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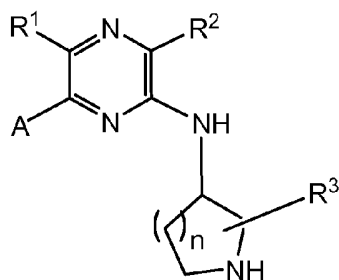
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(54) Title: 6 SUBSTITUTED 2-HETEROCYCLYLAMINO PYRAZINE COMPOUNDS AS CHK-1 INHIBITORS



(I)

(57) Abstract: The present invention is directed to compounds of formula (I), and pharmaceutically acceptable salts thereof, their synthesis, and their use as CHK-1 inhibitors.

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## 6 SUBSTITUTED 2- HETEROCYCLYLAMINO PYRAZINE COMPOUNDS AS CHK-1 INHIBITORS

This application claims the benefit of United States Provisional Patent Application Nos. 61/086,732, filed August 6, 2008, and 61/229,428, filed July 29, 2009, the disclosures of which are hereby incorporated by reference in their entireties.

### Field of the Invention

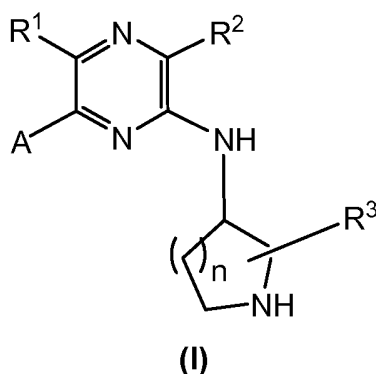
The present invention is directed to compounds, and pharmaceutically acceptable salts thereof, their synthesis, and their use as modulators or inhibitors of check point kinase 1 (CHK-1). The compounds of the present invention are useful for modulating (e.g. inhibiting) CHK-1 activity and for treating diseases or conditions mediated by CHK-1, such as for example, disease states associated with abnormal cell growth such as cancer.

### Background

It has been well known in the art that check point kinase 1 (CHK-1) is one of the important enzymes that are involved in maintaining the order and fidelity of events in the cell cycle and CHK-1 inhibitors have been proposed for cancer therapy. (*Science*, 277, 1501-1505 (1997); *Science*, 277, 1497-1501 (1997)). (*Cell*, 91, 865-867 (1997); *Science*, 277, 1450-1451 (1997); *Nature*, 363, 368-371 (1993); *Molec. Biol. Cell*, 5, 147-160 (1994)). Flaggs, G. et. al. (1997) *Current Biology* 7:977-986; U.S. Patent Nos. 6,967,198, 6,413,755, 6,383,744 and 6,211,164; and International Publication Nos. WO 01/16306, WO 01/21771, WO 00/16781, and WO 02/070494).

### Summary of Invention

The current invention is directed to a compound of formula (I)

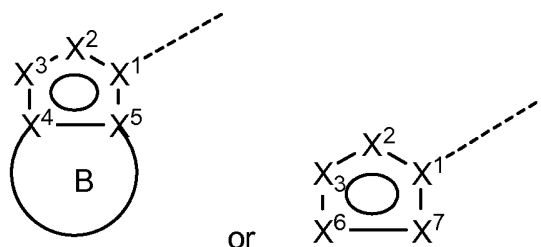


wherein,

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n is 0, 1 or 2; preferably n is 1 or 2, more preferably, n is 2;

A is of the structure



and A is optionally further substituted with 1-6  $R^4$ ;

5  $X^1$ ,  $X^2$ ,  $X^3$ ,  $X^4$  and  $X^5$  form a 5 member heteroaryl having 1-4 nitrogen ring atoms;

$X^1$ ,  $X^2$ ,  $X^3$ ,  $X^6$  and  $X^7$  form a 5 member heteroaryl having 1-4 nitrogen ring atoms;

10  $X^1$  is N or C;  $X^2$  is N, NH or CH;  $X^3$  is N; each of  $X^4$  and  $X^5$  is independently N or C; each of  $X^6$  and  $X^7$  is independently N, NH or CH;

B together with  $X^4$  and  $X^5$  form a ring selected from phenyl, 5-6 member heteroaryl, 5-6 member heterocyclyl,  $C_5$ - $C_6$  cycloalkyl and  $C_5$ - $C_6$  cycloalkenyl, each of the said 5-6 member heteroaryl and 5-6 member heterocyclyl has 1-3 ring heteroatoms selected from N, O and S;

15 each of  $R^1$  and  $R^2$  is independently selected from hydrogen, fluorine, chlorine, -CN,  $-OR^b$ ,  $-N(R^b)_2$ , and  $C_1$ - $C_3$  alkyl optionally substituted with 1-6 groups selected from fluorine, chlorine and -CN;

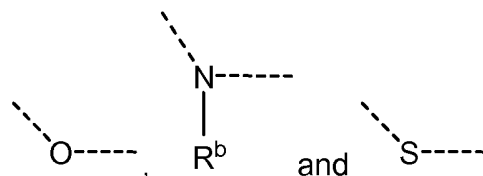
$R^3$  represents 1-6 optional substituents independently selected from the group consisting of -oxo- and  $R^0$ ;

20 two  $R^3$  attached to the same ring atom, together with the ring atom attached to, may form a ring selected from  $C_3$ - $C_6$  cycloalkyl,  $C_5$ - $C_6$  cycloalkenyl and 3-6 member heterocyclyl; each of the said  $C_3$ - $C_6$  cycloalkyl,  $C_5$ - $C_6$  cycloalkenyl and 3-6 member heterocyclyl is optionally further substituted with 1-5 groups selected from -oxo- and  $R^w$ ;

25 two  $R^3$  attached to two adjacent ring atoms, together with the ring atoms attached to, may form a fused ring selected from  $C_3$ - $C_6$  cycloalkyl,  $C_5$ - $C_6$  cycloalkenyl, 3-6 member heterocyclyl, phenyl and 5-6 member heteroaryl; the said  $C_3$ - $C_6$  cycloalkyl,  $C_5$ - $C_6$  cycloalkenyl, 3-6 member heterocyclyl, phenyl and 5-6 member heteroaryl is optionally further substituted with 1-5 groups selected from oxo and  $R^w$ ;

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two  $R^3$  attached to, two different ring atoms with at least one ring atom in between, may form a  $C_1$ - $C_4$  alkylene, a 2-4 member heteroalkylene, or a diradical selected from the group consisting of:



5 such  $C_1$ - $C_4$  alkylene, 2-4 member heteroalkylene and diradical together with the azetidiny (when  $n$  is 0), pyrrolidiny (when  $n$  is 1) or the piperidiny (when  $n$  is 2) form a bicyclic bridged ring system, the said bicyclic bridged ring system having a total of 6-9 ring atoms with 1-3 of the ring atoms selected from O, N and S; the  $C_1$ - $C_4$  alkylene or a 1-4 member heteroalkylene is optionally further substituted with 1-5  
10 groups selected from -oxo- and  $R^w$ ;

each  $R^4$  is independently  $R^0$ ;

each  $R^0$  is independently selected from the group consisting of **(a)** fluorine, chlorine and -CN; **(b)**  $C_1$ - $C_6$  alkyl,  $C_2$ - $C_6$  alkenyl and  $C_2$ - $C_6$  alkynyl, each of which is optionally further substituted with 1-6 groups selected from fluorine, chlorine and CN;  
15 **(c)**  $C_3$ - $C_6$  cycloalkyl, -L-( $C_3$ - $C_6$  cycloalkyl), 4-6 member heterocyclyl, -L-(4-6 member heterocyclyl), phenyl, -L-phenyl, 5-6 member heteroaryl, -L-(5-6 member heteroaryl),  $C_5$ - $C_6$  cycloalkenyl, -L-( $C_5$ - $C_6$  cycloalkenyl), wherein each  $C_3$ - $C_6$  cycloalkyl, phenyl, 5-6 member heteroaryl, 4-6 member heterocyclyl and  $C_5$ - $C_6$  cycloalkenyl is independently optionally further substituted with 1-6  $R^x$ ; **(d)**  $-N(R^a)_2$ , -L- $N(R^a)_2$ ; **(e)** -  
20  $OR^a$ , -L- $OR^a$ ; **(f)** -O-L- $N(R^a)_2$ , -N( $R^b$ )-L- $OR^a$ , -L-O-L- $N(R^a)_2$ , -L-N( $R^b$ )-L- $OR^a$ ; **(g)** -  
 $C(O)R^a$ , -C(O) $OR^a$ , -C(O) $N(R^a)_2$ , -L-C(O) $R^a$ , -L-C(O) $OR^a$ , -L-C(O) $N(R^a)_2$ ; **(h)** -N( $R^b$ )-  
( $L$ ) $_p$ -C(O) $R^a$ , -N( $R^b$ )-( $L$ ) $_p$ -C(O) $OR^a$ , -N( $R^b$ )-( $L$ ) $_p$ -C(O) $N(R^a)_2$ , -L-N( $R^b$ )-( $L$ ) $_p$ -C(O) $R^a$ , -L-  
N( $R^b$ )-( $L$ ) $_p$ -C(O) $OR^a$ , -L-N( $R^b$ )-( $L$ ) $_p$ -C(O) $N(R^a)_2$ ; **(i)** -O-( $L$ ) $_p$ -C(O) $R^a$ , -O-( $L$ ) $_p$ -C(O) $N(R^a)_2$ ,  
-O-( $L$ ) $_p$ -C(O)O- $R^a$ , -L-O-( $L$ ) $_p$ -C(O) $R^a$ , -L-O-( $L$ ) $_p$ -C(O) $N(R^a)_2$  -L-O-( $L$ ) $_p$ -C(O)O- $R^a$ ; **(j)** -  
25  $S(O)_2R^a$ , - $S(O)_2OR^a$ , - $S(O)_2N(R^a)_2$ , -L- $S(O)_2R^a$ , -L- $S(O)_2OR^a$ , -L- $S(O)_2N(R^a)_2$ ; **(k)** -O-  
( $L$ ) $_p$ - $S(O)_2R^a$ , ) -O-( $L$ ) $_p$ - $S(O)_2O- $R^a$ , -O-( $L$ ) $_p$ - $S(O)_2N(R^a)_2$ , -L-O-( $L$ ) $_p$ - $S(O)_2R^a$ , -L-O-  
( $L$ ) $_p$ - $S(O)_2O- $R^a$ , ) -L-O-( $L$ ) $_p$ - $S(O)_2N(R^a)_2$ ; **(l)** -N( $R^b$ )-( $L$ ) $_p$ - $S(O)_2R^a$ , -N( $R^b$ )-( $L$ ) $_p$ - $S(O)_2O- $R^a$ ,  
-N( $R^b$ )-( $L$ ) $_p$ - $S(O)_2N(R^a)_2$ , -L-N( $R^b$ )-( $L$ ) $_p$ - $S(O)_2R^a$ , -L-N( $R^b$ )-( $L$ ) $_p$ - $S(O)_2O- $R^a$ , ) -L-  
N( $R^b$ )-( $L$ ) $_p$ - $S(O)_2N(R^a)_2$ ; and **(m)** -C( $R^a$ )=N-CN, -L-C( $R^a$ )=N-CN;$$$$

30 each  $R^a$  is independently selected from the group consisting of **(a)** hydrogen,  $C_1$ - $C_6$  alkyl and  $C_1$ - $C_6$  perfluoroalkyl; **(b)**  $C_1$ - $C_6$  alkyl further substituted by 1-2 groups



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selected from fluorine, chlorine,  $-\text{CN}$ ,  $-\text{OR}^b$  and  $-\text{N}(\text{R}^b)_2$ ; **(c)**  $\text{C}_2\text{-C}_6$  alkenyl and  $\text{C}_2\text{-C}_6$  alkynyl, each of which is optionally further substituted by 1-3 groups selected from fluorine, chlorine,  $-\text{CN}$ ,  $-\text{OR}^b$  and  $-\text{N}(\text{R}^b)_2$ ; **(d)**  $-(\text{C}_1\text{-C}_6 \text{ alkylene})_p\text{-(C}_3\text{-C}_6 \text{ cycloalkyl)}$ ,  $-(\text{C}_1\text{-C}_6 \text{ alkylene})_p\text{-phenyl}$ ,  $-(\text{C}_1\text{-C}_6 \text{ alkylene})_p\text{-(5-6 member heteroaryl)}$ ,  $-(\text{C}_1\text{-C}_6 \text{ alkylene})_p\text{-(4-6 member heterocyclyl)}$ ,  $-(\text{C}_1\text{-C}_6 \text{ alkylene})_p\text{-(C}_5\text{-C}_6 \text{ cycloalkenyl)}$ , wherein each  $\text{C}_1\text{-C}_6$  alkylene is optionally further substituted with 1-3 groups selected from fluorine, chlorine and  $-\text{CN}$ , wherein each of the said  $\text{C}_3\text{-C}_6$  cycloalkyl, phenyl, 5-6 member heteroaryl, 4-6 member heterocyclyl and  $\text{C}_5\text{-C}_6$  cycloalkenyl is independently optionally further substituted with 1-3  $\text{R}^y$ ;

or two  $\text{R}^a$  connected to the same nitrogen form a 3-10 member heterocyclyl or 5-10 member heteroaryl, the said 3-10 member heterocyclyl and the said 5-10 member heteroaryl is optionally further substituted with 1-3  $\text{R}^z$ ;

each L is independently  $\text{C}_1\text{-C}_6$  alkylene,  $\text{C}_2\text{-C}_6$  alkenylene or  $\text{C}_2\text{-C}_6$  alkynylene, and each L is optionally further substituted with 1-3 groups selected from fluorine, chlorine, OH and  $-\text{CN}$ ;

each  $\text{R}^w$ ,  $\text{R}^x$ ,  $\text{R}^y$  and  $\text{R}^z$  is independently selected from the group consisting of

**(i)** fluorine, chlorine,  $-\text{CN}$ ,  $-\text{OR}^b$ ,  $\text{C}_1\text{-C}_6$  alkyl,  $\text{C}_1\text{-C}_3$  perfluoroalkyl,  $\text{C}_2\text{-C}_6$  alkenyl,  $\text{C}_2\text{-C}_6$  alkynyl and  $-\text{N}(\text{R}^b)_2$ ; **(ii)**  $\text{C}_1\text{-C}_6$  alkyl further substituted with 1-2 groups selected from fluorine, chlorine,  $-\text{CN}$ ,  $-\text{OR}^b$  and  $-\text{N}(\text{R}^b)_2$ ; **(iii)**  $-\text{C}(\text{O})\text{-R}^b$ ,  $-\text{C}(\text{O})\text{OR}^b$ ,  $-\text{C}(\text{O})\text{-N}(\text{R}^b)_2$ ; **(iv)**  $-\text{N}(\text{R}^b)\text{-C}(\text{O})\text{-R}^b$ ,  $-\text{N}(\text{R}^b)\text{-C}(\text{O})\text{OR}^b$ ,  $-\text{N}(\text{R}^b)\text{-C}(\text{O})\text{-N}(\text{R}^b)_2$ ; **(v)**  $-\text{O-C}(\text{O})\text{-R}^b$ ,  $-\text{O-C}(\text{O})\text{OR}^b$ ,  $-\text{O-C}(\text{O})\text{-N}(\text{R}^b)_2$ ; **(vi)**  $-\text{S}(\text{O})_2\text{-R}^b$ ,  $-\text{S}(\text{O})_2\text{-O-R}^b$ ,  $-\text{S}(\text{O})_2\text{-N}(\text{R}^b)_2$ ; **(vii)**  $-\text{N}(\text{R}^b)\text{-S}(\text{O})_2\text{-R}^b$ ,  $-\text{N}(\text{R}^b)\text{-S}(\text{O})_2\text{-O-R}^b$ ,  $-\text{N}(\text{R}^b)\text{-S}(\text{O})_2\text{-N}(\text{R}^b)_2$ ; and **(viii)**  $-\text{O-S}(\text{O})_2\text{-R}^b$ ,  $-\text{O-S}(\text{O})_2\text{-O-R}^b$ ,  $-\text{O-S}(\text{O})_2\text{-N}(\text{R}^b)_2$ ;

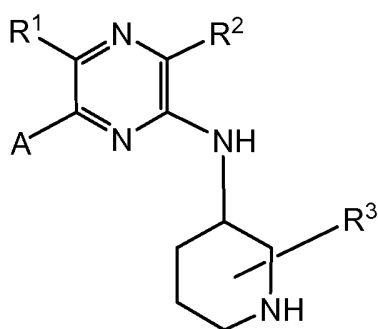
each  $\text{R}^b$  is independently selected from the group consisting of hydrogen,  $\text{C}_1\text{-C}_3$  alkyl,  $\text{C}_1\text{-C}_3$  perfluoroalkyl and  $\text{C}_1\text{-C}_3$  alkyl further substituted by 1-2 groups selected from fluorine, chlorine and CN;

each p is independently 0 or 1;

or a pharmaceutically acceptable salt thereof.

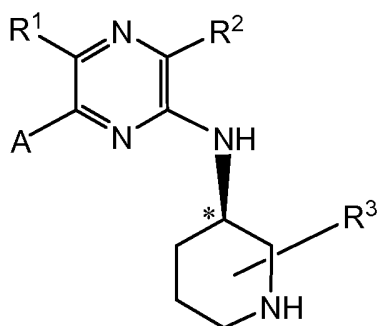
In one preferred embodiment, the invention provides a compound of formula II, and pharmaceutically acceptable salt thereof.

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(II)

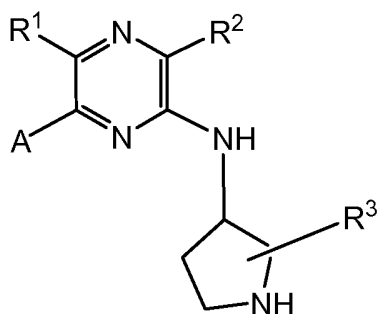
In another preferred embodiment, the invention provides a compound of formula III, or pharmaceutically acceptable salt thereof,



(III)

wherein the stereo chemistry of the chiral center marked by "\*" is the absolute stereochemistry as indicated in formula (III). In one aspect of this embodiment, the compound has 80% or higher, preferably 90% or higher, more preferably 95% or higher, even more preferably 99% or higher, of enantiomeric excess with regard to the absolute stereo chemistry indicated in above formula III.

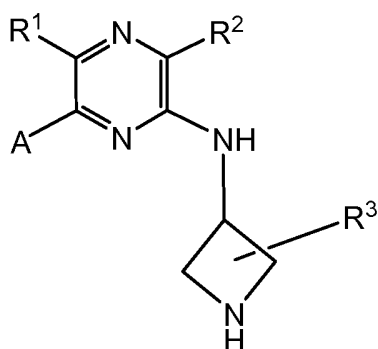
In another preferred embodiment, the invention provides a compound of formula IV, or pharmaceutically acceptable salt thereof.



(IV).

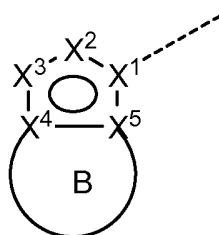
In another preferred embodiment, the invention provides a compound of formula V, or pharmaceutically acceptable salt thereof.

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(V)

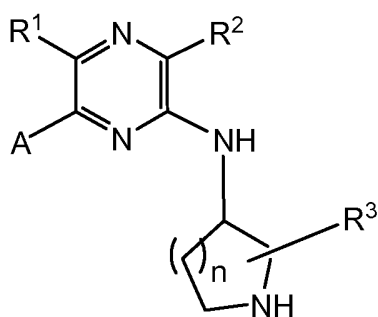
In a preferred aspect of the invention or any of the above described  
 5 embodiments of the invention, and in combination with any other preferred aspects  
 not inconsistent,  $A$  is



and  $A$  is optionally further substituted with 1-6  $R^4$ .

In another preferred embodiment, the invention provides a compound of formula

I,



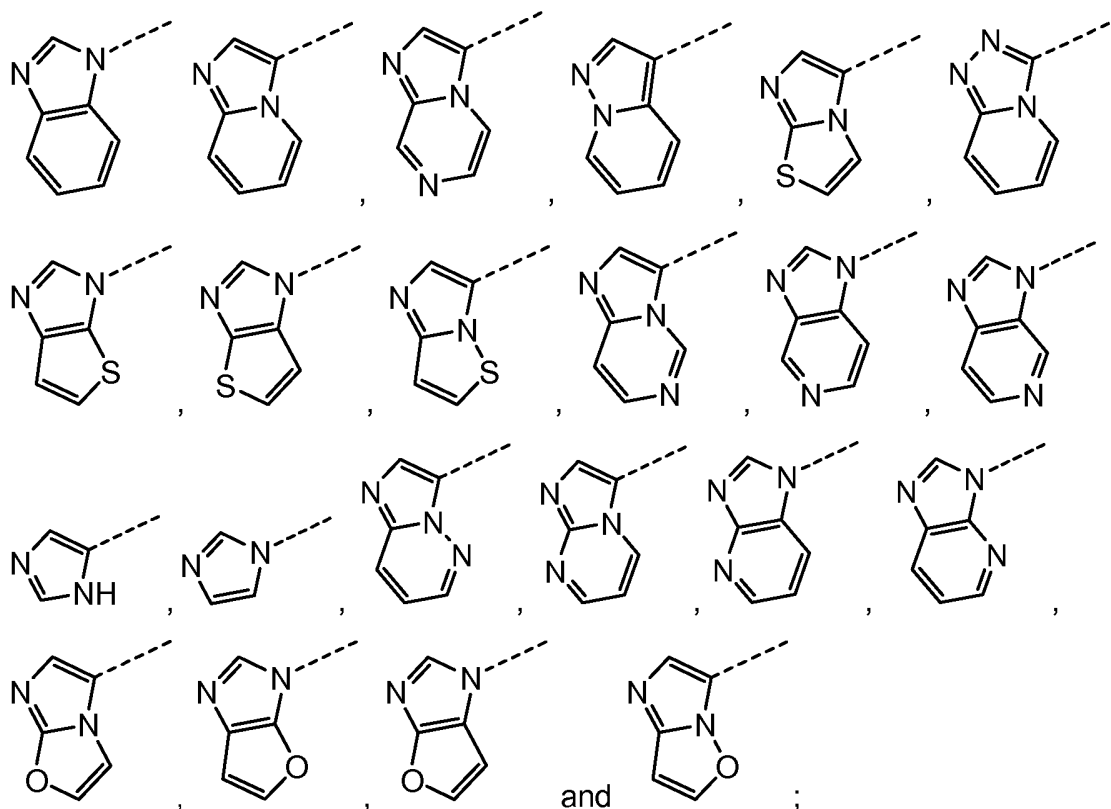
(I)

wherein,

$n$  is 0, 1 or 2, preferably,  $n$  is 1 or 2, more preferably  $n$  is 2;

$A$  is a heteroaryl selected from the group consisting of

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5 and A is optionally further substituted with 1-5  $R^4$ ;

each of  $R^1$  and  $R^2$  is independently selected from hydrogen, fluorine, chlorine, -CN,  $-OR^b$ ,  $-N(R^b)_2$ , and  $C_1-C_3$  alkyl optionally substituted with 1-6 groups selected from fluorine, chlorine and -CN;

10  $R^3$  represents 1-6 optional substituents independently selected from the group consisting of -oxo- and  $R^0$ ;

each  $R^4$  is independently  $R^0$ ;

