1.89–1.92 (m, 2 H), 3.12–3.20 (m, 1 H), 4.10 (s, 5 H), 4.35 (s, 2 H), 4.93 (s, 2 H), 6.74 (t, J = 7.2 Hz, 1 H), 7.09 (t, J = 8.4 Hz, 1 H), 7.51 (d, J = 9.2 Hz, 1 H), 8.08 (d, J = 6.8 Hz, 1 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 25.0 (2 CH_2), 25.8, 34.3 (2 CH_2), 57.2, 66.8 (2 CH), 68.6 (2 CH), 69.2 (5 CH), 78.9, 111.1, 116.7, 122.3, 123.2, 123.7, 136.2, 141.5.

MS (ESI): m/z = 400 (MH^+).

***N*-*tert*-Butyl-2-pentylimidazo[1,2-*a*]pyridin-3-amine (Table 2, Entry 14)**
Dark yellow viscous liquid.

IR (neat): 3362, 2925, 2854, 1592, 1464, 751 cm^{-1}.

^1H NMR (300 MHz, $CDCl_3$): δ = 0.80–0.88 (m, 3 H), 1.12 (s, 9 H), 1.18–1.30 (m, 4 H), 1.69–1.72 (m, 2 H), 2.64 (t, J = 8.1 Hz, 2 H), 6.63 (t, J = 6.6 Hz, 1 H), 6.99 (t, J = 7.8 Hz, 1 H), 7.37 (d, J = 9.0 Hz, 1 H), 8.07 (d, J = 6.9 Hz, 1 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 13.0, 21.5, 26.8, 28.2, 29.3 (3 CH_3), 31.1, 54.4, 109.7, 115.5, 122.2, 122.3, 127.7, 129.8, 140.3.

MS (ESI) m/z = 260 (MH^+).

Anal. Calcd for $C_{16}H_{25}N_3$: C, 74.09; H, 9.71; N, 16.20. Found: C, 74.01; H, 9.57; N, 16.42.

***N*-2-(2,4,4-Trimethylpentan-2-yl) 2-(4-chlorophenyl)imidazo[1,2-*a*]pyridin-3-amine (Table 2, Entry 15)**
Light yellow solid; mp 200–201 °C.

IR (KBr): 3401, 2952, 2873, 1384, 1245, 1050, 754 cm^{-1}.

^1H NMR (400 MHz, $CDCl_3$): δ = 0.93 (s, 6 H), 0.98 (s, 9 H), 1.58 (s, 2 H), 7.15 (t, J = 6.8 Hz, 1 H), 7.25 (d, J = 8.4 Hz, 2 H), 7.47 (t, J = 7.6 Hz, 1 H), 7.80 (d, J = 8.8 Hz, 1 H), 8.00 (d, J = 8.4 Hz, 2 H), 8.52 (d, J = 6.8 Hz, 1 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 29.2 (2 CH_3), 31.7, 31.8 (3 CH_3), 57.1, 60.6, 111.5, 117.2, 123.3, 123.5, 124.3, 128.4 (2 CH), 129.6 (2 CH), 133.2, 133.8, 138.6, 142.0.

MS (ESI): m/z = 356 (MH^+).

Anal. Calcd for $C_{21}H_{26}ClN_3$: C, 70.87; H, 7.36; N, 11.81. Found: C, 71.16; H, 7.62; N, 11.65.

***N*-(4-Methoxyphenyl) 2-(4-chlorophenyl)imidazo[1,2-*a*]pyridin-3-amine (Table 2, Entry 16)**
Yellowish cream solid; mp 190–191 °C.

IR (KBr): 3233, 2829, 1508, 1235, 1092, 1036, 823, 754, 737 cm^{-1}.

^1H NMR (400 MHz, $CDCl_3$): δ = 3.75 (s, 3 H), 5.51 (br s, 1 H, NH), 6.54 (d, J = 8.8 Hz, 2 H), 6.78–6.81 (m, 3 H), 7.24 (t, J = 6.8 Hz, 1 H), 7.32 (d, J = 8.8 Hz, 2 H), 7.63 (d, J = 9.2 Hz, 1 H), 7.84 (d, J = 6.8 Hz, 1 H), 7.96 (d, J = 8.4 Hz, 2 H).

^{13}C NMR (100 MHz, $CDCl_3$): δ = 112.4, 114.4 (2 CH), 115.3 (2 CH), 116.2, 117.5, 118.9, 122.8, 125.4, 128.4 (2 CH), 128.7 (2 CH), 131.7, 133.7, 138.0, 142.5, 153.7.

MS (ESI): *m*/*z* = 350 (MH^+).

Anal. Calcd for $C_{20}H_{16}ClN_3O$: C, 68.67; H, 4.61; N, 12.01. Found: C, 68.83; H, 4.92; N, 11.78.

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