15 each  $R^0$  is independently selected from the group consisting of **(a)** fluorine, chlorine and -CN; **(b)**  $C_1-C_6$  alkyl, optionally further substituted with 1-6 groups selected from fluorine, chlorine and CN; **(c)**  $C_3-C_6$  cycloalkyl, -L-( $C_3-C_6$  cycloalkyl), 4-6 member heterocyclyl, -L-(4-6 member heterocyclyl), wherein each  $C_3-C_6$  cycloalkyl and 4-6 member heterocyclyl is independently optionally further substituted with 1-6  $R^x$ ; **(d)**  $-N(R^a)_2$ , -L- $N(R^a)_2$ ; **(e)**  $-OR^a$ , -L- $OR^a$ ; and **(g)**  $-C(O)R^a$ ,  $-C(O)OR^a$ ,  $-C(O)N(R^a)_2$ , -L- $C(O)R^a$ , -L- $C(O)OR^a$ , -L- $C(O)N(R^a)_2$ ;

20 each  $R^a$  is independently selected from the group consisting of **(a)** hydrogen,  $C_1-C_6$  alkyl and  $C_1-C_6$  perfluoroalkyl; **(b)**  $C_1-C_6$  alkyl further substituted by 1-2 groups selected from fluorine, chlorine, -CN,  $-OR^b$  and  $-N(R^b)_2$ ; **(d)**  $-(C_1-C_6 \text{ alkylene})_p-(C_3-C_6 \text{ cycloalkyl})$ ,  $-(C_1-C_6 \text{ alkylene})_p-(4-6 \text{ member heterocyclyl})$ , wherein each  $C_1-C_6$

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alkylene is optionally further substituted with 1-3 groups selected from fluorine, chlorine and  $-\text{CN}$ , wherein each of the said  $\text{C}_3\text{-C}_6$  cycloalkyl and 4-6 member heterocyclyl is independently optionally further substituted with 1-3  $\text{R}^y$ ;

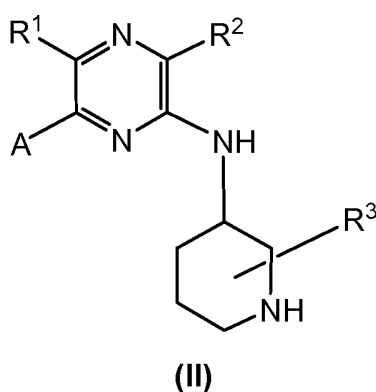
or two  $\text{R}^a$  connected to the same nitrogen form a 3-10 member heterocyclyl or 5-10 member heteroaryl, the said 3-10 member heterocyclyl and the said 5-10 member heteroaryl is optionally further substituted with 1-3  $\text{R}^z$ ;

each L is independently  $\text{C}_1\text{-C}_6$  alkylene optionally further substituted with 1-3 groups selected from fluorine, chlorine, OH and  $-\text{CN}$ ;

each  $\text{R}^w$ ,  $\text{R}^x$ ,  $\text{R}^y$  and  $\text{R}^z$  is independently selected from the group consisting of  
 (i) fluorine, chlorine,  $-\text{CN}$ ,  $-\text{OR}^b$ ,  $\text{C}_1\text{-C}_6$  alkyl,  $\text{C}_1\text{-C}_3$  perfluoroalkyl,  $\text{C}_2\text{-C}_6$  alkenyl,  $\text{C}_2\text{-C}_6$  alkynyl and  $-\text{N}(\text{R}^b)_2$ ; (ii)  $\text{C}_1\text{-C}_6$  alkyl further substituted with 1-2 groups selected from fluorine, chlorine,  $-\text{CN}$ ,  $-\text{OR}^b$  and  $-\text{N}(\text{R}^b)_2$ ; (iii)  $-\text{C}(\text{O})\text{-R}^b$ ,  $-\text{C}(\text{O})\text{OR}^b$ ,  $-\text{C}(\text{O})\text{-N}(\text{R}^b)_2$ ; and

each  $\text{R}^b$  is independently selected from the group consisting of hydrogen,  $\text{C}_1\text{-C}_3$  alkyl,  $\text{C}_1\text{-C}_3$  perfluoroalkyl and  $\text{C}_1\text{-C}_3$  alkyl further substituted by 1-2 groups selected from fluorine, chlorine and CN;  
 or a pharmaceutically acceptable salt thereof.

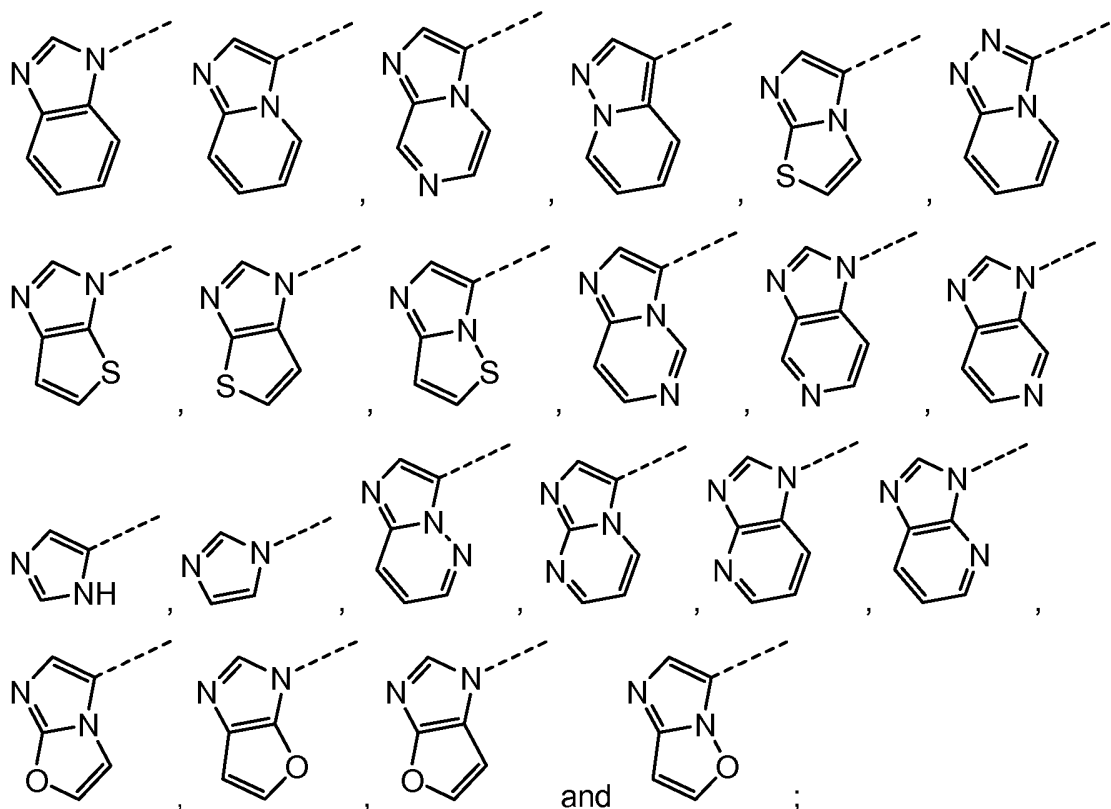
In another preferred embodiment, the invention provides compound of formula II,



wherein,

A is a heteroaryl selected from the group consisting of

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5

A is optionally further substituted with 1-5  $R^4$ ;

each of  $R^1$  and  $R^2$  is independently selected from hydrogen, fluorine, chlorine, -CN,  $-OR^b$ ,  $-N(R^b)_2$ , and  $C_1$ - $C_3$  alkyl optionally substituted with 1-6 groups selected from fluorine, chlorine and -CN;

10  $R^3$  represents 1-6 optional substituents independently selected from the group consisting of -oxo- and  $R^0$ ; further more, two of the  $R^3$  may also

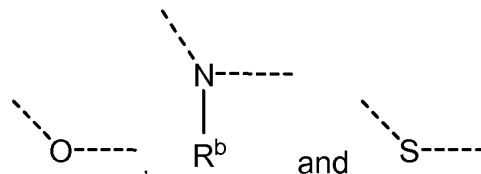
(i) two  $R^3$  attached to the same ring atom, together with the ring atom attached to, may also form a ring selected from  $C_3$ - $C_6$  cycloalkyl,  $C_5$ - $C_6$  cycloalkenyl and 3-6 member heterocyclyl; each of the said  $C_3$ - $C_6$  cycloalkyl,  $C_5$ - $C_6$  cycloalkenyl and 3-6 member heterocyclyl is optionally further substituted with 1-5 groups selected from -oxo- and  $R^w$ ; or

(ii) two  $R^3$  attached to two adjacent ring atoms, together with the ring atoms attached to, may also form a fused ring selected from  $C_3$ - $C_6$  cycloalkyl,  $C_5$ - $C_6$  cycloalkenyl, 3-6 member heterocyclyl, phenyl, 5-6 member heteroaryl; the said  $C_3$ - $C_6$  cycloalkyl,  $C_5$ - $C_6$  cycloalkenyl, 3-6 member heterocyclyl, phenyl and 5-6 member heteroaryl is optionally further substituted with 1-5 groups selected from -oxo- and  $R^w$ ; or

20

- 10 -

(iii) two  $R^3$  attached to, two different ring atoms with at least one ring atom in between, may form a  $C_1-C_4$  alkylene, a 2-4 member heteroalkylene, or a diradical selected from the group consisting of:



such  $C_1-C_4$  alkylene, 2-4 member heteroalkylene and diradical together with the piperidiny (when  $n$  is 2) form a bicyclic bridged ring system, the said bicyclic bridged ring system having a total of 6-9 ring atoms with 1-3 of the ring atoms selected from N, O and S; the  $C_1-C_4$  alkylene or a 1-4 member heteroalkylene is optionally further substituted with 1-5 groups selected from -oxo- and  $R^w$ ;

each  $R^4$  is independently  $R^0$ ;

each  $R^0$  is independently elected from the group consisting of **(a)** fluorine, chlorine and -CN; **(b)**  $C_1-C_6$  alkyl,  $C_2-C_6$  alkenyl and  $C_2-C_6$  alkynyl, each of which is optionally further substituted with 1-6 groups selected from fluorine, chlorine and CN; **(c)**  $C_3-C_6$  cycloalkyl, -L-( $C_3-C_6$  cycloalkyl), 4-6 member heterocyclyl, -L-(4-6 member heterocyclyl), phenyl, -L-phenyl, 5-6 member heteroaryl, -L-(5-6 member heteroaryl),  $C_5-C_6$  cycloalkenyl, -L-( $C_5-C_6$  cycloalkenyl), wherein each  $C_3-C_6$  cycloalkyl, phenyl, 5-6 member heteroaryl, 4-6 member heterocyclyl and  $C_5-C_6$  cycloalkenyl is independently optionally further substituted with 1-6  $R^x$ ; **(d)**  $-N(R^a)_2$ , -L- $N(R^a)_2$ ; **(e)**  $-OR^a$ , -L- $OR^a$ ; **(f)**  $-O-L-N(R^a)_2$ ,  $-N(R^b)-L-OR^a$ ,  $-L-O-L-N(R^a)_2$ ,  $-L-N(R^b)-L-OR^a$ ; **(g)**  $-C(O)R^a$ ,  $-C(O)OR^a$ ,  $-C(O)N(R^a)_2$ , -L- $C(O)R^a$ , -L- $C(O)OR^a$ , -L- $C(O)N(R^a)_2$ ; **(h)**  $-N(R^b)-(L)_p-C(O)R^a$ ,  $-N(R^b)-(L)_p-C(O)OR^a$ ,  $-N(R^b)-(L)_p-C(O)N(R^a)_2$ ,  $-L-N(R^b)-(L)_p-C(O)R^a$ , -L- $N(R^b)-(L)_p-C(O)OR^a$ ,  $-L-N(R^b)-(L)_p-C(O)N(R^a)_2$ ; **(i)**  $-O-(L)_p-C(O)R^a$ ,  $-O-(L)_p-C(O)N(R^a)_2$ ,  $-O-(L)_p-C(O)O-R^a$ ,  $-L-O-(L)_p-C(O)R^a$ ,  $-L-O-(L)_p-C(O)N(R^a)_2$ ,  $-L-O-(L)_p-C(O)O-R^a$ ; and **(m)**  $-C(R^a)=N-CN$ , -L- $C(R^a)=N-CN$ ;

each  $R^a$  is independently selected from the group consisting of **(a)** hydrogen,  $C_1-C_6$  alkyl and  $C_1-C_6$  perfluoroalkyl; **(b)**  $C_1-C_6$  alkyl further substituted by 1-2 groups selected from fluorine, chlorine, -CN,  $-OR^b$  and  $-N(R^b)_2$ ; **(c)**  $C_2-C_6$  alkenyl and  $C_2-C_6$  alkynyl, each of which is optionally further substituted by 1-3 groups selected from fluorine, chlorine, -CN,  $-OR^b$  and  $-N(R^b)_2$ ; **(d)**  $-(C_1-C_6 \text{ alkylene})_p-(C_3-C_6 \text{ cycloalkyl})$ ,  $-(C_1-C_6 \text{ alkylene})_p$ -phenyl,  $-(C_1-C_6 \text{ alkylene})_p$ -(5-6 member heteroaryl),  $-(C_1-C_6 \text{ alkylene})_p$ -(4-6 member heterocyclyl),  $-(C_1-C_6 \text{ alkylene})_p-(C_5-C_6 \text{ cycloalkenyl})$ ,

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wherein each C<sub>1</sub>-C<sub>6</sub> alkylene is optionally further substituted with 1-3 groups selected from fluorine, chlorine and -CN, wherein each of the said C<sub>3</sub>-C<sub>6</sub> cycloalkyl, phenyl, 5-6 member heteroaryl, 4-6 member heterocyclyl and C<sub>5</sub>-C<sub>6</sub> cycloalkenyl is independently optionally further substituted with 1-3 R<sup>y</sup>;

5 or two R<sup>a</sup> connected to the same nitrogen form a 3-10 member heterocyclyl or 5-10 member heteroaryl, the said 3-10 member heterocyclyl and the said 5-10 member heteroaryl is optionally further substituted with 1-3 R<sup>z</sup>;

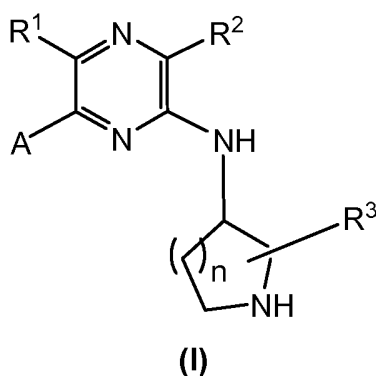
each L is independently C<sub>1</sub>-C<sub>6</sub> alkylene and C<sub>2</sub>-C<sub>6</sub> alkenylene, and each L is optionally further substituted with 1-3 groups selected from fluorine, chlorine, OH and  
10 -CN;

each R<sup>w</sup>, R<sup>x</sup>, R<sup>y</sup> and R<sup>z</sup> is independently selected from the group consisting of  
(i) fluorine, chlorine, -CN, -OR<sup>b</sup>, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl and -N(R<sup>b</sup>)<sub>2</sub>; (ii) C<sub>1</sub>-C<sub>6</sub> alkyl further substituted with 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub>; (iii) -C(O)-R<sup>b</sup>, -C(O)OR<sup>b</sup>, -C(O)-  
15 N(R<sup>b</sup>)<sub>2</sub>; (iv) -N(R<sup>b</sup>)-C(O)-R<sup>b</sup>, -N(R<sup>b</sup>)-C(O)OR<sup>b</sup>, -N(R<sup>b</sup>)-C(O)-N(R<sup>b</sup>)<sub>2</sub>; (v) -O-C(O)-R<sup>b</sup>, -O-C(O)OR<sup>b</sup>, -O-C(O)-N(R<sup>b</sup>)<sub>2</sub>;

each R<sup>b</sup> is independently selected from the group consisting of hydrogen, C<sub>1</sub>-C<sub>3</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl and C<sub>1</sub>-C<sub>3</sub> alkyl further substituted by 1-2 groups selected from fluorine, chlorine and CN;

20 each p is independently 0 or 1;  
or a pharmaceutically acceptable salt thereof.

In another preferred embodiment, the invention provides compound of formula I,



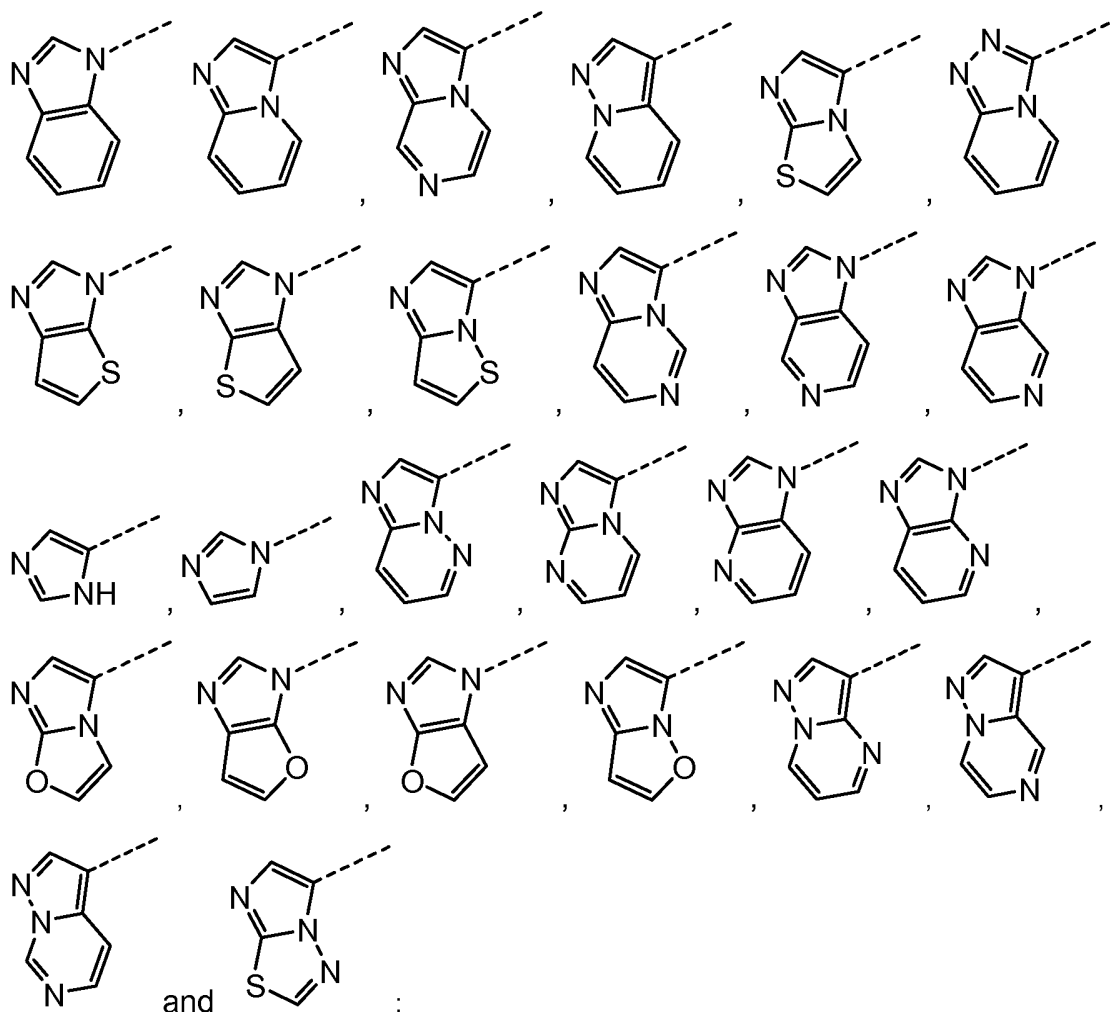
25 wherein,

n is 1 or 2, preferably n is 2;

A is a heteroaryl selected from the group consisting of



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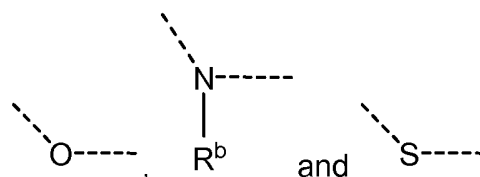


A is optionally further substituted with 1-5  $R^4$ ;

$R^1$  is hydrogen;

$R^2$  is selected from hydrogen, fluorine, chlorine,  $-CN$ ,  $-OR^b$ , and  $C_1-C_3$  alkyl;

10  $R^3$  represents 1-6 optional substituents independently selected from the group consisting of  $-oxo-$  and  $R^0$ ; further more, when n is 2, two  $R^3$  attached to, two different ring atoms with at least one ring atom in between, may form a  $C_1-C_4$  alkylene, a 2-4 member heteroalkylene, or a diradical selected from the group consisting of:



such  $C_1-C_4$  alkylene, 2-4 member heteroalkylene and diradical together with the piperidiny (when n is 2) form a bicyclic bridged ring system, the said bicyclic bridged

- 13 -

ring system having a total of 6-9 ring atoms with 1-3 of the ring atoms selected from N, O and S; the C<sub>1</sub>-C<sub>4</sub> alkylene or a 1-4 member heteroalkylene is optionally further substituted with 1-5 groups selected from -oxo- and R<sup>w</sup>;

each R<sup>4</sup> is independently R<sup>0</sup>;

5 each R<sup>0</sup> is independently selected from the group consisting of **(a)** fluorine, chlorine and -CN; **(b)** C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl and C<sub>2</sub>-C<sub>6</sub> alkynyl, each of which is optionally further substituted with 1-6 groups selected from fluorine, chlorine and CN; **(c)** C<sub>3</sub>-C<sub>6</sub> cycloalkyl, -L-(C<sub>3</sub>-C<sub>6</sub> cycloalkyl), 4-6 member heterocyclyl, -L-(4-6 member heterocyclyl), wherein each C<sub>3</sub>-C<sub>6</sub> cycloalkyl and 4-6 member heterocyclyl is  
 10 optionally further substituted with 1-6 R<sup>x</sup>; **(d)** -N(R<sup>a</sup>)<sub>2</sub>, -L-N(R<sup>a</sup>)<sub>2</sub>; **(e)** -OR<sup>a</sup>, -L-OR<sup>a</sup>; and **(f)** -C(O)R<sup>a</sup>, -C(O)OR<sup>a</sup>, -C(O)N(R<sup>a</sup>)<sub>2</sub>, -L-C(O)R<sup>a</sup>, -L-C(O)OR<sup>a</sup>, -L-C(O)N(R<sup>a</sup>)<sub>2</sub>;

each R<sup>a</sup> is independently selected from the group consisting of **(a)** hydrogen, C<sub>1</sub>-C<sub>6</sub> alkyl and C<sub>1</sub>-C<sub>6</sub> perfluoroalkyl; and **(b)** C<sub>1</sub>-C<sub>6</sub> alkyl further substituted by 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub>; **(c)** -(C<sub>1</sub>-C<sub>6</sub>  
 15 alkylene)<sub>p</sub>-(C<sub>3</sub>-C<sub>6</sub> cycloalkyl), -(C<sub>1</sub>-C<sub>6</sub> alkylene)<sub>p</sub>-(4-6 member heterocyclyl), wherein each C<sub>1</sub>-C<sub>6</sub> alkylene is optionally further substituted with 1-3 groups selected from fluorine, chlorine and -CN, wherein each of the said C<sub>3</sub>-C<sub>6</sub> cycloalkyl, 4-6 member heterocyclyl is independently optionally further substituted with 1-3 R<sup>y</sup>;

or two R<sup>a</sup> connected to the same nitrogen form a 3-10 member heterocyclyl or  
 20 5-10 member heteroaryl, the said 3-10 member heterocyclyl and the said 5-10 member heteroaryl is optionally further substituted with 1-3 R<sup>z</sup>;

each L is independently C<sub>1</sub>-C<sub>6</sub> alkylene and each L is optionally further substituted with 1-3 groups selected from fluorine, chlorine, OH and -CN;

each R<sup>w</sup>, R<sup>x</sup>, R<sup>y</sup> and R<sup>z</sup> is independently selected from the group consisting of  
 25 **(i)** fluorine, chlorine, -CN, -OR<sup>b</sup>, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl and -N(R<sup>b</sup>)<sub>2</sub>; **(ii)** C<sub>1</sub>-C<sub>6</sub> alkyl further substituted with 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub>;

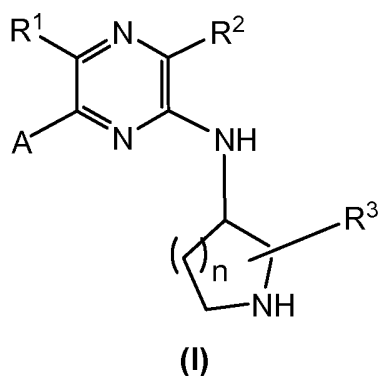
each R<sup>b</sup> is independently selected from the group consisting of hydrogen, C<sub>1</sub>-C<sub>3</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl and C<sub>1</sub>-C<sub>3</sub> alkyl further substituted by 1-2 groups selected  
 30 from fluorine, chlorine and CN;

each p is independently 0 or 1;

or a pharmaceutically acceptable salt thereof.

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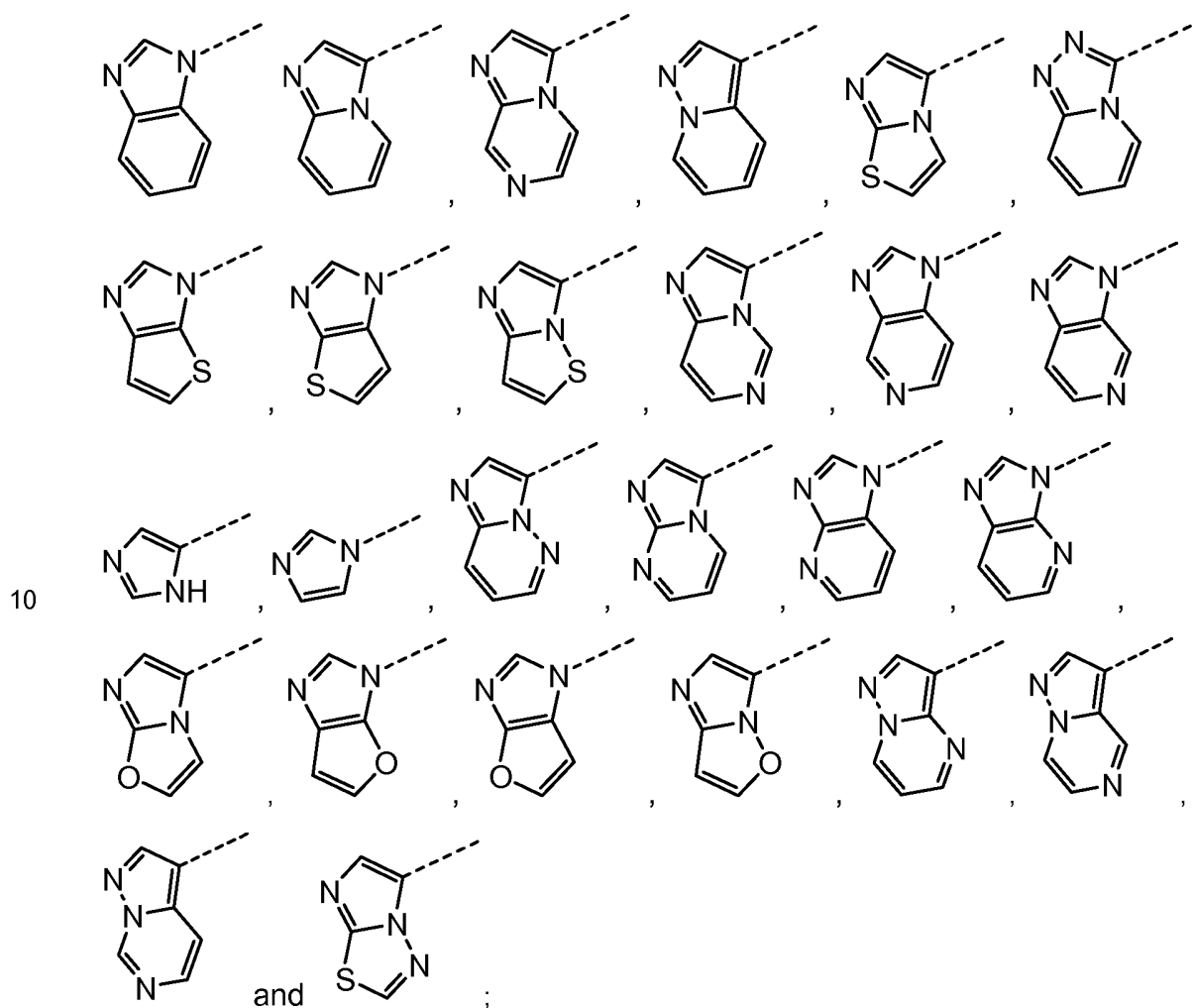
In another preferred embodiment, the invention provides compound of formula I,



wherein,

5            n is 1 or 2, preferably n is 2;

A is a heteroaryl selected from the group consisting of



A is optionally further substituted with 1-5  $R^4$ ;

$R^1$  is hydrogen;

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$R^2$  is selected from hydrogen, fluorine, chlorine, -CN, -OR<sup>b</sup> and C<sub>1</sub>-C<sub>3</sub> alkyl;

$R^3$  represents 1-6 optional substituents independently selected from the group consisting of -oxo- and R<sup>0</sup>;

each R<sup>4</sup> is independently R<sup>0</sup>;

5 each R<sup>0</sup> is independently selected from the group consisting of **(a)** fluorine, chlorine and -CN; **(b)** C<sub>1</sub>-C<sub>6</sub> alkyl optionally further substituted with 1-6 groups selected from fluorine, chlorine and CN; **(c)** C<sub>3</sub>-C<sub>6</sub> cycloalkyl, -L-(C<sub>3</sub>-C<sub>6</sub> cycloalkyl), 4-6 member heterocyclyl, -L-(4-6 member heterocyclyl), wherein each C<sub>3</sub>-C<sub>6</sub> cycloalkyl and 4-6 member heterocyclyl is optionally further substituted with 1-6 R<sup>x</sup>; **(d)** -OR<sup>a</sup>, -  
10 L-OR<sup>a</sup>; and **(e)** -C(O)N(R<sup>a</sup>)<sub>2</sub>, -L-C(O)N(R<sup>a</sup>)<sub>2</sub>;

each R<sup>a</sup> is independently selected from the group consisting of **(a)** hydrogen, C<sub>1</sub>-C<sub>6</sub> alkyl and C<sub>1</sub>-C<sub>6</sub> perfluoroalkyl; and **(b)** C<sub>1</sub>-C<sub>6</sub> alkyl further substituted by 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub>; **(c)** -(C<sub>1</sub>-C<sub>6</sub>  
15 alkylene)<sub>p</sub>-(C<sub>3</sub>-C<sub>6</sub> cycloalkyl), -(C<sub>1</sub>-C<sub>6</sub> alkylene)<sub>p</sub>-(4-6 member heterocyclyl), wherein each C<sub>1</sub>-C<sub>6</sub> alkylene is optionally further substituted with 1-3 groups selected from fluorine, chlorine and -CN, wherein each of the said C<sub>3</sub>-C<sub>6</sub> cycloalkyl, 4-6 member heterocyclyl is independently optionally further substituted with 1-3 R<sup>y</sup>;

or two R<sup>a</sup> connected to the same nitrogen form a 3-10 member heterocyclyl or  
20 5-10 member heteroaryl, the said 3-10 member heterocyclyl and the said 5-10 member heteroaryl is optionally further substituted with 1-3 R<sup>z</sup>;

each L is independently C<sub>1</sub>-C<sub>6</sub> alkylene and each L is optionally further substituted with 1-3 groups selected from fluorine, chlorine, OH and -CN;

each R<sup>w</sup>, R<sup>x</sup>, R<sup>y</sup> and R<sup>z</sup> is independently selected from the group consisting of  
25 **(i)** fluorine, chlorine, -CN, -OR<sup>b</sup> and C<sub>1</sub>-C<sub>6</sub> alkyl; **(ii)** C<sub>1</sub>-C<sub>6</sub> alkyl further substituted with 1-2 groups selected from fluorine, chlorine and -CN;

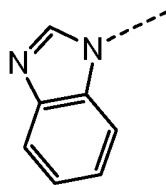
each R<sup>b</sup> is independently selected from the group consisting of hydrogen and C<sub>1</sub>-C<sub>3</sub> alkyl;

each p is independently 0 or 1;

30 or a pharmaceutically acceptable salt thereof.

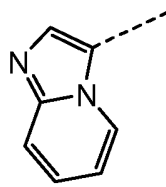
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In a preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, A is



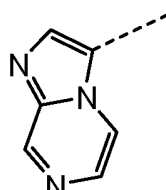
5 and A is optionally further substituted with 1-5  $R^4$ .

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, A is



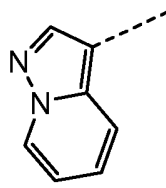
10 and A is optionally further substituted with 1-5  $R^4$ .

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, A is



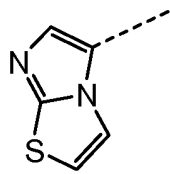
15 and A is optionally further substituted with 1-4  $R^4$ .

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, A is



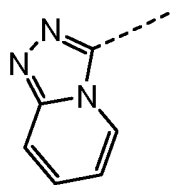
20 and A is optionally further substituted with 1-5  $R^4$ .

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, A is



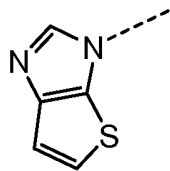
5 and A is optionally further substituted with 1-3  $R^4$ .

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, A is



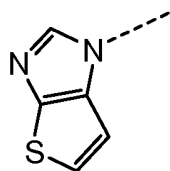
10 and A is optionally further substituted with 1-4  $R^4$ .

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, A is



15 and A is optionally further substituted with 1-3  $R^4$ .

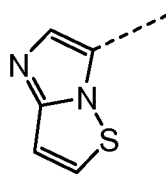
In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, A is



20 and A is optionally further substituted with 1-3  $R^4$ .

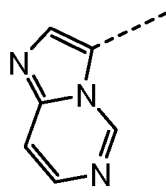
In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, A is

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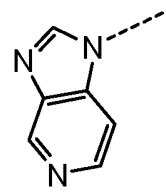
and A is optionally further substituted with 1-3R<sup>4</sup>.

In another preferred aspect of the invention or any of the above described  
embodiments of the invention, and in combination with any other preferred aspects  
5 not inconsistent, A is



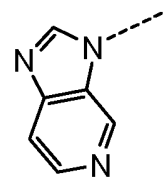
and A is optionally further substituted with 1-4 R<sup>4</sup>.

In another preferred aspect of the invention or any of the above described  
embodiments of the invention, and in combination with any other preferred aspects  
10 not inconsistent, A is



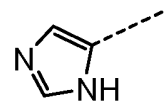
and A is optionally further substituted with 1-4 R<sup>4</sup>.

In another preferred aspect of the invention or any of the above described  
embodiments of the invention, and in combination with any other preferred aspects  
15 not inconsistent, A is



and A is optionally further substituted with 1-4 R<sup>4</sup>.

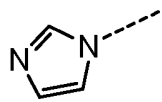
In another preferred aspect of the invention or any of the above described  
embodiments of the invention, and in combination with any other preferred aspects  
20 not inconsistent, A is



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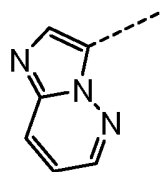
and A is optionally further substituted with 1-3  $R^4$ .

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, wherein A is



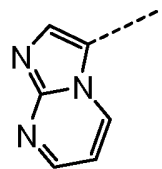
and A is optionally further substituted with 1-3  $R^4$ .

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, wherein A is



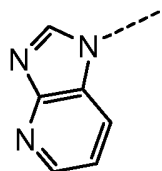
and A is optionally further substituted with 1-4  $R^4$ .

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, wherein A is



and A is optionally further substituted with 1-4  $R^4$ .

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, A is

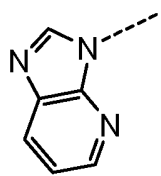


and A is optionally further substituted with 1-4  $R^4$ .

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, A is



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and A is optionally further substituted with 1-4  $R^4$ .

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent,  $R^1$  is hydrogen,

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent,  $R^1$  is selected from hydrogen, fluorine, chlorine and -CN.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent,  $R^1$  is  $C_1$ - $C_3$  alkyl.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent,  $R^1$  is  $C_1$ - $C_3$  alkyl further substituted with 1-6 fluorine.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent,  $R^1$  is  $C_1$ - $C_3$  alkyl further substituted with 1-2 groups selected from chlorine and -CN.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent,  $R^1$  is  $-OR^b$ .

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent,  $R^1$  is  $-N(R^b)_2$ .

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent,  $R^2$  is hydrogen,

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent,  $R^2$  is selected from hydrogen, fluorine, chlorine and -CN.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent,  $R^2$  is  $C_1-C_3$  alkyl.

5 In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent,  $R^2$  is  $C_1-C_3$  alkyl further substituted with 1-6 fluorine.

10 In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent,  $R^2$  is  $C_1-C_3$  alkyl further substituted with 1-2 groups selected from chlorine and  $-CN$ .

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent,  $R^2$  is  $-OR^b$ .

15 In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent,  $R^2$  is  $-N(R^b)_2$ .

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent,  $R^1$  is hydrogen and  $R^2$  is hydrogen.

20 In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, A is further substituted with 1-3  $R^4$  selected from the group consisting of fluorine, chlorine,  $C_1-C_3$  alkyl,  $C_1-C_3$  alkoxy, and  $CF_3$ .

25 In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, A is further substituted with 1-3  $R^4$  selected from the group consisting of

(a) fluorine, chlorine and  $-CN$ ; and

30 (b)  $C_1-C_6$  alkyl, optionally further substituted with 1-6 groups selected from fluorine, chlorine and  $CN$ .

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects

not inconsistent, A is further substituted with 1-3  $R^4$  selected from the group consisting of

(a) fluorine, chlorine and -CN;

(b)  $C_1-C_6$  alkyl, optionally further substituted with 1-6 groups selected from fluorine, chlorine and CN; and

(c)  $C_3-C_6$  cycloalkyl, -L-( $C_3-C_6$  cycloalkyl), 4-6 member heterocyclyl, -L-(4-6 member heterocyclyl), wherein each  $C_3-C_6$  cycloalkyl and 4-6 member heterocyclyl is independently optionally further substituted with 1-6  $R^x$ .

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, A is further substituted with 1-3  $R^4$  selected from the group consisting of

(a) fluorine, chlorine and -CN;

(b)  $C_1-C_6$  alkyl, optionally further substituted with 1-6 groups selected from fluorine, chlorine and CN; and

(d)  $-N(R^a)_2$ ,  $-L-N(R^a)_2$ .

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, A is further substituted with 1-3  $R^4$  selected from the group consisting of

(a) fluorine, chlorine and -CN;

(b)  $C_1-C_6$  alkyl, optionally further substituted with 1-6 groups selected from fluorine, chlorine and CN; and

(e)  $-OR^a$ ,  $-L-OR^a$ .

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, A is further substituted with 1-3  $R^4$  selected from the group consisting of

(a) fluorine, chlorine and -CN;

(b)  $C_1-C_6$  alkyl, optionally further substituted with 1-6 groups selected from fluorine, chlorine and CN; and

(g)  $-C(O)R^a$ ,  $-C(O)OR^a$ ,  $-C(O)N(R^a)_2$ ,  $-L-C(O)R^a$ ,  $-L-C(O)OR^a$ ,  $-L-C(O)N(R^a)_2$ .

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, A is further substituted with 1-3  $R^4$  selected from the group consisting of

(a) fluorine, chlorine and -CN;

(b)  $C_1$ - $C_6$  alkyl,  $C_2$ - $C_6$  alkenyl and  $C_2$ - $C_6$  alkynyl, each of which is optionally further substituted with 1-6 groups selected from fluorine, chlorine and CN; and

(h)  $-N(R^b)-(L)_p-C(O)R^a$ ,  $-N(R^b)-(L)_p-C(O)OR^a$ ,  $-N(R^b)-(L)_p-C(O)N(R^a)_2$ ,  $-L-N(R^b)-(L)_p-C(O)R^a$ ,  $-L-N(R^b)-(L)_p-C(O)OR^a$ ,  $-L-N(R^b)-(L)_p-C(O)N(R^a)_2$ .

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, A is further substituted with 1-3  $R^4$  selected from the group consisting of

(a) fluorine, chlorine and -CN;

(b)  $C_1$ - $C_6$  alkyl,  $C_2$ - $C_6$  alkenyl and  $C_2$ - $C_6$  alkynyl, each of which is optionally further substituted with 1-6 groups selected from fluorine, chlorine and CN; and

(i)  $-O-(L)_p-C(O)R^a$ ,  $-O-(L)_p-C(O)N(R^a)_2$ ,  $-O-(L)_p-C(O)O-R^a$ ,  $-L-O-(L)_p-C(O)R^a$ ,  $-L-O-(L)_p-C(O)N(R^a)_2$ ,  $-L-O-(L)_p-C(O)O-R^a$ .

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, A is further substituted with 1-3  $R^4$  selected from the group consisting of

(a) fluorine, chlorine and -CN;

(b)  $C_1$ - $C_6$  alkyl,  $C_2$ - $C_6$  alkenyl and  $C_2$ - $C_6$  alkynyl, each of which is optionally further substituted with 1-6 groups selected from fluorine, chlorine and CN; and

(j)  $-S(O)_2R^a$ ,  $-S(O)_2OR^a$ ,  $-S(O)_2N(R^a)_2$ ,  $-L-S(O)_2R^a$ ,  $-L-S(O)_2OR^a$ ,  $-L-S(O)_2N(R^a)_2$ .

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, A is further substituted with 1-3  $R^4$  selected from the group consisting of

(a) fluorine, chlorine and -CN;

(b) C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl and C<sub>2</sub>-C<sub>6</sub> alkynyl, each of which is optionally further substituted with 1-6 groups selected from fluorine, chlorine and CN; and

(k)  $-O-(L)_p-S(O)_2R^a$ ,  $-O-(L)_p-S(O)_2O-R^a$ ,  $-O-(L)_p-S(O)_2N(R^a)_2$ ,  $-L-O-(L)_p-S(O)_2R^a$ ,  $-L-O-(L)_p-S(O)_2O-R^a$ ,  $-L-O-(L)_p-S(O)_2N(R^a)_2$ .

5 In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, A is further substituted with 1-3 R<sup>4</sup> selected from the group consisting of

(a) fluorine, chlorine and -CN;

10 (b) C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl and C<sub>2</sub>-C<sub>6</sub> alkynyl, each of which is optionally further substituted with 1-6 groups selected from fluorine, chlorine and CN; and

(l)  $-N(R^b)-(L)_p-S(O)_2R^a$ ,  $-N(R^b)-(L)_p-S(O)_2O-R^a$ ,  $-N(R^b)-(L)_p-S(O)_2N(R^a)_2$ ,  $-L-N(R^b)-(L)_p-S(O)_2R^a$ ,  $-L-N(R^b)-(L)_p-S(O)_2O-R^a$ ,  $-L-N(R^b)-(L)_p-S(O)_2N(R^a)_2$ .

15 In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, A is further substituted with 1-3 R<sup>4</sup> selected from the group consisting of

(a) fluorine, chlorine and -CN;

20 (b) C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl and C<sub>2</sub>-C<sub>6</sub> alkynyl, each of which is optionally further substituted with 1-6 groups selected from fluorine, chlorine and CN; and

(m)  $-C(R^a)=N-CN$ ,  $-L-C(R^a)=N-CN$ .

25 In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each R<sup>a</sup> is independently selected from the group consisting of hydrogen, C<sub>1</sub>-C<sub>6</sub> alkyl and C<sub>1</sub>-C<sub>6</sub> perfluoroalkyl.

30 In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, R<sup>a</sup> is independently selected from the group consisting of hydrogen, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>6</sub> perfluoroalkyl and C<sub>1</sub>-C<sub>6</sub> alkyl further substituted by 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub>.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each R<sup>a</sup> is independently selected from the group consisting of

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(a) hydrogen, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>6</sub> perfluoroalkyl,

(b) C<sub>1</sub>-C<sub>6</sub> alkyl further substituted by 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub> and

(c) C<sub>2</sub>-C<sub>6</sub> alkenyl and C<sub>2</sub>-C<sub>6</sub> alkynyl, each of which is optionally further substituted by 1-3 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub>.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each R<sup>a</sup> is independently selected from the group consisting of

(a) hydrogen, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>6</sub> perfluoroalkyl,

(b) C<sub>1</sub>-C<sub>6</sub> alkyl further substituted by 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub> and

(d) -(C<sub>1</sub>-C<sub>6</sub> alkylene)<sub>p</sub>-(C<sub>3</sub>-C<sub>6</sub> cycloalkyl), -(C<sub>1</sub>-C<sub>6</sub> alkylene)<sub>p</sub>-phenyl, -(C<sub>1</sub>-C<sub>6</sub> alkylene)<sub>p</sub>-(5-6 member heteroaryl), -(C<sub>1</sub>-C<sub>6</sub> alkylene)<sub>p</sub>-(4-6 member heterocyclyl), -(C<sub>1</sub>-C<sub>6</sub> alkylene)<sub>p</sub>-(C<sub>5</sub>-C<sub>6</sub> cycloalkenyl), wherein each C<sub>1</sub>-C<sub>6</sub> alkylene is optionally further substituted with 1-3 groups selected from fluorine, chlorine and -CN, wherein each C<sub>3</sub>-C<sub>6</sub> cycloalkyl, phenyl, 5-6 member heteroaryl, 4-6 member heterocyclyl and C<sub>5</sub>-C<sub>6</sub> cycloalkenyl is independently optionally further substituted with 1-3 R<sup>y</sup>.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each R<sup>a</sup> is independently selected from the group consisting of

(a) hydrogen, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>6</sub> perfluoroalkyl,

(b) C<sub>1</sub>-C<sub>6</sub> alkyl further substituted by 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub>;

or two R<sup>a</sup> connected to the same nitrogen form a 3-10 member heterocyclyl or 5-10 member heteroaryl, the said 3-10 member heterocyclyl and the said 5-10 member heteroaryl is optionally further substituted with 1-3 R<sup>z</sup>.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each L is -C<sub>1</sub>-C<sub>6</sub> alkylene.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each L is independently -C<sub>1</sub>-C<sub>6</sub> alkylene or C<sub>2</sub>-C<sub>6</sub> alkenylene.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each L is independently  $-C_1-C_6$  alkylene or  $C_2-C_6$  alkynylene.

In another preferred aspect of the invention or any of the above described  
5 embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^w$  is independently selected from the group consisting of fluorine, chlorine,  $-CN$  and  $C_1-C_6$  alkyl,.

In another preferred aspect of the invention or any of the above described  
10 embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^w$  is independently selected from the group consisting of fluorine, chlorine,  $-CN$ ,  $-OR^b$ ,  $C_1-C_6$  alkyl,  $C_1-C_3$  perfluoroalkyl,  $C_2-C_6$  alkenyl,  $C_2-C_6$  alkynyl and  $-N(R^b)_2$ .

In another preferred aspect of the invention or any of the above described  
15 embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^w$  is independently selected from the group consisting of (i) fluorine, chlorine,  $-CN$ ,  $-OR^b$ ,  $C_1-C_6$  alkyl,  $C_1-C_3$  perfluoroalkyl,  $C_2-C_6$  alkenyl,  $C_2-C_6$  alkynyl and  $-N(R^b)_2$ ; and (ii)  $C_1-C_6$  alkyl further substituted with 1-2 groups selected from fluorine, chlorine,  $-CN$ ,  $-OR^b$  and  $-N(R^b)_2$ .

In another preferred aspect of the invention or any of the above described  
20 embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^w$  is independently selected from the group consisting of (i) fluorine, chlorine,  $-CN$ ,  $-OR^b$ ,  $C_1-C_6$  alkyl,  $C_1-C_3$  perfluoroalkyl,  $C_2-C_6$  alkenyl,  $C_2-C_6$  alkynyl and  $-N(R^b)_2$ ; and (ii)  $C_1-C_6$  alkyl further substituted with 1-2 groups selected from fluorine, chlorine,  $-CN$ ,  $-OR^b$  and  $-N(R^b)_2$  and (iii)  $-C(O)-R^b$ ,  $-C(O)OR^b$ ,  $-C(O)-$   
25  $N(R^b)_2$ .

In another preferred aspect of the invention or any of the above described  
embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^w$  is independently selected from the group consisting of (i) fluorine, chlorine,  $-CN$ ,  $-OR^b$ ,  $C_1-C_6$  alkyl,  $C_1-C_3$  perfluoroalkyl,  $C_2-C_6$  alkenyl,  $C_2-C_6$   
30 alkynyl and  $-N(R^b)_2$ ; and (ii)  $C_1-C_6$  alkyl further substituted with 1-2 groups selected from fluorine, chlorine,  $-CN$ ,  $-OR^b$  and  $-N(R^b)_2$  and (iv)  $-N(R^b)-C(O)-R^b$ ,  $-N(R^b)-C(O)OR^b$ ,  $-N(R^b)-C(O)-N(R^b)_2$ .

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^w$  is independently selected from the group consisting of (i) fluorine, chlorine, -CN, -OR<sup>b</sup>, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl and -N(R<sup>b</sup>)<sub>2</sub>; and (ii) C<sub>1</sub>-C<sub>6</sub> alkyl further substituted with 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub> and (v) -O-C(O)-R<sup>b</sup>, -O-C(O)OR<sup>b</sup>, -O-C(O)-N(R<sup>b</sup>)<sub>2</sub>.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^w$  is independently selected from the group consisting of (i) fluorine, chlorine, -CN, -OR<sup>b</sup>, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl and -N(R<sup>b</sup>)<sub>2</sub>; and (ii) C<sub>1</sub>-C<sub>6</sub> alkyl further substituted with 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub> and (vi) -S(O)<sub>2</sub>-R<sup>b</sup>, -S(O)<sub>2</sub>-O-R<sup>b</sup> - S(O)<sub>2</sub>-N(R<sup>b</sup>)<sub>2</sub>.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^w$  is independently selected from the group consisting of (i) fluorine, chlorine, -CN, -OR<sup>b</sup>, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl and -N(R<sup>b</sup>)<sub>2</sub>; and (ii) C<sub>1</sub>-C<sub>6</sub> alkyl further substituted with 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub> and (vii) -N(R<sup>b</sup>)-S(O)<sub>2</sub>-R<sup>b</sup>, -N(R<sup>b</sup>)-S(O)<sub>2</sub>-O-R<sup>b</sup>, -N(R<sup>b</sup>)-S(O)<sub>2</sub>-N(R<sup>b</sup>)<sub>2</sub>.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^w$  is independently selected from the group consisting of (i) fluorine, chlorine, -CN, -OR<sup>b</sup>, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl and -N(R<sup>b</sup>)<sub>2</sub>; and (ii) C<sub>1</sub>-C<sub>6</sub> alkyl further substituted with 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub> and (viii) -O-S(O)<sub>2</sub>-R<sup>b</sup>, -O-S(O)<sub>2</sub>-O-R<sup>b</sup> -O-S(O)<sub>2</sub>-N(R<sup>b</sup>)<sub>2</sub>.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^x$  is independently selected from the group consisting of fluorine, chlorine, -CN and C<sub>1</sub>-C<sub>6</sub> alkyl,.



In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^x$  is independently selected from the group consisting of fluorine, chlorine, -CN, -OR<sup>b</sup>, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl and -N(R<sup>b</sup>)<sub>2</sub>.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^x$  is independently selected from the group consisting of (i) fluorine, chlorine, -CN, -OR<sup>b</sup>, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl and -N(R<sup>b</sup>)<sub>2</sub>; and (ii) C<sub>1</sub>-C<sub>6</sub> alkyl further substituted with 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub>.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^x$  is independently selected from the group consisting of (i) fluorine, chlorine, -CN, -OR<sup>b</sup>, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl and -N(R<sup>b</sup>)<sub>2</sub>; and (ii) C<sub>1</sub>-C<sub>6</sub> alkyl further substituted with 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub> and (iii) -C(O)-R<sup>b</sup>, -C(O)OR<sup>b</sup>, -C(O)-N(R<sup>b</sup>)<sub>2</sub>.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^x$  is independently selected from the group consisting of (i) fluorine, chlorine, -CN, -OR<sup>b</sup>, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl and -N(R<sup>b</sup>)<sub>2</sub>; and (ii) C<sub>1</sub>-C<sub>6</sub> alkyl further substituted with 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub> and (iv) -N(R<sup>b</sup>)-C(O)-R<sup>b</sup>, -N(R<sup>b</sup>)-C(O)OR<sup>b</sup>, -N(R<sup>b</sup>)-C(O)-N(R<sup>b</sup>)<sub>2</sub>.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^x$  is independently selected from the group consisting of (i) fluorine, chlorine, -CN, -OR<sup>b</sup>, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl and -N(R<sup>b</sup>)<sub>2</sub>; and (ii) C<sub>1</sub>-C<sub>6</sub> alkyl further substituted with 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub> and (v) -O-C(O)-R<sup>b</sup>, -O-C(O)OR<sup>b</sup>, -O-C(O)-N(R<sup>b</sup>)<sub>2</sub>.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^x$  is independently selected from the group consisting of (i) fluorine, chlorine, -CN, -OR<sup>b</sup>, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl and -N(R<sup>b</sup>)<sub>2</sub>; and (ii) C<sub>1</sub>-C<sub>6</sub> alkyl further substituted with 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub> and (vi) -S(O)<sub>2</sub>-R<sup>b</sup>, -S(O)<sub>2</sub>-O-R<sup>b</sup> - S(O)<sub>2</sub>-N(R<sup>b</sup>)<sub>2</sub>.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^x$  is independently selected from the group consisting of (i) fluorine, chlorine, -CN, -OR<sup>b</sup>, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl and -N(R<sup>b</sup>)<sub>2</sub>; and (ii) C<sub>1</sub>-C<sub>6</sub> alkyl further substituted with 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub> and (vii) -N(R<sup>b</sup>)-S(O)<sub>2</sub>-R<sup>b</sup>, -N(R<sup>b</sup>)-S(O)<sub>2</sub>-O-R<sup>b</sup>, -N(R<sup>b</sup>)-S(O)<sub>2</sub>-N(R<sup>b</sup>)<sub>2</sub>.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^x$  is independently selected from the group consisting of (i) fluorine, chlorine, -CN, -OR<sup>b</sup>, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl and -N(R<sup>b</sup>)<sub>2</sub>; and (ii) C<sub>1</sub>-C<sub>6</sub> alkyl further substituted with 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub> and (viii) -O-S(O)<sub>2</sub>-R<sup>b</sup>, -O-S(O)<sub>2</sub>-O-R<sup>b</sup> -O-S(O)<sub>2</sub>-N(R<sup>b</sup>)<sub>2</sub>.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^y$  is independently selected from the group consisting of fluorine, chlorine, -CN and C<sub>1</sub>-C<sub>6</sub> alkyl,.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^y$  is independently selected from the group consisting of fluorine, chlorine, -CN, -OR<sup>b</sup>, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl and -N(R<sup>b</sup>)<sub>2</sub>.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^y$  is independently selected from the group consisting of (i)

fluorine, chlorine, -CN, -OR<sup>b</sup>, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl and -N(R<sup>b</sup>)<sub>2</sub>; and **(ii)** C<sub>1</sub>-C<sub>6</sub> alkyl further substituted with 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub>.

In another preferred aspect of the invention or any of the above described  
 5 embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each R<sup>y</sup> is independently selected from the group consisting of **(i)** fluorine, chlorine, -CN, -OR<sup>b</sup>, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl and -N(R<sup>b</sup>)<sub>2</sub>; and **(ii)** C<sub>1</sub>-C<sub>6</sub> alkyl further substituted with 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub> and **(iii)** -C(O)-R<sup>b</sup>, -C(O)OR<sup>b</sup>, -C(O)-  
 10 N(R<sup>b</sup>)<sub>2</sub>.

In another preferred aspect of the invention or any of the above described  
 embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each R<sup>y</sup> is independently selected from the group consisting of **(i)** fluorine, chlorine, -CN, -OR<sup>b</sup>, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub>  
 15 alkynyl and -N(R<sup>b</sup>)<sub>2</sub>; and **(ii)** C<sub>1</sub>-C<sub>6</sub> alkyl further substituted with 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub> and **(iv)** -N(R<sup>b</sup>)-C(O)-R<sup>b</sup>, -N(R<sup>b</sup>)-C(O)OR<sup>b</sup>, -N(R<sup>b</sup>)-C(O)-N(R<sup>b</sup>)<sub>2</sub>.

In another preferred aspect of the invention or any of the above described  
 embodiments of the invention, and in combination with any other preferred aspects  
 20 not inconsistent, each R<sup>y</sup> is independently selected from the group consisting of **(i)** fluorine, chlorine, -CN, -OR<sup>b</sup>, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl and -N(R<sup>b</sup>)<sub>2</sub>; and **(ii)** C<sub>1</sub>-C<sub>6</sub> alkyl further substituted with 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub> and **(v)** -O-C(O)-R<sup>b</sup>, -O-C(O)OR<sup>b</sup>, -O-C(O)-N(R<sup>b</sup>)<sub>2</sub>.

In another preferred aspect of the invention or any of the above described  
 25 embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each R<sup>y</sup> is independently selected from the group consisting of **(i)** fluorine, chlorine, -CN, -OR<sup>b</sup>, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl and -N(R<sup>b</sup>)<sub>2</sub>; and **(ii)** C<sub>1</sub>-C<sub>6</sub> alkyl further substituted with 1-2 groups selected  
 30 from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub> and **(vi)** -S(O)<sub>2</sub>-R<sup>b</sup>, -S(O)<sub>2</sub>-O-R<sup>b</sup> -S(O)<sub>2</sub>-N(R<sup>b</sup>)<sub>2</sub>.

In another preferred aspect of the invention or any of the above described  
 embodiments of the invention, and in combination with any other preferred aspects

not inconsistent, each  $R^y$  is independently selected from the group consisting of **(i)** fluorine, chlorine, -CN, -OR<sup>b</sup>, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl and -N(R<sup>b</sup>)<sub>2</sub>; and **(ii)** C<sub>1</sub>-C<sub>6</sub> alkyl further substituted with 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub> and **(vii)** -N(R<sup>b</sup>)-S(O)<sub>2</sub>-R<sup>b</sup>, -N(R<sup>b</sup>)-S(O)<sub>2</sub>-O-R<sup>b</sup>, -N(R<sup>b</sup>)-S(O)<sub>2</sub>-N(R<sup>b</sup>)<sub>2</sub>.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^y$  is independently selected from the group consisting of **(i)** fluorine, chlorine, -CN, -OR<sup>b</sup>, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl and -N(R<sup>b</sup>)<sub>2</sub>; and **(ii)** C<sub>1</sub>-C<sub>6</sub> alkyl further substituted with 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub> and **(viii)** -O-S(O)<sub>2</sub>-R<sup>b</sup>, -O-S(O)<sub>2</sub>-O-R<sup>b</sup> -O-S(O)<sub>2</sub>-N(R<sup>b</sup>)<sub>2</sub>.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^z$  is independently selected from the group consisting of fluorine, chlorine, -CN and C<sub>1</sub>-C<sub>6</sub> alkyl,.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^z$  is independently selected from the group consisting of fluorine, chlorine, -CN, -OR<sup>b</sup>, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl and -N(R<sup>b</sup>)<sub>2</sub>.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^z$  is independently selected from the group consisting of **(i)** fluorine, chlorine, -CN, -OR<sup>b</sup>, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl and -N(R<sup>b</sup>)<sub>2</sub>; and **(ii)** C<sub>1</sub>-C<sub>6</sub> alkyl further substituted with 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub>.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^z$  is independently selected from the group consisting of **(i)** fluorine, chlorine, -CN, -OR<sup>b</sup>, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl and -N(R<sup>b</sup>)<sub>2</sub>; and **(ii)** C<sub>1</sub>-C<sub>6</sub> alkyl further substituted with 1-2 groups selected

from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub> and **(iii)** -C(O)-R<sup>b</sup>, -C(O)OR<sup>b</sup>, -C(O)-N(R<sup>b</sup>)<sub>2</sub>.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each R<sup>z</sup> is independently selected from the group consisting of **(i)** fluorine, chlorine, -CN, -OR<sup>b</sup>, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl and -N(R<sup>b</sup>)<sub>2</sub>; and **(ii)** C<sub>1</sub>-C<sub>6</sub> alkyl further substituted with 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub> and **(iv)** -N(R<sup>b</sup>)-C(O)-R<sup>b</sup>, -N(R<sup>b</sup>)-C(O)OR<sup>b</sup>, -N(R<sup>b</sup>)-C(O)-N(R<sup>b</sup>)<sub>2</sub>.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each R<sup>z</sup> is independently selected from the group consisting of **(i)** fluorine, chlorine, -CN, -OR<sup>b</sup>, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl and -N(R<sup>b</sup>)<sub>2</sub>; and **(ii)** C<sub>1</sub>-C<sub>6</sub> alkyl further substituted with 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub> and **(v)** -O-C(O)-R<sup>b</sup>, -O-C(O)OR<sup>b</sup>, -O-C(O)-N(R<sup>b</sup>)<sub>2</sub>.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each R<sup>z</sup> is independently selected from the group consisting of **(i)** fluorine, chlorine, -CN, -OR<sup>b</sup>, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl and -N(R<sup>b</sup>)<sub>2</sub>; and **(ii)** C<sub>1</sub>-C<sub>6</sub> alkyl further substituted with 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub> and **(vi)** -S(O)<sub>2</sub>-R<sup>b</sup>, -S(O)<sub>2</sub>-O-R<sup>b</sup> - S(O)<sub>2</sub>-N(R<sup>b</sup>)<sub>2</sub>.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each R<sup>z</sup> is independently selected from the group consisting of **(i)** fluorine, chlorine, -CN, -OR<sup>b</sup>, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl and -N(R<sup>b</sup>)<sub>2</sub>; and **(ii)** C<sub>1</sub>-C<sub>6</sub> alkyl further substituted with 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub> and **(vii)** -N(R<sup>b</sup>)-S(O)<sub>2</sub>-R<sup>b</sup>, -N(R<sup>b</sup>)-S(O)<sub>2</sub>-O-R<sup>b</sup>, -N(R<sup>b</sup>)-S(O)<sub>2</sub>-N(R<sup>b</sup>)<sub>2</sub>.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each R<sup>z</sup> is independently selected from the group consisting of **(i)**

fluorine, chlorine, -CN, -OR<sup>b</sup>, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl, C<sub>2</sub>-C<sub>6</sub> alkynyl and -N(R<sup>b</sup>)<sub>2</sub>; and **(ii)** C<sub>1</sub>-C<sub>6</sub> alkyl further substituted with 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub> and **(viii)** -O-S(O)<sub>2</sub>-R<sup>b</sup>, -O-S(O)<sub>2</sub>-O-R<sup>b</sup> -O-S(O)<sub>2</sub>-N(R<sup>b</sup>)<sub>2</sub>.

5 In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each R<sup>b</sup> is hydrogen.

In another preferred aspect of the invention or any of the above described  
embodiments of the invention, and in combination with any other preferred aspects  
10 not inconsistent, each R<sup>b</sup> is independently selected from the group consisting of hydrogen and C<sub>1</sub>-C<sub>3</sub> alkyl.

In another preferred aspect of the invention or any of the above described  
embodiments of the invention, and in combination with any other preferred aspects  
not inconsistent, each R<sup>b</sup> is independently selected from the group consisting of  
15 hydrogen, C<sub>1</sub>-C<sub>3</sub> alkyl and C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl.

In another preferred aspect of the invention or any of the above described  
embodiments of the invention, and in combination with any other preferred aspects  
not inconsistent, each R<sup>b</sup> is independently selected from the group consisting of  
hydrogen, C<sub>1</sub>-C<sub>3</sub> alkyl and C<sub>1</sub>-C<sub>3</sub> alkyl further substituted by 1-2 groups selected from  
20 fluorine, chlorine and CN.

In another preferred aspect of the invention or any of the above described  
embodiments of the invention, and in combination with any other preferred aspects  
not inconsistent, each R<sup>3</sup> is independently selected from the group consisting of -  
oxo-, fluorine, chlorine, C<sub>1</sub>-C<sub>3</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> alkoxy, and CF<sub>3</sub>.

25 In another preferred aspect of the invention or any of the above described  
embodiments of the invention, and in combination with any other preferred aspects  
not inconsistent, each R<sup>3</sup> is independently selected from the group consisting of -  
oxo- and

(a) fluorine, chlorine and -CN; and

30 (b) C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl and C<sub>2</sub>-C<sub>6</sub> alkynyl, each of which is optionally  
further substituted with 1-6 groups selected from fluorine, chlorine and CN.

In another preferred aspect of the invention or any of the above described  
embodiments of the invention, and in combination with any other preferred aspects

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not inconsistent, each  $R^3$  is independently selected from the group consisting of – oxo- and

(a) fluorine, chlorine and -CN;

(b)  $C_1-C_6$  alkyl,  $C_2-C_6$  alkenyl and  $C_2-C_6$  alkynyl, each of which is optionally further substituted with 1-6 groups selected from fluorine, chlorine and CN; and

(c)  $C_3-C_6$  cycloalkyl, -L-( $C_3-C_6$  cycloalkyl), 4-6 member heterocyclyl, -L-(4-6 member heterocyclyl), phenyl, -L-phenyl, 5-6 member heteroaryl, -L-(5-6 member heteroaryl),  $C_5-C_6$  cycloalkenyl, -L-( $C_5-C_6$  cycloalkenyl), wherein each  $C_3-C_6$  cycloalkyl, phenyl, 5-6 member heteroaryl, 4-6 member heterocyclyl and  $C_5-C_6$  cycloalkenyl is independently optionally further substituted with 1-6  $R^x$ .

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^3$  is independently selected from the group consisting of – oxo- and

(a) fluorine, chlorine and -CN;

(b)  $C_1-C_6$  alkyl,  $C_2-C_6$  alkenyl and  $C_2-C_6$  alkynyl, each of which is optionally further substituted with 1-6 groups selected from fluorine, chlorine and CN; and

(d)  $-N(R^a)_2$ , -L- $N(R^a)_2$ .

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^3$  is independently selected from the group consisting of – oxo- and

(a) fluorine, chlorine and -CN;

(b)  $C_1-C_6$  alkyl,  $C_2-C_6$  alkenyl and  $C_2-C_6$  alkynyl, each of which is optionally further substituted with 1-6 groups selected from fluorine, chlorine and CN; and

(e)  $-OR^a$ , -L- $OR^a$ .

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^3$  is independently selected from the group consisting of – oxo- and

(a) fluorine, chlorine and -CN;

(b)  $C_1-C_6$  alkyl,  $C_2-C_6$  alkenyl and  $C_2-C_6$  alkynyl, each of which is optionally further substituted with 1-6 groups selected from fluorine, chlorine and CN; and

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(g)  $-C(O)R^a$ ,  $-C(O)OR^a$ ,  $-C(O)N(R^a)_2$ ,  $-L-C(O)R^a$ ,  $-L-C(O)OR^a$ ,  $-L-C(O)N(R^a)_2$ .

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^3$  is independently selected from the group consisting of –  
 5 oxo- and

(a) fluorine, chlorine and  $-CN$ ;

(b)  $C_1-C_6$  alkyl,  $C_2-C_6$  alkenyl and  $C_2-C_6$  alkynyl, each of which is optionally further substituted with 1-6 groups selected from fluorine, chlorine and  $CN$ ; and

10 (h)  $-N(R^b)-(L)_p-C(O)R^a$ ,  $-N(R^b)-(L)_p-C(O)OR^a$ ,  $-N(R^b)-(L)_p-C(O)N(R^a)_2$ ,  $-L-N(R^b)-(L)_p-C(O)R^a$ ,  $-L-N(R^b)-(L)_p-C(O)OR^a$ ,  $-L-N(R^b)-(L)_p-C(O)N(R^a)_2$ .

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^3$  is independently selected from the group consisting of –  
 15 oxo- and

(a) fluorine, chlorine and  $-CN$ ;

(b)  $C_1-C_6$  alkyl,  $C_2-C_6$  alkenyl and  $C_2-C_6$  alkynyl, each of which is optionally further substituted with 1-6 groups selected from fluorine, chlorine and  $CN$ ; and

20 (i)  $-O-(L)_p-C(O)R^a$ ,  $-O-(L)_p-C(O)N(R^a)_2$ ,  $-O-(L)_p-C(O)O-R^a$ ,  $-L-O-(L)_p-C(O)R^a$ ,  $-L-O-(L)_p-C(O)N(R^a)_2$ ,  $-L-O-(L)_p-C(O)O-R^a$ .

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^3$  is independently selected from the group consisting of –  
 25 oxo- and

(a) fluorine, chlorine and  $-CN$ ;

25 (b)  $C_1-C_6$  alkyl,  $C_2-C_6$  alkenyl and  $C_2-C_6$  alkynyl, each of which is optionally further substituted with 1-6 groups selected from fluorine, chlorine and  $CN$ ; and

(j)  $-S(O)_2R^a$ ,  $-S(O)_2OR^a$ ,  $-S(O)_2N(R^a)_2$ ,  $-L-S(O)_2R^a$ ,  $-L-S(O)_2OR^a$ ,  $-L-S(O)_2N(R^a)_2$ .

In another preferred aspect of the invention or any of the above described  
 30 embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^3$  is independently selected from the group consisting of –  
 oxo- and

(a) fluorine, chlorine and  $-CN$ ;



(b) C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl and C<sub>2</sub>-C<sub>6</sub> alkynyl, each of which is optionally further substituted with 1-6 groups selected from fluorine, chlorine and CN; and

(k)  $-O-(L)_p-S(O)_2R^a$ ,  $-O-(L)_p-S(O)_2O-R^a$ ,  $-O-(L)_p-S(O)_2N(R^a)_2$ ,  $-L-O-(L)_p-S(O)_2R^a$ ,  $-L-O-(L)_p-S(O)_2O-R^a$ ,  $-L-O-(L)_p-S(O)_2N(R^a)_2$ .

5 In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each R<sup>3</sup> is independently selected from the group consisting of – oxo- and

(a) fluorine, chlorine and –CN;

10 (b) C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl and C<sub>2</sub>-C<sub>6</sub> alkynyl, each of which is optionally further substituted with 1-6 groups selected from fluorine, chlorine and CN; and

(l)  $-N(R^b)-(L)_p-S(O)_2R^a$ ,  $-N(R^b)-(L)_p-S(O)_2O-R^a$ ,  $-N(R^b)-(L)_p-S(O)_2N(R^a)_2$ ,  $-L-N(R^b)-(L)_p-S(O)_2R^a$ ,  $-L-N(R^b)-(L)_p-S(O)_2O-R^a$ ,  $-L-N(R^b)-(L)_p-S(O)_2N(R^a)_2$ .

15 In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each R<sup>3</sup> is independently selected from the group consisting of – oxo- and

(a) fluorine, chlorine and –CN;

20 (b) C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl and C<sub>2</sub>-C<sub>6</sub> alkynyl, each of which is optionally further substituted with 1-6 groups selected from fluorine, chlorine and CN; and

(m)  $-C(R^a)=N-CN$ ,  $-L-C(R^a)=N-CN$ .

25 In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each R<sup>3</sup> is independently selected from the group consisting of – oxo- and

(a) fluorine, chlorine and –CN;

(b) C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>2</sub>-C<sub>6</sub> alkenyl and C<sub>2</sub>-C<sub>6</sub> alkynyl, each of which is optionally further substituted with 1-6 groups selected from fluorine, chlorine and CN;

30 further more, two of the R<sup>3</sup> attached to the same ring atom, together with the ring atom attached to, may also form a ring selected from C<sub>3</sub>-C<sub>6</sub> cycloalkyl, C<sub>5</sub>-C<sub>6</sub> cycloalkenyl and 3-6 member heterocyclyl; each of the said C<sub>3</sub>-C<sub>6</sub> cycloalkyl, C<sub>5</sub>-C<sub>6</sub> cycloalkenyl and 3-6 member heterocyclyl is optionally further substituted with 1-5 groups selected from –oxo- and R<sup>w</sup>.

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^3$  is independently selected from the group consisting of –oxo- and

(a) fluorine, chlorine and -CN;

(b)  $C_1$ - $C_6$  alkyl,  $C_2$ - $C_6$  alkenyl and  $C_2$ - $C_6$  alkynyl, each of which is optionally further substituted with 1-6 groups selected from fluorine, chlorine and CN;

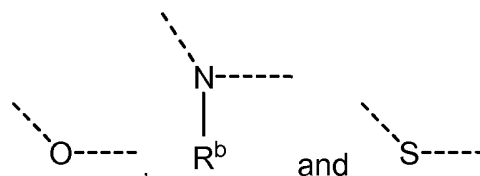
further more, two of the  $R^3$  attached to two adjacent ring atoms, together with the ring atoms attached to, form a fused ring selected from  $C_3$ - $C_6$  cycloalkyl,  $C_5$ - $C_6$  cycloalkenyl, 3-6 member heterocyclyl, phenyl, 5-6 member heteroaryl; the said  $C_3$ - $C_6$  cycloalkyl,  $C_5$ - $C_6$  cycloalkenyl, 3-6 member heterocyclyl, phenyl and 5-6 member heteroaryl is optionally further substituted with 1-5 groups selected from –oxo- and  $R^w$ .

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each  $R^3$  is independently selected from the group consisting of –oxo- and

(a) fluorine, chlorine and -CN;

(b)  $C_1$ - $C_6$  alkyl,  $C_2$ - $C_6$  alkenyl and  $C_2$ - $C_6$  alkynyl, each of which is optionally further substituted with 1-6 groups selected from fluorine, chlorine and CN;

further more, two  $R^3$  attached to, two different ring atoms with at least one ring atom in between, may form a  $C_1$ - $C_4$  alkylene, a 2-4 member heteroalkylene, or a diradical selected from the group consisting of:



such  $C_1$ - $C_4$  alkylene, 2-4 member heteroalkylene and diradical together with the azetidiny (when  $n$  is 0), pyrrolidiny (when  $n$  is 1) or the piperidiny (when  $n$  is 2) form a bicyclic bridged ring system, the said bicyclic bridged ring system having a total of 6-9 ring atoms with 1-3 of the ring atoms selected from O, N and S; the  $C_1$ - $C_4$  alkylene or a 1-4 member heteroalkylene is optionally further substituted with 1-5 groups selected from –oxo- and  $R^w$ .

In another preferred aspect of the invention or any of the above described embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each p is 0.

In another preferred aspect of the invention or any of the above described  
5 embodiments of the invention, and in combination with any other preferred aspects not inconsistent, each p is 1.

This invention also relates to a method for the treatment of abnormal cell growth in a mammal, including a human, comprising administering to said mammal an amount of a compound of the Formula I, as defined above, or a pharmaceutically acceptable  
10 salt or solvate thereof, that is effective in treating abnormal cell growth.

In one embodiment of this method, the abnormal cell growth is cancer, including, but not limited to, mesothelioma, hepatobiliary (hepatic and biliary duct), a primary or secondary CNS tumor, a primary or secondary brain tumor, lung cancer (NSCLC and SCLC), bone cancer, pancreatic cancer, skin cancer, cancer of the head or neck,  
15 cutaneous or intraocular melanoma, ovarian cancer, colon cancer, rectal cancer, cancer of the anal region, stomach cancer, gastrointestinal (gastric, colorectal, and duodenal), breast cancer, uterine cancer, carcinoma of the fallopian tubes, carcinoma of the endometrium, carcinoma of the cervix, carcinoma of the vagina, carcinoma of the vulva, Hodgkin's Disease, cancer of the esophagus, cancer of the small intestine,  
20 cancer of the endocrine system, cancer of the thyroid gland, cancer of the parathyroid gland, cancer of the adrenal gland, sarcoma of soft tissue, cancer of the urethra, cancer of the penis, prostate cancer, testicular cancer, chronic or acute leukemia, chronic myeloid leukemia, lymphocytic lymphomas, cancer of the bladder, cancer of the kidney or ureter, renal cell carcinoma, carcinoma of the renal pelvis, neoplasms of  
25 the central nervous system (CNS), primary CNS lymphoma, non hodgkins's lymphoma, spinal axis tumors, brain stem glioma, pituitary adenoma, adrenocortical cancer, gall bladder cancer, multiple myeloma, cholangiocarcinoma, fibrosarcoma, neuroblastoma, retinoblastoma, or a combination of one or more of the foregoing cancers.

In another embodiment of said method, said abnormal cell growth is a benign  
30 proliferative disease, including, but not limited to, psoriasis, benign prostatic hypertrophy or restinosis.

In a preferred embodiment of the present invention the cancer is selected from lung cancer (NSCLC and SCLC), cancer of the head or neck, ovarian cancer, colon cancer, rectal cancer, cancer of the anal region, stomach cancer, breast cancer, cancer of the kidney or ureter, renal cell carcinoma, carcinoma of the renal pelvis, neoplasms of the central nervous system (CNS), primary CNS lymphoma, non hodgkins's lymphoma, spinal axis tumors, or a combination of one or more of the foregoing cancers.

In another preferred embodiment of the present invention the cancer is selected from lung cancer (NSCLC and SCLC), ovarian cancer, colon cancer, rectal cancer, cancer of the anal region, or a combination of one or more of the foregoing cancers.

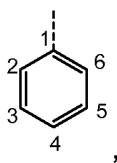
In a more preferred embodiment of the present invention the cancer is selected from lung cancer (NSCLC and SCLC), ovarian cancer, colon cancer, rectal cancer, or a combination of one or more of the foregoing cancers.

In another embodiment of said method, said abnormal cell growth is a benign proliferative disease, including, but not limited to, psoriasis, benign prostatic hypertrophy or restinosis.



This invention also relates to a pharmaceutical composition for the treatment of abnormal cell growth in a mammal, including a human, comprising an amount of a compound of the Formula I, as defined above, or a pharmaceutically acceptable salt or solvate thereof, that is effective in treating abnormal cell growth, and a pharmaceutically acceptable carrier. In one embodiment of said composition, said abnormal cell growth is cancer, including, but not limited to, mesothelioma, hepatobilliary (hepatic and billiary duct), a primary or secondary CNS tumor, a primary or secondary brain tumor, lung cancer (NSCLC and SCLC), bone cancer, pancreatic cancer, skin cancer, cancer of the head or neck, cutaneous or intraocular melanoma, ovarian cancer, colon cancer, rectal cancer, cancer of the anal region, stomach cancer, gastrointestinal (gastric, colorectal, and duodenal), breast cancer, uterine cancer, carcinoma of the fallopian tubes, carcinoma of the endometrium, carcinoma of the cervix, carcinoma of the vagina, carcinoma of the vulva, Hodgkin's Disease, cancer of the esophagus, cancer of the small intestine, cancer of the endocrine system, cancer of the thyroid gland, cancer of the parathyroid gland, cancer of the adrenal gland, sarcoma of soft tissue, cancer of the urethra, cancer of the penis, prostate cancer, testicular cancer, chronic or acute leukemia, chronic



myeloid leukemia, lymphocytic lymphomas, cancer of the bladder, cancer of the kidney or ureter, renal cell carcinoma, carcinoma of the renal pelvis, neoplasms of the central nervous system (CNS), primary CNS lymphoma, non hodgkins's lymphoma, spinal axis tumors, brain stem glioma, pituitary adenoma, adrenocortical cancer, gall bladder cancer, multiple myeloma, cholangiocarcinoma, fibrosarcoma, neuroblastoma, retinoblastoma, or a combination of one or more of the foregoing cancers. In another embodiment of said pharmaceutical composition, said abnormal cell growth is a benign proliferative disease, including, but not limited to, psoriasis, benign prostatic hypertrophy or restinosis.

As used herein, the symbol [-----] when incorporated into the chemical structure of a substituent means that the atom to which [-----] is attached is the point of attachment of that substituent to some position on another molecule. For example, X in the hypothetical molecule  $\text{CH}_3\text{CH}_2\text{-X}$  might be defined as X is



in which case, the placement of [-----] attached to the arbitrarily numbered position C-1, means that C-1 of the phenyl ring is attached to the methylene carbon.

The symbols “” and “”, when used together in a single molecule without further indication otherwise, for example, chemical name or accompanying description, merely indicate relative stereochemistry of *trans* or *cis* where applicable.

The symbol “” and the symbol “”, used together or separately, in combination with an indication of them representing the absolute stereochemistry, for example, an indication of “S” or “R” in the corresponding chemical structure or the accompanying chemical name, indicate the absolute stereochemistry of the corresponding chiral center.

“ $\text{C}_m\text{-C}_n$  alkyl”, wherein m is an integer of 1-19, n is an integer of 2 to 20 and  $n > m$ , refers to a straight chain or branched saturated hydrocarbon radical having from m to n carbon atoms, wherein n is an integer of 2 to 20. A  $\text{C}_m\text{-C}_n$  alkyl group may be unsubstituted or further substituted by at least one substituent. Examples of  $\text{C}_1\text{-C}_{12}$  alkyl groups include, but are not limited to methyl, ethyl, propyl, isopropyl, butyl, sec-butyl, iso-butyl, tert-butyl, pentyl, neo-pentyl, sec-pentyl, hexyl, heptyl, octyl, and the like, including substituted forms thereof. Further, the term “alkyl” refers to a straight

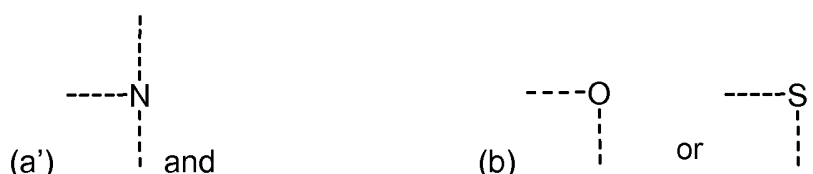
chain or branched saturated hydrocarbon radical of 1 to 20 carbon atoms, or 1 to 12 carbon atoms, or 1 to 8 carbon atoms, or 1 to 6 carbon atoms, or 1 to 4 carbon atoms. Alkyl may be unsubstituted or further substituted by at least one substituent. Suitable substituents on an alkyl group are the same as those described for a C<sub>1</sub>-C<sub>12</sub> alkyl group.

A "m to n member heteroalkyl", wherein m is an integer of 2-19, n is an integer of 3 to 20 and n > m, refers to a C<sub>m</sub>-C<sub>n</sub> alkyl, as defined above, wherein 1 to 3 groups selected from



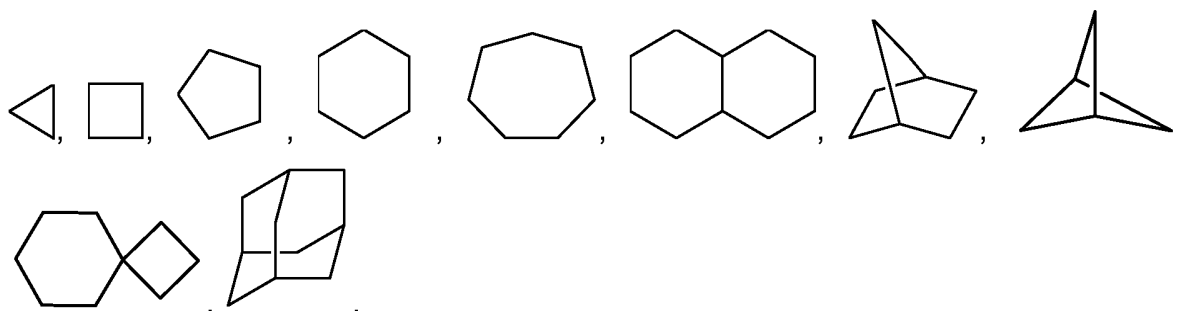
wherein the "-----" indicates the point of attachment of the group with other parts of the C<sub>m</sub>-C<sub>n</sub> alkyl, and wherein the above group (a) and (b) are components of the C<sub>m</sub>-C<sub>n</sub> alkyl,

are replaced by a group selected, respectively, from

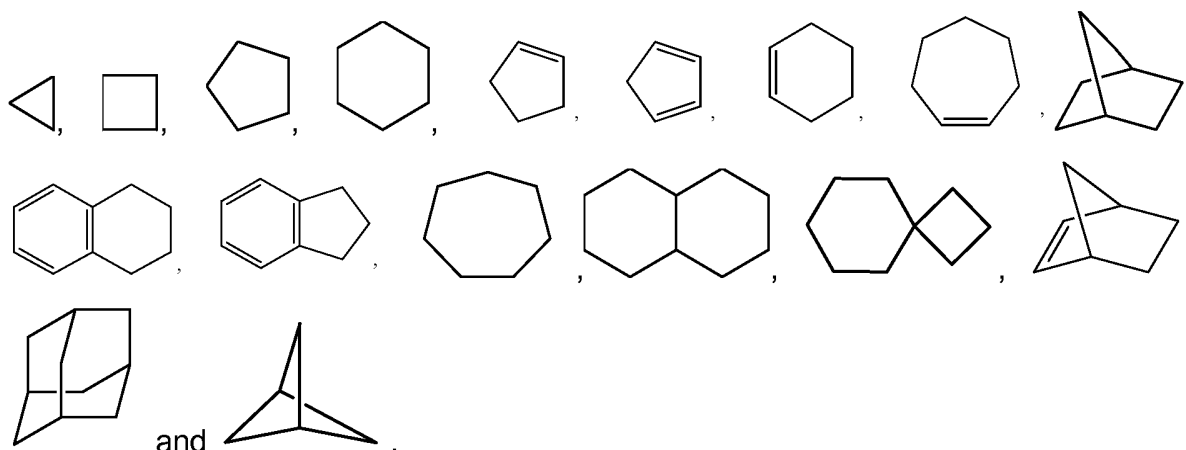


Examples of heteroalkyl include, but are not limited to: -O-CH<sub>3</sub>, -NH-CH<sub>3</sub>, -N(CH<sub>3</sub>)-CH<sub>3</sub>, -S-CH<sub>3</sub>, -CH<sub>2</sub>-O-CH<sub>3</sub>, -CH<sub>2</sub>-N(H)-CH<sub>3</sub> and -CH<sub>2</sub>-S-CH<sub>3</sub>.

"C<sub>m</sub>-C<sub>n</sub> cycloalkyl", wherein m is an integer of 3-19, n is an integer of 4 to 20 and n > m, refers to a cyclic saturated hydrocarbon radical having from m to n carbon atoms. A cycloalkyl group may be monocyclic and where permissible may be bicyclic or polycyclic. A cycloalkyl may also be a spirocyclic. A cycloalkyl group may be optionally substituted by at least one substituent. Illustrative examples of cycloalkyl are derived from, but not limited to, the following:



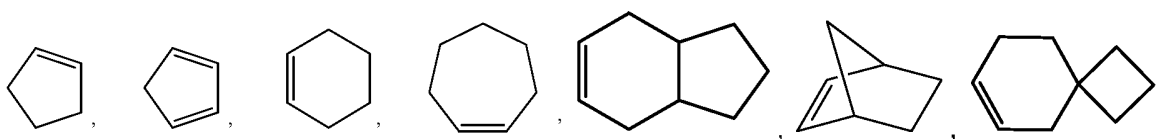
"C<sub>m</sub>-C<sub>n</sub> Nonaromatic carbocyclyl", wherein m is an integer of 3-19, n is an integer of 4 to 20 and n > m, refers to a m to n member all-carbon monocyclic ring group, all-carbon bicyclic or multicyclic ring system group wherein one or more of the rings may contain one or more double bonds or an aromatic ring as part of the bicyclic or multicyclic ring system, but the monocyclic ring, the bicyclic or multicyclic ring system does not have a completely conjugated pi-electron system. Examples, without limitation, of nonaromatic carbocyclyl are cyclopropyl, cyclobutyl, cyclopentyl, cyclopentenyl, cyclohexyl, cyclohexadienyl, adamantanyl, cycloheptyl, cycloheptatrienyl and the like. A nonaromatic carbocyclyl may be substituted or unsubstituted. Illustrative examples of nonaromatic carbocyclyl are derived from, but not limited to, the following:



"C<sub>m</sub>-C<sub>n</sub> alkenyl", wherein m is an integer of 2-19, n is an integer of 3 to 20 and n > m, refers to a straight chain or branched unsaturated hydrocarbon radical having from 2 to 12 carbon atoms. A C<sub>m</sub>-C<sub>n</sub> alkenyl group have one more carbon-carbon double bonds, which can be conjugated or unconjugated, but do not form a completely conjugated pi-electron system. A C<sub>m</sub>-C<sub>n</sub> cycloalkenyl group may be monocyclic, bicyclic or polycyclic. A cycloalkenyl may also be a spirocyclic. A C<sub>m</sub>-C<sub>n</sub> cycloalkenyl group may be optionally substituted by at least one substituent.

"C<sub>m</sub>-C<sub>n</sub> cycloalkenyl", wherein m is an integer of 4-19, n is an integer of 5 to 20 and n > m, refers to a cyclic alkenyl radical having from m to n carbon atoms, and having one or more carbon-carbon double bond. A C<sub>m</sub>-C<sub>n</sub> cycloalkyl group may be monocyclic and where permissible may be bicyclic or polycyclic. A C<sub>m</sub>-C<sub>n</sub> cycloalkyl may also be a spirocyclic. A cycloalkyl group may be optionally substituted by at least one substituent. Illustrative examples of cycloalkyl are derived from, but not limited to, the following:

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“Alkoxy” or “alkoxyl” refers to  $-OR^c$  wherein  $R^c$  is  $C_1$ - $C_{12}$  alkyl,  $C_2$ - $C_{12}$  alkenyl,  $C_2$ - $C_{12}$  alkynyl,  $C_3$ - $C_{12}$  cycloalkyl or  $(C_1$ - $C_6$  alkylene)-( $C_3$ - $C_{12}$  cycloalkyl). A “ $C_1$ - $C_{12}$  alkoxy” or “ $C_1$ - $C_{12}$  alkoxyl” refers to an alkoxy group, as defined herein, wherein  $R^c$  has 1 to 12 total carbon atoms.

“Alkoxyalkyl” refers to an alkyl, as defined herein, that is substituted by at least one alkoxy group as defined herein. A “ $C_2$ - $C_6$  alkylalkoxy” refers an alkylalkoxy wherein the total carbon number of the alkyl and its alkoxy substituents are from 2 to 6.

“Alkylamino” refers to  $-NR^pR^q$  wherein each  $R^p$  and  $R^q$  is independently H,  $C_1$ - $C_{12}$  alkyl,  $C_2$ - $C_{12}$  alkenyl,  $C_2$ - $C_{12}$  alkynyl,  $C_3$ - $C_{12}$  cycloalkyl,  $(C_1$ - $C_6$  alkylene)-( $C_3$ - $C_{12}$  cycloalkyl) provided  $R^p$  and  $R^q$  are not both H. A “monoalkylamino” refers to an alkylamino group, as defined herein, wherein one of  $R^p$  and  $R^q$  is H. A “dialkylamino” refers to an alkylamino group, as defined herein, wherein none of  $R^p$  and  $R^q$  is H. A “ $C_{1-12}$  alkylamino” refers to an alkylamino group that contains 1 to 10 carbon atoms.

“ $C_2$ - $C_{12}$  alkynyl” refers to a straight chain or branched hydrocarbon radical having from 2-12 carbon atoms and at least one carbon-carbon triple bond. In the case where  $C_2$ - $C_{12}$  alkynyl has more than one carbon-carbon double bond, the carbon-carbon double bonds can be conjugated or unconjugated. A  $C_2$ - $C_{12}$  alkynyl group may be optionally substituted by at least one substituent. Further, the term “alkynyl” refers to a straight chain or branched hydrocarbon radical of 2 to 20 carbon atoms, or 2 to 12 carbon atoms, or 2 to 8 carbon atoms, or 2 to 6 carbon atoms, or 2 to 4 carbon atoms, and having at least one carbon-carbon triple bond. Alkynyl may be substituted or unsubstituted. Suitable substituents on an alkynyl group are the same as those described for a  $C_1$ - $C_{12}$  alkyl group.

“Amino” refers to  $-NH_2$ .

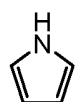
“ $C_6$ - $C_{10}$  aryl” refers to an all-carbon monocyclic ring or polycyclic ring of 6 to 10 carbon atoms having a completely conjugated pi-electron system. A  $C_6$ - $C_{10}$  aryl group may be optionally substituted by at least one substituent. Examples of  $C_6$ - $C_{10}$  aryl include, but are not limited to, phenyl and naphthyl. Further, the term “aryl” refers to an all-carbon monocyclic ring or polycyclic ring of 6 to 20 carbon atoms having a completely conjugated pi-electron system. The aryl group may be substituted or



unsubstituted. Examples of aryl include, but are not limited to, anthracenyl, phenanthrenyl and perylenyl.

"Heteroaryl" refers to a monocyclic or fused ring group of 5 to 12 ring atoms containing one, two, three or four ring heteroatoms selected from N, O, and S, the remaining ring atoms being C, and, in addition, having a completely conjugated pi-electron system. Examples, without limitation, of unsubstituted heteroaryl groups are pyrrole, furan, thiophene, imidazole, oxazole, thiazole, pyrazole, pyridine, pyrimidine, quinoline, isoquinoline, purine, tetrazole, triazine, and carbazole. The heteroaryl group may be substituted or unsubstituted. Typical substituents include C<sub>1-12</sub> aliphatic, 3-10 member heterocyclyl, 6-10 member aryl, halogen, -NO<sub>2</sub>, NH<sub>2</sub>, NR<sub>2</sub>, -CN, -COR, -COOR, -CONR<sub>2</sub>, -OH, -OR, -OCOR, -SR, -SOR, -SO<sub>2</sub>R, -SONR<sub>2</sub>, -SO<sub>2</sub>NR<sub>2</sub>, wherein R is a C<sub>1-10</sub> aliphatic, 3-10 member heterocyclyl, C<sub>6-10</sub> aryl, 5-10 member heteroaryl.

Examples of typical monocyclic heteroaryl groups include, but are not limited to:



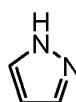
pyrrole  
(pyrrolyl)



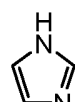
furan  
(furyl)



thiophene  
(thiophenyl)



pyrazole  
(pyrazolyl)



imidazole  
(imidazolyl)



isoxazole  
(isoxazolyl)



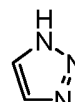
oxazole  
(oxazolyl)



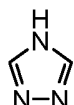
isothiazole  
(isothiazolyl)



thiazolyl  
(thiazolyl)



1,2,3-triazole  
(1,2,3-triazolyl)



1,3,4-triazole  
(1,3,4-triazolyl)



1-oxa-2,3-diazole  
(1-oxa-2,3-diazolyl)



1-oxa-2,4-diazole  
(1-oxa-2,4-diazolyl)



1-oxa-2,5-diazole  
(1-oxa-2,5-diazolyl)



1-oxa-3,4-diazole  
(1-oxa-3,4-diazolyl)



1-thia-2,3-diazole  
(1-thia-2,3-diazolyl)



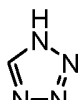
1-thia-2,4-diazole  
(1-thia-2,4-diazolyl)



1-thia-2,5-diazole  
(1-thia-2,5-diazolyl)



1-thia-3,4-diazole  
(1-thia-3,4-diazolyl)



tetrazole  
(tetrazolyl)



pyridine  
(pyridinyl)

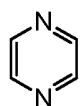


pyridazine  
(pyridazinyl)

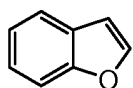
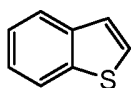
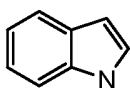
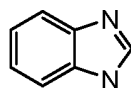
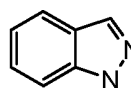
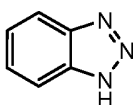
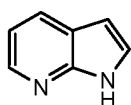
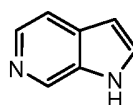
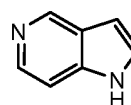
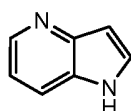
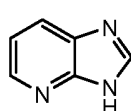
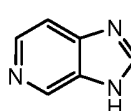
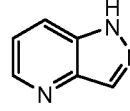
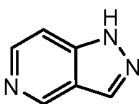
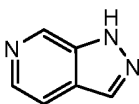
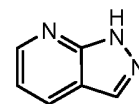
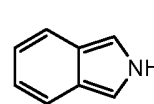
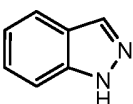
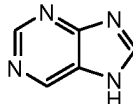
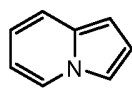
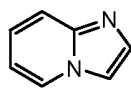
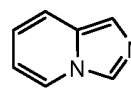
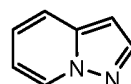
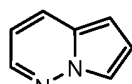
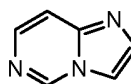
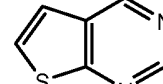
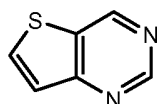
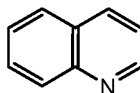
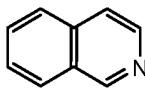
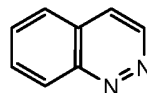
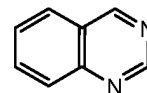


pyrimidine  
(pyrimidinyl)

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pyrazine  
(pyrazinyl)1,3,5-triazine  
triazinyl

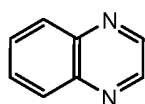
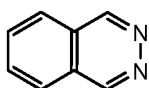
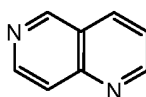
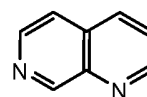
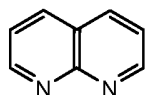
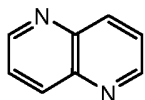
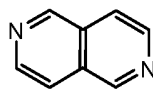
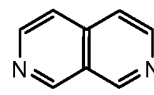
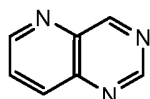
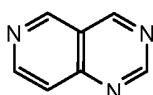
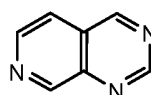
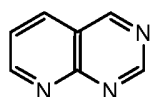
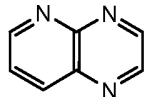
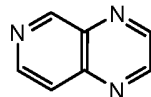
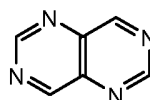
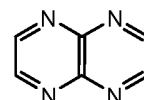
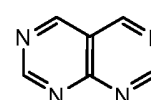
Examples of bicyclic heteroaryl groups include, but are not limited to:

benzofuran  
(benzofuranyl)benzothiophene  
(benzothiophenyl)indole  
(indolyl)benzimidazole  
(benzimidazolyl)indazole  
(indazolyl)benzotriazole  
(benzotriazolyl)pyrrolo[2,3-b]pyridine  
(pyrrolo[2,3-b]pyridinyl)pyrrolo[2,3-c]pyridine  
(pyrrolo[2,3-c]pyridinyl)pyrrolo[3,2-c]pyridine  
(pyrrolo[3,2-c]pyridinyl)pyrrolo[3,2-b]pyridine  
(pyrrolo[3,2-b]pyridinyl)imidazo[4,5-b]pyridine  
(imidazo[4,5-b]pyridinyl)imidazo[4,5-c]pyridine  
(imidazo[4,5-c]pyridinyl)pyrazolo[4,3-d]pyridine  
(pyrazolo[4,3-d]pyridinyl)pyrazolo[4,3-c]pyridine  
(pyrazolo[4,3-c]pyridinyl)pyrazolo[3,4-c]pyridine  
(pyrazolo[3,4-c]pyridinyl)pyrazolo[3,4-b]pyridine  
(pyrazolo[3,4-b]pyridinyl)isoindole  
(isoindolyl)indazole  
(indazolyl)purine  
(purinyl)indolizine  
(indolinyl)imidazo[1,2-a]pyridine  
(imidazo[1,2-a]pyridinyl)imidazo[1,5-a]pyridine  
(imidazo[1,5-a]pyridinyl)pyrazolo[1,5-a]pyridine  
(pyrazolo[1,5-a]pyridinyl)pyrrolo[1,2-b]pyridazine  
(pyrrolo[1,2-b]pyridazinyl)imidazo[1,2-c]pyrimidine  
(imidazo[1,2-c]pyrimidinyl)thienopyrimidine  
(thienopyrimidinyl)thienopyrimidine  
(thienopyrimidinyl)quinoline  
(quinolinyl)isoquinoline  
(isoquinolinyl)cinnoline  
(cinnolinyl)quinazoline  
(azaquinazoline)

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quinoxaline  
(quinoxaliny)phthalazine  
(phthalaziny)1,6-naphthyridine  
(1,6-naphthyridiny)1,7-naphthyridine  
(1,7-naphthyridiny)1,8-naphthyridine  
(1,8-naphthyridiny)1,5-naphthyridine  
(1,5-naphthyridiny)2,6-naphthyridine  
(2,6-naphthyridiny)2,7-naphthyridine  
(2,7-naphthyridiny)pyrido[3,2-d]pyrimidine  
(pyrido[3,2-d]pyrimidinyl)pyrido[4,3-d]pyrimidine  
(pyrido[4,3-d]pyrimidinyl)pyrido[3,4-d]pyrimidine  
(pyrido[3,4-d]pyrimidinyl)pyrido[2,3-d]pyrimidine  
(pyrido[2,3-d]pyrimidinyl)pyrido[2,3-b]pyrazine  
(pyrido[2,3-b]pyrazinyl)pyrido[3,4-b]pyrazine  
(pyrido[3,4-b]pyrazinyl)pyrimido[5,4-d]pyrimidine  
(pyrimido[5,4-d]pyrimidinyl)pyrazino[2,3-b]pyrazine  
(pyrazino[2,3-b]pyrazinyl)pyrimido[4,5-d]pyrimidine  
(pyrimido[4,5-d]pyrimidinyl)

5

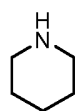
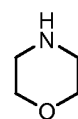
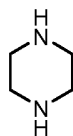
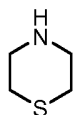
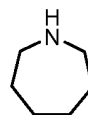
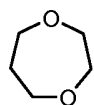
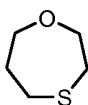
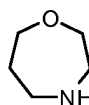
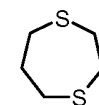
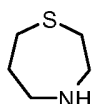
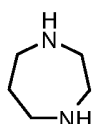
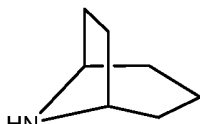
"Heterocyclyl" refers to a monocyclic or polycyclic group having from 3 to 12 ring atoms, wherein from 1 to 4 ring atoms are heteroatoms selected from N, O, and S. "Heteroalicyclic" or "heterocyclyl" may also have one or more double bonds. However, "Heteroalicyclic" or "heterocyclyl" do not have a completely conjugated pi-electron system. "Heteroalicyclic" or "heterocyclyl" can be substituted or unsubstituted.

Examples of saturated heterocyclyl groups include, but are not limited to:

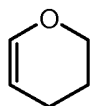
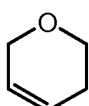
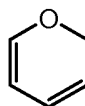
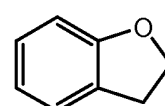
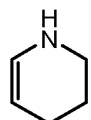
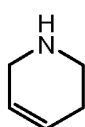
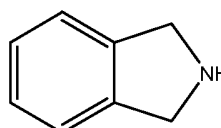
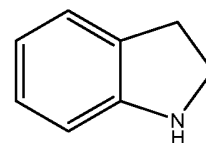
oxirane  
(oxiranyl)thiarane  
(thiaranyl)aziridine  
(aziridinyl)oxetane  
(oxetanyl)thiatane  
(thiatanyl)azetidine  
(azetidiny)tetrahydrofuran  
(tetrahydrofuranyl)tetrahydrothiophene  
(tetrahydrothiophenyl)pyrrolidine  
(pyrrolidinyl)tetrahydropyran  
(tetrahydropyranyl)tetrahydrothiopyran  
(tetrahydrothiopyranyl)

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piperidine  
(piperidinyl)1,4-dioxane  
(1,4-dioxanyl)1,4-oxathiane  
(1,4-oxathianyl)morpholine  
(morpholinyl)1,4-dithiane  
(1,4-dithianyl)piperazine  
(piperazinyl)1,4-azathiane  
(1,4-azathianyl)oxepane  
(oxepanyl)thiepane  
(thiepanyl)azepane  
(azepanyl)1,4-dioxepane  
(1,4-dioxepanyl)1,4-oxathiepane  
(1,4-oxathiepanyl)1,4-oxaazepane  
(1,4-oxaazepanyl)1,4-dithiepane  
(1,4-dithiepanyl)1,4-thiazepane  
(1,4-thiazepanyl)1,4-diazepane  
(1,4-diazepanyl)tropane  
(tropanyl)(1*S*,5*R*)-3-aza-bicyclo[3.1.0]hexane  
(1*S*,5*R*)-3-aza-bicyclo[3.1.0]hexyl

5        Examples of partially unsaturated heterocyclyl groups include, but are not limited to:

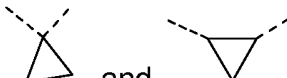
3,4-dihydro-2H-pyran  
(3,4-dihydro-2H-pyranyl)5,6-dihydro-2H-pyran  
(5,6-dihydro-2H-pyranyl)2H-pyran  
(2H-pyranyl)2,3-dihydrobenzofuran  
(2,3-dihydrobenzofuranyl)1,2,3,4-tetrahydropyridine  
(1,2,3,4-tetrahydropyridinyl)1,2,5,6-tetrahydropyridine  
(1,2,5,6-tetrahydropyridinyl)isoindoline  
isoindolinylindoline  
indolinyl

10        A "diradical" refers to a group that has two open valences and is further connected to two other groups, or forms a double bond with the same atom of one group, or forms two single bonds with the same atom of one group. Examples of diradicals are, but are not limited to  $-\text{CH}_2-$ ,  $-\text{O}-$ ,  $-\text{O}-\text{CH}_2-$ ,  $-(\text{C}_1-\text{C}_3 \text{ alkylene})-\text{NH}-$  and  $-\text{CH}_2-\text{CH}_2-$ . When a diradical is referred to as, for example,  $-\text{O}-\text{CH}_2-$  or  $-(\text{C}_1-\text{C}_3 \text{ alkylene})-\text{NH}-$ , it is understood that each end of the diradical can equally connect to another moiety. For example, if K is defined as A-L-B, and L is a diradical selected

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from  $-O-CH_2-$  and  $-(C_1-C_3 \text{ alkylene})-$ , it is understood that K is therefore selected from  $A-O-CH_2-B$ ,  $A-CH_2-O-B$ , and  $A-(C_1-C_3 \text{ alkylene})-B$ . A and B herein are referred to as different organic moieties.

When "ene" is added after the "yl" at the end of any of the previously defined terms to form a new term, the new term refers to a diradical formed by removing one hydrogen atom from the original term of which the new term derived from. For example, an alkylene refers to a diradical group formed by removing one hydrogen atom from an alkyl group and that a "methylene" refers to a divalent radical  $-CH_2-$  derived from removing one hydrogen atom from methyl. More examples of such diradicals include, but are not limited to: alkenylene, alkynylene, cycloalkylene, phenylene, heterocyclylene, heteroarylene and (nonaromatic unsaturated carbocyclylene), which are derived from alkenyl, alkynyl, cycloalkyl, phenyl, heterocyclyl, heteroaryl and (nonaromatic unsaturated carbocyclyl), respectively. For

example, "cyclopropylene" refers to both . For example, " $C_1-C_2$  alkylene" refers to all of the following:  $-CH_2-$ ,  $-CH(CH_3)-$  and  $-CH_2-CH_2-$ .

A " $C_m-C_n$  alkenylene", wherein m is an integer of 2-19, n is an integer of 3 to 20 and  $n > m$ , refers to a diradical formed by removing one hydrogen atom from a " $C_m-C_n$  alkenyl", as defined previously. Examples of an alkenylene include, but are not limited to:  $-CH=CH-$ ,  $-CH=CH-CH_2-$ ,  $-CH=CH(CH_3)-$  and  $-C(=CH-CH_3)-$ .

A " $C_m-C_n$  alkynylene", wherein m is an integer of 2-19, n is an integer of 3 to 20 and  $n > m$ , refers to a diradical formed by removing one hydrogen atom from a " $C_m-C_n$  alkynyl", as defined previously. Examples of an alkenylene include, but are not limited to:  $-C\equiv C-$ ,  $-C\equiv C-CH_2-$  and  $-C\equiv C(CH_3)-$ .

A "m to n member heteroalkylene", wherein m is an integer of 2-19, n is an integer of 3 to 20 and  $n > m$ , refers to a diradical formed by removing one hydrogen atom from a "m to n member" heteroalkyl, as defined previously. Examples of heteroalkylene include, but are not limited to:  $-O-CH_2-$ ,  $-NH-CH_2-$ ,  $-N(CH_3)-CH_2-$ ,  $-S-CH_2-$ ,  $-CH_2-O-CH_2-$ ,  $-CH_2-N(H)-CH_2-$ ,  $-CH_2-S-CH_2-$ ,  $-CH_2-CH(OCH_3)-$ ,  $-CH(OCH_3)-$  and  $-CH(NH_2)-CH_2-$ .

"oxo" or "-oxo-" refers to an oxygen double bond " $=O$ " substitution.

"Hydroxy" or "hydroxyl" both refer to  $-OH$ .

"Perfluoroalkyl" refers to an alkyl group in which all of its hydrogen atoms are replaced by fluorine atoms.

"Optional" or "optionally" means that the subsequently described event or circumstance may but need not occur, and that the description includes instances where the event or circumstance occurs and instances in which it does not. For example, "heterocyclyl group optionally substituted with an alkyl group" means that the alkyl may but need not be present, and the description includes situations where the heterocyclyl group is substituted with an alkyl group and situations where the heterocyclyl group is not substituted with the alkyl group.

When a group is "optionally substituted" or "optionally further substituted" by some substituents, it means a carbon or a nitrogen atom of this group wherein one or more hydrogen atoms are attached to the carbon or nitrogen atom, such carbon or nitrogen atom is optionally substituted by some other substituents. For example, "R is H, C<sub>1</sub>-C<sub>3</sub> alkyl or phenyl, and R is optionally further substituted by 1-3 groups selected from -F, oxo and C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl", means that R is 1) H (when R is H, R cannot be further substituted); 2) C<sub>1</sub>-C<sub>3</sub> alkyl optionally further substituted by 1-3 groups selected from -F, oxo and C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl; and 3) phenyl optionally further substituted by 1-3 groups selected from -F and C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl. Optional substitution of oxo does not apply when R is phenyl because no single atom of the phenyl group possess two hydrogen atoms to be substituted by oxo, i.e. =O bond. When a group is further substituted by a "-(C<sub>1</sub>-C<sub>4</sub> alkylene)-", it means the "-(C<sub>1</sub>-C<sub>4</sub> alkylene)-", together with the nitrogen atom or the carbon atom of the group to which "C<sub>1</sub>-C<sub>4</sub> alkylene" is attached to, form a carbo or hetero spiro cycle.

A "pharmaceutical composition" refers to a mixture of one or more of the compounds described herein, or physiologically/pharmaceutically acceptable salts, solvates, hydrates or prodrugs thereof, with other chemical components, such as physiologically/pharmaceutically acceptable carriers and excipients. The purpose of a pharmaceutical composition is to facilitate administration of a compound to an organism.

As used herein, a "physiologically/pharmaceutically acceptable carrier" refers to a carrier or diluent that does not cause significant irritation to an organism and does not abrogate the biological activity and properties of the administered compound.

A "pharmaceutically acceptable excipient" refers to an inert substance added to a pharmaceutical composition to further facilitate administration of a compound. Examples, without limitation, of excipients include calcium carbonate, calcium phosphate, various sugars and types of starch, cellulose derivatives, gelatin,  
5 vegetable oils and polyethylene glycols.

As used herein, the term "pharmaceutically acceptable salt" refers to those salts that retain the biological effectiveness and properties of the parent compound. Such salts include:

(1) acid addition salts, which can be obtained by reaction of the free base of the  
10 parent compound with inorganic acids such as hydrochloric acid, hydrobromic acid, nitric acid, phosphoric acid, sulfuric acid, and perchloric acid and the like, or with organic acids such as acetic acid, oxalic acid, (D) or (L) malic acid, maleic acid, methanesulfonic acid, ethanesulfonic acid, *p*-toluenesulfonic acid, salicylic acid, tartaric acid, citric acid, succinic acid or malonic acid and the like; or

15 (2) salts formed when an acidic proton present in the parent compound either is replaced by a metal ion, e.g., an alkali metal ion, an alkaline earth ion, or an aluminum ion; or coordinates with an organic base such as ethanolamine, diethanolamine, triethanolamine, tromethamine, N-methylglucamine, and the like.

"PK" refers to receptor protein tyrosine kinase (RTKs), non-receptor or "cellular"  
20 tyrosine kinase (CTKs) and serine-threonine kinases (STKs).

"Modulation" or "modulating" refers to the alteration of the catalytic activity of RTKs, CTKs and STKs. In particular, modulating refers to the activation of the catalytic activity of RTKs, CTKs and STKs, preferably the activation or inhibition of the catalytic activity of RTKs, CTKs and STKs, depending on the concentration of the compound  
25 or salt to which the RTK, CTK or STK is exposed or, more preferably, the inhibition of the catalytic activity of RTKs, CTKs and STKs.

"Catalytic activity" refers to the rate of phosphorylation of tyrosine under the influence, direct or indirect, of RTKs and/or CTKs or the phosphorylation of serine and threonine under the influence, direct or indirect, of STKs.

30 "Contacting" refers to bringing a compound of the present teachings and a target PK together in such a manner that the compound can affect the catalytic activity of the PK, either directly, i.e., by interacting with the kinase itself, or indirectly, i.e., by interacting with another molecule on which the catalytic activity of the kinase is

dependent. Such "contacting" can be accomplished "*in vitro*," i.e., in a test tube, a petri dish or the like. In a test tube, contacting may involve only a compound and a PK of interest or it may involve whole cells. Cells may also be maintained or grown in cell culture dishes and contacted with a compound in that environment. In this context, the ability of a particular compound to affect a PK related disorder, i.e., the  $IC_{50}$  of the compound, can be determined before use of compounds *in vivo* with more complex living organisms is attempted. For cells outside the organism, multiple methods exist, and are well-known to those skilled in the art, to get the PKs in contact with the compounds including, but not limited to, direct cell microinjection and numerous transmembrane carrier techniques.

"*In vitro*" refers to procedures performed in an artificial environment such as, e.g., without limitation, in a test tube or culture medium.

"*In vivo*" refers to procedures performed within a living organism such as, without limitation, a mouse, rat or rabbit.

"PK related disorder," "PK driven disorder," and "abnormal PK activity" all refer to a condition characterized by inappropriate, i.e., under or, more commonly, over, PK catalytic activity, where the particular PK can be an RTK, a CTK or an STK. Inappropriate catalytic activity can arise as the result of either: (1) PK expression in cells which normally do not express PKs, (2) increased PK expression leading to unwanted cell proliferation, differentiation and/or growth, or, (3) decreased PK expression leading to unwanted reductions in cell proliferation, differentiation and/or growth. Over-activity of a PK refers to either amplification of the gene encoding a particular PK or production of a level of PK activity which can correlate with a cell proliferation, differentiation and/or growth disorder (that is, as the level of the PK increases, the severity of one or more of the symptoms of the cellular disorder increases). Under-activity is, of course, the converse, wherein the severity of one or more symptoms of a cellular disorder increase as the level of the PK activity decreases.

"Treat", "treating" and "treatment" refer to a method of alleviating or abrogating a PK mediated cellular disorder and/or its attendant symptoms. With regard particularly to cancer, these terms simply mean that the life expectancy of an individual affected with a cancer will be increased or that one or more of the symptoms of the disease will be reduced.



"Organism" refers to any living entity comprised of at least one cell. A living organism can be as simple as, for example, a single eukariotic cell or as complex as a mammal, including a human being.

"Therapeutically effective amount" refers to that amount of the compound being administered which will relieve to some extent one or more of the symptoms of the disorder being treated. In reference to the treatment of cancer, a therapeutically effective amount refers to that amount which has at least one of the following effects:

(1) reducing the size of the tumor;

(2) inhibiting (that is, slowing to some extent, preferably stopping) tumor metastasis;

(3) inhibiting to some extent (that is, slowing to some extent, preferably stopping) tumor growth, and

(4) relieving to some extent (or, preferably, eliminating) one or more symptoms associated with the cancer.

"Monitoring" means observing or detecting the effect of contacting a compound with a cell expressing a particular PK. The observed or detected effect can be a change in cell phenotype, in the catalytic activity of a PK or a change in the interaction of a PK with a natural binding partner. Techniques for observing or detecting such effects are well-known in the art. The effect is selected from a change or an absence of change in a cell phenotype, a change or absence of change in the catalytic activity of said protein kinase or a change or absence of change in the interaction of said protein kinase with a natural binding partner in a final aspect of this invention.

"Cell phenotype" refers to the outward appearance of a cell or tissue or the biological function of the cell or tissue. Examples, without limitation, of a cell phenotype are cell size, cell growth, cell proliferation, cell differentiation, cell survival, apoptosis, and nutrient uptake and use. Such phenotypic characteristics are measurable by techniques well-known in the art.

"Natural binding partner" refers to a polypeptide that binds to a particular PK in a cell. Natural binding partners can play a role in propagating a signal in a PK-mediated signal transduction process. A change in the interaction of the natural binding partner with the PK can manifest itself as an increased or decreased

concentration of the PK/natural binding partner complex and, as a result, in an observable change in the ability of the PK to mediate signal transduction.

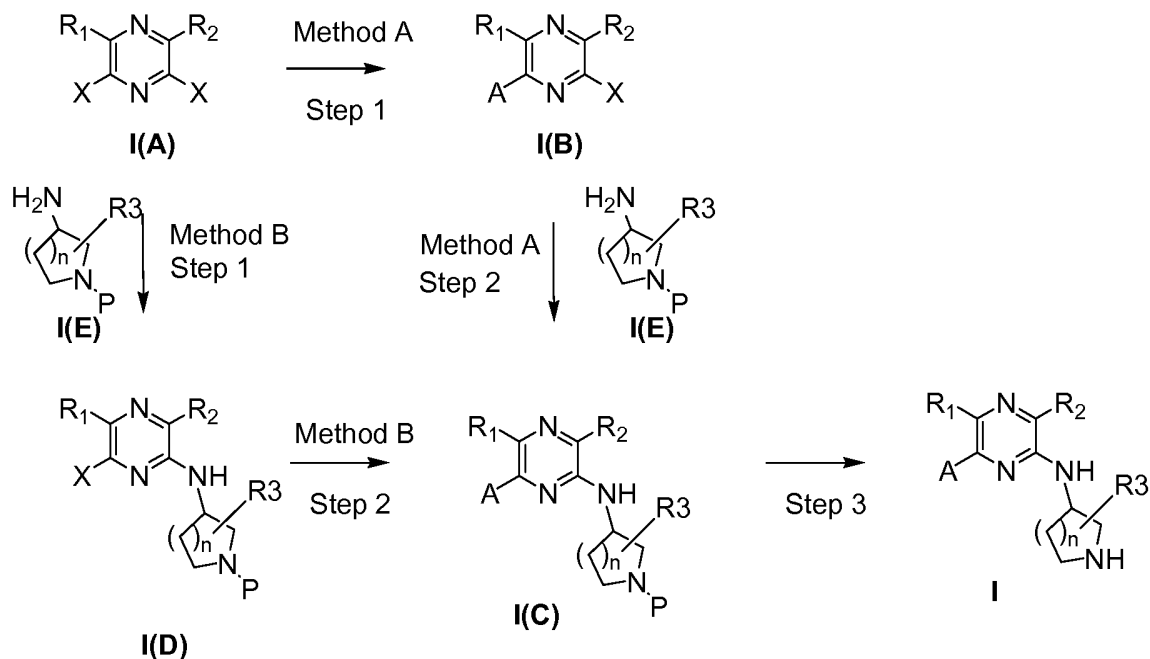
The term "stereoisomers" refers to compounds that have identical chemical constitution, but differ with regard to the arrangement of their atoms or groups in space. In particular, the term "enantiomers" refers to two stereoisomers of a compound that are non-superimposable mirror images of one another. The terms "racemic" or "racemic mixture," as used herein, refer to a 1:1 mixture of enantiomers of a particular compound. The term "diastereomers", on the other hand, refers to the relationship between a pair of stereoisomers that comprise two or more asymmetric centers and are not mirror images of one another.

#### Detailed Description

Compounds of the present invention may be prepared using the reaction routes and synthetic schemes described below, employing the techniques available in the art using starting materials that are readily available. The preparation of certain embodiments of the present invention is described in detail in the following examples, but those of ordinary skill in the art will recognize that the preparations described may be readily adapted to prepare other embodiments of the present invention. For example, the synthesis of non-exemplified compounds according to the invention may be performed by modifications apparent to those skilled in the art, e.g. by appropriately protecting interfering groups, by changing to other suitable reagents known in the art, or by making routine modifications of reaction conditions. Alternatively, other reactions referred to herein or known in the art will be recognized as having adaptability for preparing other compounds of the invention.

Compounds of the general structure represented by I are prepared according to three general synthetic processes; **Method A** and **Method B** described in Scheme 1, **Method C** and **Method D** in Scheme 2 and **Method E** and **Method F** described in Scheme 3.

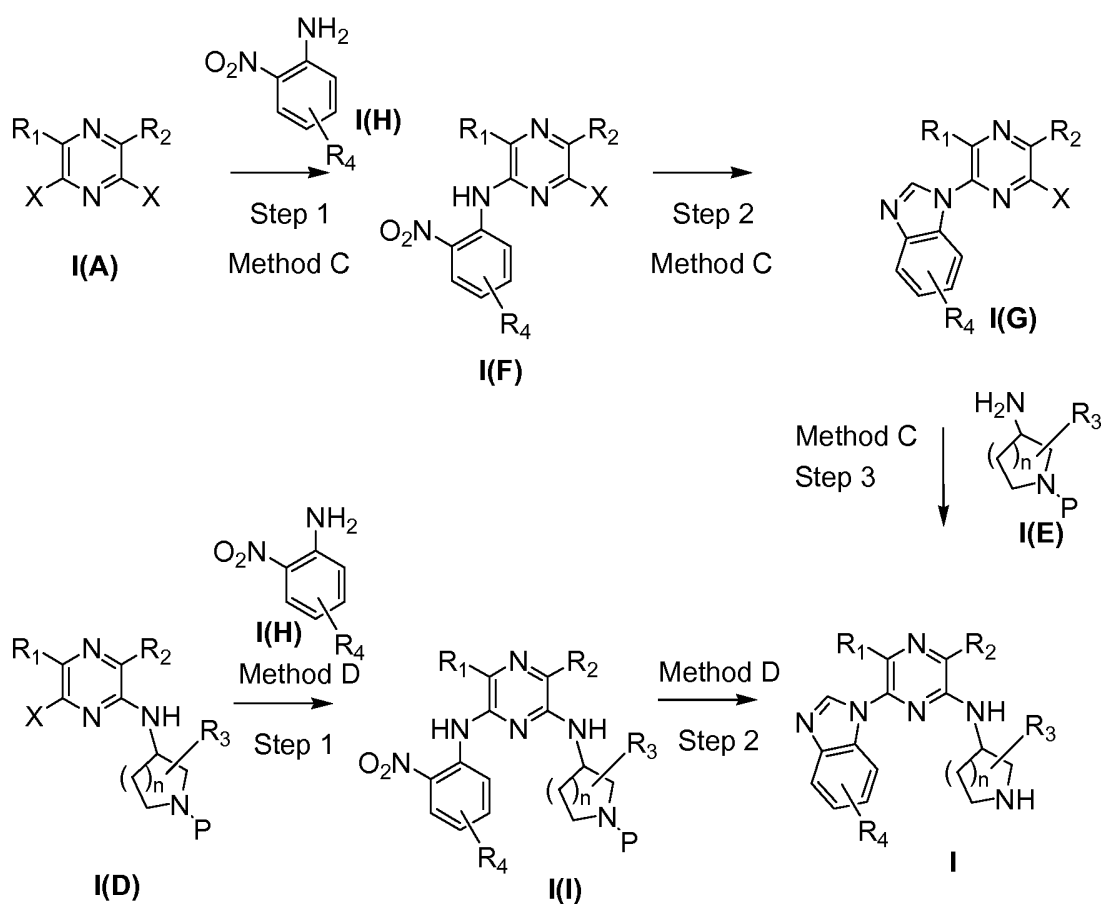
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**Scheme 1****Method A**

Compound **I(A)**, wherein X is Cl, Br or I, is converted to Compound **I(B)** by treating **I(A)** with a heterocycle and using the Heck reaction conditions, or with boronic acid of the formula A-B(OH)<sub>2</sub> or a corresponding boronic ester, following modified Suzuki reaction conditions known to those skilled in the art, or with a trimethylstannyl or tributylstannyl of the formula A-Sn(R)<sub>3</sub>. In cases where Compound **I(B)** contains an N-linked heterocycle "A", it can be obtained by reacting appropriate heterocycle with Compound **I(A)**, wherein X is F, Cl, Br or I in a suitable solvent, for example, dimethylformamide, in the presence of a base, for example, cesium carbonate, at an elevated temperature ranging from 40° C to 220° C for a period of time ranging from one hour to a few days. Compound **I(B)** is converted to Compound **I(C)** by treatment with an amine of the type **I(E)** in a suitable solvent, for example, dimethylsulfoxide, in the presence of a base, for example, cesium fluoride, at an elevated temperature ranging from 40° C to 220° C for a period of time ranging from one hour to a few days. Depending of the protection group **P** used, Compound **I(C)** can be converted to Compound **I** by either acidic conditions such as HCl in a solvent such as dioxane, methanol or water, or by hydrogenation using a catalyst such as palladium on charcoal, or under basic conditions at temperatures varying from 20° C to 200° C.

**Method B**

Compound **I(A)**, wherein X is F, Cl, Br or I is converted to Compound **I(D)** by treatment with an amine of the type **I(E)** in a suitable solvent, for example, dimethylsulfoxide, in the presence of a base, for example, cesium fluoride, at an elevated temperature ranging from 40° C to 220° C for a period of time ranging from one hour to a few days. Compound **I(D)** is converted to Compound **I(C)** by treatment with a heterocycle following conditions for the Heck reaction or with boronic acid of the formula  $R_1-B(OH)_2$  or a corresponding boronic ester, following modified Suzuki reaction conditions known to those skilled in the art, or with a trimethylstannyl or tributylstannyl of the formula  $R_1-Sn(R)_3$ . In cases where Compound **I(C)** contains an N-linked heterocycle "A", it can be obtained by reacting the appropriate heterocycle with Compound **I(D)**, wherein X is F, Cl, Br or I in a suitable solvent, for example, dimethylformamide, in the presence of a base, for example, cesium carbonate, at an elevated temperature ranging from 40° C to 220° C for a period of time ranging from one hour to a few days. Compound **I** can be obtain from Compound **I(C)** by removing a protection group **P** as described in **Method A**.

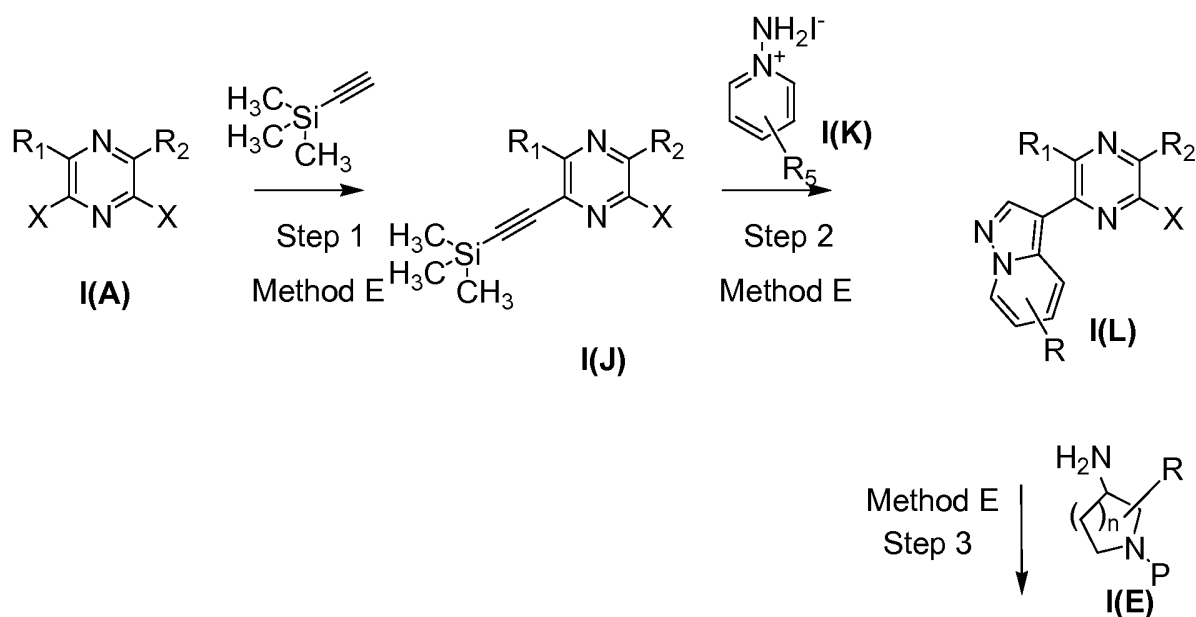
**Scheme 2**

**Method C**

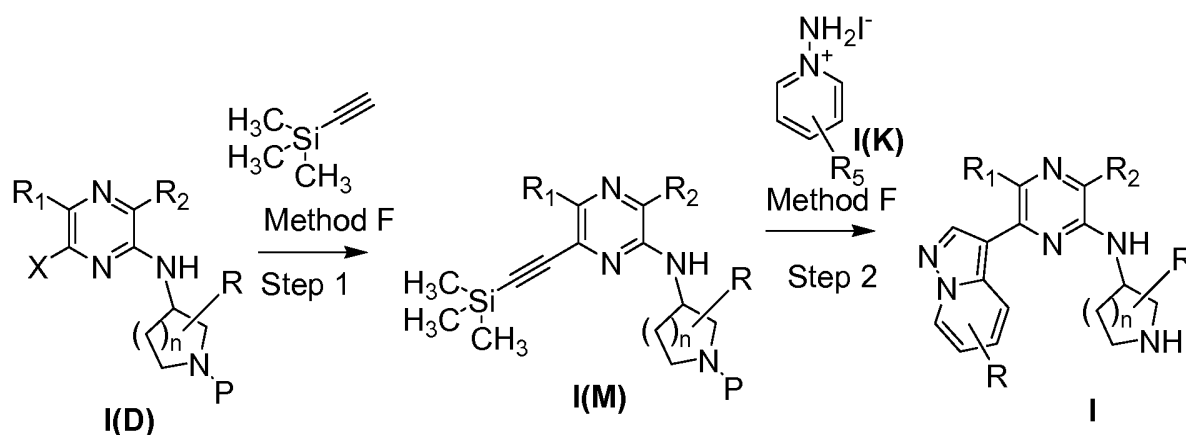
With reference to Scheme 2 above, Compound **I** may be prepared starting with the palladium amination reaction of Compound **I(A)**, wherein X is F, Cl, Br or I and an appropriate 2-amino-nitrobenzene **I(H)** to provide Compound **I(F)** according to Step 1. Reduction of the nitro group followed by addition of formamidine acetate provides the benzimidazole **I(G)**. In Step 3, Compound **I(G)** is converted to Compound **I** by treatment with an amine of the type **I(E)** in a suitable solvent, for example, dimethylsulfoxide, in the presence of a base, for example, cesium fluoride, at an elevated temperature ranging from 40° C to 220° C for a period of time ranging from one hour to a few days followed by subsequent removal of the protection group **P** as described in Step 3 of **Method A**.

**Method D**

Compound **I(D)**, obtained according to step 1 of **Method A** as described in Scheme 1, wherein X is Cl, Br or I can be converted to Compound **I(I)** via a palladium amination reaction by treatment with 2-amino-nitrobenzene **I(H)**. Reduction of the nitro group followed by addition of formamidine acetate provides the benzimidazole **I** after subsequent removal of the protection group **P** as described in Step 3 of **Method A**.

**Scheme 3**

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### Method E

With reference to Scheme 3 above, Compound **I** may be prepared starting with the Sonogashira coupling reaction of compound **I(A)**, wherein X is F, Cl, Br or I, and trimethylsilylacetylene to afford Compound **I(J)**. Treatment of **I(J)** with a base such as potassium carbonate in a solvent such as methanol, followed by reaction with Compound **I(K)** and a base such as DBU in a solvent such as acetonitrile at an elevated temperature ranging from 40° C to 150° C, affords compound **I(L)**, which can be converted to Compound **I** in a manner described according to Step 3 of **Method C** in Scheme 2.

### Method F

Compound **I(D)**, obtained according to step 1 of **Method A** as described in Scheme 1, wherein X is F, Cl, Br or I, can be converted to compound **I(M)** via a palladium mediated Sonogashira coupling reaction with trimethylsilylacetylene. Treatment of **I(M)** with a base such as potassium carbonate in a solvent such as methanol, followed by reaction with Compound **I(K)** and a base such as DBU in a solvent such as acetonitrile at an elevated temperature ranging from 40° C to 150° C, affords the desired Compound **I** after removal of protecting group **P** in a manner described according to Step 3 of **Method A** in Scheme 1.

We have also prepared commercially unavailable amines which were used in the synthesis of the compounds of the current invention. The synthesis of these amines is described following the Specific Examples of the current invention.

The compounds of the present invention may have asymmetric carbon atoms. The carbon-carbon bonds of the compounds of the present invention may be depicted herein using a solid line ( — ), a solid wedge (  $\blacktriangle$  ), or a dotted wedge (  $\cdots$  ).

(.....). The use of a solid line to depict bonds to asymmetric carbon atoms is meant to indicate that all possible stereoisomers (e.g. specific enantiomers, racemic mixtures, etc.) at that carbon atom are included. The use of either a solid or dotted wedge to depict bonds to asymmetric carbon atoms is meant to indicate that only the stereoisomer shown is meant to be included. It is possible that compounds of the invention may contain more than one asymmetric carbon atom. In those compounds, the use of a solid line to depict bonds to asymmetric carbon atoms is meant to indicate that all possible stereoisomers are meant to be included. For example, unless stated otherwise, it is intended that the compounds of the present invention can exist as enantiomers and diastereomers or as racemates and mixtures thereof. The use of a solid line to depict bonds to one or more asymmetric carbon atoms in a compound of the invention and the use of a solid or dotted wedge to depict bonds to other asymmetric carbon atoms in the same compound is meant to indicate that a mixture of diastereomers is present.

Conventional techniques for the preparation/isolation of individual enantiomers include chiral synthesis from a suitable optically pure precursor or resolution of the racemate using, for example, chiral high pressure liquid chromatography (HPLC). Alternatively, the racemate (or a racemic precursor) may be reacted with a suitable optically active compound, for example, an alcohol, or, in the case where the compound contains an acidic or basic moiety, an acid or base such as tartaric acid or 1-phenylethylamine. The resulting diastereomeric mixture may be separated by chromatography and/or fractional crystallization and one or both of the diastereoisomers converted to the corresponding pure enantiomer(s) by means well known to one skilled in the art. Chiral compounds of the invention (and chiral precursors thereof) may be obtained in enantiomerically-enriched form using chromatography, typically HPLC, on an asymmetric resin with a mobile phase consisting of a hydrocarbon, typically heptane or hexane, containing from 0 to 50% isopropanol, typically from 2 to 20%, and from 0 to 5% of an alkylamine, typically 0.1% diethylamine. Concentration of the eluate affords the enriched mixture.

Stereoisomeric conglomerates may be separated by conventional techniques known to those skilled in the art. See, e.g. "Stereochemistry of Organic Compounds" by E. L. Eliel (Wiley, New York, 1994), the disclosure of which is incorporated herein by reference in its entirety.

Where a compound of the invention contains an alkenyl or alkenylene group, geometric *cis/trans* (or *Z/E*) isomers are possible. *Cis/trans* isomers may be separated by conventional techniques well known to those skilled in the art, for example, chromatography and fractional crystallization. Where structural isomers are interconvertible *via* a low energy barrier, tautomeric isomerism ('tautomerism') can occur. This can take the form of proton tautomerism in compounds of the present invention containing, for example, an imino, keto, or oxime group, or so-called valence tautomerism in compounds which contain an aromatic moiety. It follows that a single compound may exhibit more than one type of isomerism. Included within the scope of the invention are all stereoisomers, geometric isomers and tautomeric forms of the inventive compounds, including compounds exhibiting more than one type of isomerism, and mixtures of one or more thereof.

Salts of the present invention can be prepared according to methods known to those of skill in the art. Examples of salts include, but are not limited to, acetate, acrylate, benzenesulfonate, benzoate (such as chlorobenzoate, methylbenzoate, dinitrobenzoate, hydroxybenzoate, and methoxybenzoate), bicarbonate, bisulfate, bisulfite, bitartrate, borate, bromide, butyne-1,4-dioate, calcium edetate, camsylate, carbonate, chloride, caproate, caprylate, clavulanate, citrate, decanoate, dihydrochloride, dihydrogenphosphate, edetate, edislyate, estolate, esylate, ethylsuccinate, formate, fumarate, gluceptate, gluconate, glutamate, glycollate, glycollylarsanilate, heptanoate, hexyne-1,6-dioate, hexylresorcinate, hydrabamine, hydrobromide, hydrochloride,  $\gamma$ -hydroxybutyrate, iodide, isobutyrate, isothionate, lactate, lactobionate, laurate, malate, maleate, malonate, mandelate, mesylate, metaphosphate, methane-sulfonate, methylsulfate, monohydrogenphosphate, mucate, napsylate, naphthalene-1-sulfonate, naphthalene-2-sulfonate, nitrate, oleate, oxalate, pamoate (embonate), palmitate, pantothenate, phenylacetates, phenylbutyrate, phenylpropionate, phthalate, phosphate/diphosphate, polygalacturonate, propanesulfonate, propionate, propiolate, pyrophosphate, pyrosulfate, salicylate, stearate, subacetate, suberate, succinate, sulfate, sulfonate, sulfite, tannate, tartrate, teoclate, tosylate, triethiodode, and valerate salts.

The compounds of the present invention that are basic in nature are capable of forming a wide variety of salts with various inorganic and organic acids. Although such salts must be pharmaceutically acceptable for administration to animals, it is often



desirable in practice to initially isolate the compound of the present invention from the reaction mixture as a pharmaceutically unacceptable salt and then simply convert the latter back to the free base compound by treatment with an alkaline reagent and subsequently convert the latter free base to a pharmaceutically acceptable acid addition salt. The acid addition salts of the base compounds of this invention can be prepared by treating the base compound with a substantially equivalent amount of the selected mineral or organic acid in an aqueous solvent medium or in a suitable organic solvent, such as methanol or ethanol. Upon evaporation of the solvent, the desired solid salt is obtained. The desired acid salt can also be precipitated from a solution of the free base in an organic solvent by adding an appropriate mineral or organic acid to the solution.

Those compounds of the present invention that are acidic in nature are capable of forming base salts with various pharmacologically acceptable cations. Examples of such salts include the alkali metal or alkaline-earth metal salts and particularly, the sodium and potassium salts. These salts are all prepared by conventional techniques. The chemical bases which are used as reagents to prepare the pharmaceutically acceptable base salts of this invention are those which form non-toxic base salts with the acidic compounds of the present invention. Such non-toxic base salts include those derived from such pharmacologically acceptable cations as sodium, potassium calcium and magnesium, etc. These salts may be prepared by any suitable method, for example, treatment of the free acid with an inorganic or organic base, such as an amine (primary, secondary or tertiary), an alkali metal hydroxide or alkaline earth metal hydroxide, or the like. Illustrative examples of suitable salts include organic salts derived from amino acids, such as glycine and arginine, ammonia, primary, secondary, and tertiary amines, and cyclic amines, such as piperidine, morpholine and piperazine, and inorganic salts derived from sodium, calcium, potassium, magnesium, manganese, iron, copper, zinc, aluminum and lithium. These salts can also be prepared by treating the corresponding acidic compounds with an aqueous solution containing the desired pharmacologically acceptable cations, and then evaporating the resulting solution to dryness, preferably under reduced pressure. Alternatively, they may also be prepared by mixing lower alkanolic solutions of the acidic compounds and the desired alkali metal alkoxide together, and then evaporating the resulting solution to dryness in the same manner as before. In either case,

stoichiometric quantities of reagents are preferably employed in order to ensure completeness of reaction and maximum yields of the desired final product.

If the inventive compound is a base, the desired pharmaceutically acceptable salt may be prepared by any suitable method available in the art, for example, treatment of the free base with an inorganic acid, such as hydrochloric acid, hydrobromic acid, sulfuric acid, nitric acid, phosphoric acid and the like, or with an organic acid, such as acetic acid, maleic acid, succinic acid, mandelic acid, fumaric acid, malonic acid, pyruvic acid, oxalic acid, glycolic acid, salicylic acid, a pyranosidyl acid, such as glucuronic acid or galacturonic acid, an alpha-hydroxy acid, such as citric acid or tartaric acid, an amino acid, such as aspartic acid or glutamic acid, an aromatic acid, such as benzoic acid or cinnamic acid, a sulfonic acid, such as p-toluenesulfonic acid or ethanesulfonic acid, or the like.

In the case of compounds that are solids, it is understood by those skilled in the art that the inventive compounds and salts may exist in different crystalline or polymorphic forms, or in an amorphous form, all of which are intended to be within the scope of the present invention.

The invention also includes isotopically-labeled compounds of the invention, wherein one or more atoms is replaced by an atom having the same atomic number, but an atomic mass or mass number different from the atomic mass or mass number usually found in nature. Examples of isotopes suitable for inclusion in the compounds of the invention include isotopes of hydrogen, such as  $^2\text{H}$  and  $^3\text{H}$ , carbon, such as  $^{11}\text{C}$ ,  $^{13}\text{C}$  and  $^{14}\text{C}$ , chlorine, such as  $^{36}\text{Cl}$ , fluorine, such as  $^{18}\text{F}$ , iodine, such as  $^{123}\text{I}$  and  $^{125}\text{I}$ , nitrogen, such as  $^{13}\text{N}$  and  $^{15}\text{N}$ , oxygen, such as  $^{15}\text{O}$ ,  $^{17}\text{O}$  and  $^{18}\text{O}$ , phosphorus, such as  $^{32}\text{P}$ , and sulfur, such as  $^{35}\text{S}$ . Certain isotopically-labeled compounds of the invention, for example, those incorporating a radioactive isotope, are useful in drug and/or substrate tissue distribution studies. The radioactive isotopes tritium,  $^3\text{H}$ , and carbon-14,  $^{14}\text{C}$ , are particularly useful for this purpose in view of their ease of incorporation and ready means of detection. Substitution with heavier isotopes such as deuterium,  $^2\text{H}$ , may afford certain therapeutic advantages resulting from greater metabolic stability, for example, increased *in vivo* half-life or reduced dosage requirements, and hence may be preferred in some circumstances. Substitution with positron emitting isotopes, such as  $^{11}\text{C}$ ,  $^{18}\text{F}$ ,  $^{15}\text{O}$  and  $^{13}\text{N}$ , can be useful in

Positron Emission Topography (PET) studies for examining substrate receptor occupancy.

Isotopically-labeled compounds of the invention can generally be prepared by conventional techniques known to those skilled in the art or by processes analogous to those described herein, using an appropriate isotopically-labeled reagent in place of the non-labeled reagent otherwise employed.

The compounds of the invention may exist in both unsolvated and solvated forms. The term 'solvate' is used herein to describe a molecular complex comprising a compound of the invention and an amount of one or more pharmaceutically acceptable solvent molecules. The term 'hydrate' is employed when said solvent is water. Examples of solvate forms include, but are not limited to, compounds of the invention in association with water, isopropanol, ethanol, methanol, dimethylsulfoxide (DMSO), ethyl acetate, acetic acid, ethanolamine, or mixtures thereof. It is specifically contemplated that in the present invention one solvent molecule can be associated with one molecule of the compounds of the present invention, such as a hydrate.

Furthermore, it is specifically contemplated that in the present invention, more than one solvent molecule may be associated with one molecule of the compounds of the present invention, such as a dihydrate. Additionally, it is specifically contemplated that in the present invention less than one solvent molecule may be associated with one molecule of the compounds of the present invention, such as a hemihydrate. Furthermore, solvates of the present invention are contemplated as solvates of compounds of the present invention that retain the biological effectiveness of the non-hydrate form of the compounds.

Prodrugs of the compounds described herein are also within the scope of the invention. Thus certain derivatives of the compounds of the present invention, which derivatives may have little or no pharmacological activity themselves, when administered into or onto the body may be converted into compounds of the present invention having the desired activity, for example, by hydrolytic cleavage. Such derivatives are referred to as 'prodrugs'. Further information on the use of prodrugs may be found in Pro-drugs as Novel Delivery Systems, Vol. 14, ACS Symposium

Series (T. Higuchi and W. Stella) and Bioreversible Carriers in Drug Design, Pergamon Press, 1987 (ed. E. B. Roche, American Pharmaceutical Association).

Prodrugs in accordance with the invention can, for example, be produced by replacing appropriate functionalities present in the compounds of the present invention with certain moieties known to those skilled in the art as 'pro-moieties' as described, for example, in Design of Prodrugs by H. Bundgaard (Elsevier, 1985).

Some examples of prodrugs in accordance with the invention include:

(i) where the compounds of the present invention contain a carboxylic acid functionality (-COOH), a prodrug compound wherein the hydrogen of the carboxylic acid functionality of the compound is replaced by (C<sub>1</sub>-C<sub>8</sub>)alkyl to form the corresponding ester;

(ii) where the compounds of the present invention contain an alcohol functionality (-OH), a prodrug compound wherein the hydrogen of the alcohol functionality of the compound is replaced by (C<sub>1</sub>-C<sub>6</sub>) alkanoyloxymethyl to form the corresponding ether; and

(iii) where the compounds of the present invention contain a primary or secondary amino functionality (-NH<sub>2</sub> or -NHR where R ≠ H), a prodrug compound wherein, as the case may be, one or both hydrogens of the amino functionality of the compound I is/are replaced by (C<sub>1</sub>-C<sub>10</sub>) alkanoyl to form the corresponding amide.

Further examples of replacement groups in accordance with the foregoing examples and examples of other prodrug types may be found in the aforementioned references. Moreover, certain compounds of the present invention may themselves act as prodrugs of other compounds of the present invention.

Also included within the scope of the invention are metabolites of compounds of the present invention, that is, compounds formed *in vivo* upon administration of the drug. Some examples of metabolites in accordance with the invention include:

(i) where the compounds of the present invention contain a methyl group, a hydroxymethyl derivative thereof (e.g. -CH<sub>3</sub> -> -CH<sub>2</sub>OH);

(ii) where the compounds of the present invention contain an alkoxy group, a hydroxy derivative thereof (e.g. -OR -> -OH);

(iii) where the compounds of the present invention contain a tertiary amino group, a secondary amino derivative thereof (e.g. -NR<sup>1</sup>R<sup>2</sup> -> -NHR<sup>1</sup> or -NHR<sup>2</sup>);

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(iv) where the compounds of the present invention contain a secondary amino group, a primary derivative thereof (e.g.  $\text{-NHR}^1 \rightarrow \text{-NH}_2$ );

(v) where the compounds of the present invention contain a phenyl moiety, a phenol derivative thereof (e.g.  $\text{-Ph} \rightarrow \text{-PhOH}$ ); and

5 (vi) where the compounds of the present invention contain an amide group, a carboxylic acid derivative thereof (e.g.  $\text{-CONH}_2 \rightarrow \text{COOH}$ ).

Compounds of the invention intended for pharmaceutical use may be administered as crystalline or amorphous products, or mixtures thereof. They may be obtained, for example, as solid plugs, powders, or films by methods such as precipitation, crystallization, freeze drying, spray drying, or evaporative drying.  
10 Microwave or radio frequency drying may be used for this purpose.

The compounds can be administered alone or in combination with one or more other compounds of the invention, or in combination with one or more other drugs (or as any combination thereof). Generally, they will be administered as a formulation in association with one or more pharmaceutically acceptable excipients. The term  
15 "excipient" is used herein to describe any ingredient other than the compound(s) of the invention. The choice of excipient will to a large extent depend on factors such as the particular mode of administration, the effect of the excipient on solubility and stability, and the nature of the dosage form.

20 Pharmaceutical compositions suitable for the delivery of compounds of the invention and methods for their preparation will be readily apparent to those skilled in the art. Such compositions and methods for their preparation can be found, for example, in 'Remington's Pharmaceutical Sciences', 19th Edition (Mack Publishing Company, 1995), the disclosure of which is incorporated herein by reference in its entirety.  
25

#### Oral Administration

The compounds of the invention may be administered orally. Oral administration may involve swallowing, so that the compound enters the gastrointestinal tract, or buccal or sublingual administration may be employed by which the compound enters  
30 the blood stream directly from the mouth.

Formulations suitable for oral administration include solid formulations such as tablets, capsules containing particulates, liquids, or powders, lozenges (including

liquid-filled), chews, multi- and nano-particulates, gels, solid solution, liposome, films (including muco-adhesive), ovules, sprays and liquid formulations.

Liquid formulations include suspensions, solutions, syrups and elixirs. Such formulations may be used as fillers in soft or hard capsules and typically include a carrier, for example, water, ethanol, polyethylene glycol, propylene glycol, methylcellulose, or a suitable oil, and one or more emulsifying agents and/or suspending agents. Liquid formulations may also be prepared by the reconstitution of a solid, for example, from a sachet.

The compounds of the invention may also be used in fast-dissolving, fast-disintegrating dosage forms such as those described in Expert Opinion in Therapeutic Patents, 11 (6), 981-986 by Liang and Chen (2001), the disclosure of which is incorporated herein by reference in its entirety.

For tablet dosage forms, depending on dose, the drug may make up from 1 wt% to 80 wt% of the dosage form, more typically from 5 wt% to 60 wt% of the dosage form. In addition to the drug, tablets generally contain a disintegrant. Examples of disintegrants include sodium starch glycolate, sodium carboxymethyl cellulose, calcium carboxymethyl cellulose, croscarmellose sodium, crospovidone, polyvinylpyrrolidone, methyl cellulose, microcrystalline cellulose, lower alkyl-substituted hydroxypropyl cellulose, starch, pregelatinized starch and sodium alginate. Generally, the disintegrant will comprise from 1 wt% to 25 wt%, preferably from 5 wt% to 20 wt% of the dosage form.

Binders are generally used to impart cohesive qualities to a tablet formulation. Suitable binders include microcrystalline cellulose, gelatin, sugars, polyethylene glycol, natural and synthetic gums, polyvinylpyrrolidone, pregelatinized starch, hydroxypropyl cellulose and hydroxypropyl methylcellulose. Tablets may also contain diluents, such as lactose (monohydrate, spray-dried monohydrate, anhydrous and the like), mannitol, xylitol, dextrose, sucrose, sorbitol, microcrystalline cellulose, starch and dibasic calcium phosphate dihydrate.

Tablets may also optionally include surface active agents, such as sodium lauryl sulfate and polysorbate 80, and glidants such as silicon dioxide and talc. When present, surface active agents are typically in amounts of from 0.2 wt% to 5 wt% of the tablet, and glidants typically from 0.2 wt% to 1 wt% of the tablet.

Tablets also generally contain lubricants such as magnesium stearate, calcium stearate, zinc stearate, sodium stearyl fumarate, and mixtures of magnesium stearate with sodium lauryl sulphate. Lubricants generally are present in amounts from 0.25 wt% to 10 wt%, preferably from 0.5 wt% to 3 wt% of the tablet.

- 5 Other conventional ingredients include anti-oxidants, colorants, flavoring agents, preservatives and taste-masking agents.

Exemplary tablets contain up to about 80 wt% drug, from about 10 wt% to about 90 wt% binder, from about 0 wt% to about 85 wt% diluent, from about 2 wt% to about 10 wt% disintegrant, and from about 0.25 wt% to about 10 wt% lubricant.

- 10 Tablet blends may be compressed directly or by roller to form tablets. Tablet blends or portions of blends may alternatively be wet-, dry-, or melt-granulated, melt congealed, or extruded before tableting. The final formulation may include one or more layers and may be coated or uncoated; or encapsulated.

- 15 The formulation of tablets is discussed in detail in "Pharmaceutical Dosage Forms: Tablets, Vol. 1", by H. Lieberman and L. Lachman, Marcel Dekker, N.Y., N.Y., 1980 (ISBN 0-8247-6918-X), the disclosure of which is incorporated herein by reference in its entirety.

- 20 Solid formulations for oral administration may be formulated to be immediate and/or modified release. Modified release formulations include delayed-, sustained-, pulsed-, controlled-, targeted and programmed release.

- 25 Suitable modified release formulations are described in U.S. Patent No. 6,106,864. Details of other suitable release technologies such as high energy dispersions and osmotic and coated particles can be found in Verma *et al*, Pharmaceutical Technology On-line, 25(2), 1-14 (2001). The use of chewing gum to achieve controlled release is described in WO 00/35298. The disclosures of these references are incorporated herein by reference in their entireties.

#### Parenteral Administration

- 30 The compounds of the invention may also be administered directly into the blood stream, into muscle, or into an internal organ. Suitable means for parenteral administration include intravenous, intraarterial, intraperitoneal, intrathecal, intraventricular, intraurethral, intrasternal, intracranial, intramuscular and subcutaneous. Suitable devices for parenteral administration include needle (including microneedle) injectors, needle-free injectors and infusion techniques.

Parenteral formulations are typically aqueous solutions which may contain excipients such as salts, carbohydrates and buffering agents (preferably to a pH of from 3 to 9), but, for some applications, they may be more suitably formulated as a sterile non-aqueous solution or as a dried form to be used in conjunction with a suitable vehicle such as sterile, pyrogen-free water.

The preparation of parenteral formulations under sterile conditions, for example, by lyophilization, may readily be accomplished using standard pharmaceutical techniques well known to those skilled in the art.

The solubility of compounds of the invention used in the preparation of parenteral solutions may be increased by the use of appropriate formulation techniques, such as the incorporation of solubility-enhancing agents.

Formulations for parenteral administration may be formulated to be immediate and/or modified release. Modified release formulations include delayed-, sustained-, pulsed-, controlled-, targeted and programmed release. Thus compounds of the invention may be formulated as a solid, semi-solid, or thixotropic liquid for administration as an implanted depot providing modified release of the active compound. Examples of such formulations include drug-coated stents and PGLA microspheres.

#### Topical Administration

The compounds of the invention may also be administered topically to the skin or mucosa, that is, dermally or transdermally. Typical formulations for this purpose include gels, hydrogels, lotions, solutions, creams, ointments, dusting powders, dressings, foams, films, skin patches, wafers, implants, sponges, fibers, bandages and microemulsions. Liposomes may also be used. Typical carriers include alcohol, water, mineral oil, liquid petrolatum, white petrolatum, glycerin, polyethylene glycol and propylene glycol. Penetration enhancers may be incorporated; see, for example, J Pharm Sci, 88 (10), 955-958 by Finnin and Morgan (October 1999). Other means of topical administration include delivery by electroporation, iontophoresis, phonophoresis, sonophoresis and microneedle or needle-free (e.g. Powderject™, Bioject™, etc.) injection. The disclosures of these references are incorporated herein by reference in their entireties.



Formulations for topical administration may be formulated to be immediate and/or modified release. Modified release formulations include delayed-, sustained-, pulsed-, controlled-, targeted and programmed release.

#### Inhaled/Intranasal Administration

5       The compounds of the invention can also be administered intranasally or by inhalation, typically in the form of a dry powder (either alone, as a mixture, for example, in a dry blend with lactose, or as a mixed component particle, for example, mixed with phospholipids, such as phosphatidylcholine) from a dry powder inhaler or as an aerosol spray from a pressurized container, pump, spray, atomizer (preferably  
10       an atomizer using electrohydrodynamics to produce a fine mist), or nebulizer, with or without the use of a suitable propellant, such as 1,1,1,2-tetrafluoroethane or 1,1,1,2,3,3,3-heptafluoropropane. For intranasal use, the powder may include a bioadhesive agent, for example, chitosan or cyclodextrin.

15       The pressurized container, pump, spray, atomizer, or nebulizer contains a solution or suspension of the compound(s) of the invention comprising, for example, ethanol, aqueous ethanol, or a suitable alternative agent for dispersing, solubilizing, or extending release of the active, a propellant(s) as solvent and an optional surfactant, such as sorbitan trioleate, oleic acid, or an oligolactic acid.

20       Prior to use in a dry powder or suspension formulation, the drug product is micronized to a size suitable for delivery by inhalation (typically less than 5 microns). This may be achieved by any appropriate comminuting method, such as spiral jet milling, fluid bed jet milling, supercritical fluid processing to form nanoparticles, high pressure homogenisation, or spray drying.

25       Capsules (made, for example, from gelatin or HPMC), blisters and cartridges for use in an inhaler or insufflator may be formulated to contain a powder mix of the compound of the invention, a suitable powder base such as lactose or starch and a performance modifier such as *L*-leucine, mannitol, or magnesium stearate. The lactose may be anhydrous or in the form of the monohydrate, preferably the latter. Other suitable excipients include dextran, glucose, maltose, sorbitol, xylitol, fructose,  
30       sucrose and trehalose.

      A suitable solution formulation for use in an atomizer using electrohydrodynamics to produce a fine mist may contain from 1µg to 20mg of the compound of the invention per actuation and the actuation volume may vary from 1µL

to 100 $\mu$ L. A typical formulation includes a compound of the invention, propylene glycol, sterile water, ethanol and sodium chloride. Alternative solvents which may be used instead of propylene glycol include glycerol and polyethylene glycol.

Suitable flavors, such as menthol and levomenthol, or sweeteners, such as saccharin or saccharin sodium, may be added to those formulations of the invention intended for inhaled/intranasal administration.

Formulations for inhaled/intranasal administration may be formulated to be immediate and/or modified release using, for example, poly(DL-lactic-co-glycolic acid (PGLA). Modified release formulations include delayed-, sustained-, pulsed-, controlled-, targeted and programmed release.

In the case of dry powder inhalers and aerosols, the dosage unit is determined by means of a valve which delivers a metered amount. Units in accordance with the invention are typically arranged to administer a metered dose or "puff" containing a desired amount of the compound of the invention. The overall daily dose may be administered in a single dose or, more usually, as divided doses throughout the day.

#### Rectal/Intravaginal Administration

Compounds of the invention may be administered rectally or vaginally, for example, in the form of a suppository, pessary, or enema. Cocoa butter is a traditional suppository base, but various alternatives may be used as appropriate.

Formulations for rectal/vaginal administration may be formulated to be immediate and/or modified release. Modified release formulations include delayed-, sustained-, pulsed-, controlled-, targeted and programmed release.

#### Ocular Administration

Compounds of the invention may also be administered directly to the eye or ear, typically in the form of drops of a micronized suspension or solution in isotonic, pH-adjusted, sterile saline. Other formulations suitable for ocular and aural administration include ointments, biodegradable (e.g. absorbable gel sponges, collagen) and non-biodegradable (e.g. silicone) implants, wafers, lenses and particulate or vesicular systems, such as niosomes or liposomes. A polymer such as cross-linked polyacrylic acid, polyvinylalcohol, hyaluronic acid, a cellulosic polymer, for example, hydroxypropylmethylcellulose, hydroxyethylcellulose, or methyl cellulose, or a heteropolysaccharide polymer, for example, gelatin gum, may be incorporated

together with a preservative, such as benzalkonium chloride. Such formulations may also be delivered by iontophoresis.

Formulations for ocular/aural administration may be formulated to be immediate and/or modified release. Modified release formulations include delayed-, sustained-,  
5 pulsed-, controlled-, targeted, or programmed release.

#### Other Technologies

Compounds of the invention may be combined with soluble macromolecular entities, such as cyclodextrin and suitable derivatives thereof or polyethylene glycol-containing polymers, in order to improve their solubility, dissolution rate, taste-  
10 masking, bioavailability and/or stability for use in any of the aforementioned modes of administration.

Drug-cyclodextrin complexes, for example, are found to be generally useful for most dosage forms and administration routes. Both inclusion and non-inclusion complexes may be used. As an alternative to direct complexation with the drug, the  
15 cyclodextrin may be used as an auxiliary additive, *i.e.* as a carrier, diluent, or solubilizer. Most commonly used for these purposes are alpha-, beta- and gamma-cyclodextrins, examples of which may be found in PCT Publication Nos. WO 91/11172, WO 94/02518 and WO 98/55148, the disclosures of which are incorporated herein by reference in their entireties.

The amount of the active compound administered will be dependent on the  
20 subject being treated, the severity of the disorder or condition, the rate of administration, the disposition of the compound and the discretion of the prescribing physician. However, an effective dosage is typically in the range of about 0.001 to about 100 mg per kg body weight per day, preferably about 0.01 to about 35  
25 mg/kg/day, in single or divided doses. For a 70 kg human, this would amount to about 0.07 to about 7000 mg/day, preferably about 0.7 to about 2500 mg/day. In some instances, dosage levels below the lower limit of the aforesaid range may be more than adequate, while in other cases still larger doses may be used without causing any harmful side effect, with such larger doses typically divided into several  
30 smaller doses for administration throughout the day.

This invention also relates to a method for the treatment of abnormal cell growth in a mammal which comprises administering to said mammal an amount of a compound of the present invention, or a salt or solvate thereof, that is effective in

treating abnormal cell growth in combination with an anti-tumor agent selected from the group consisting of mitotic inhibitors, alkylating agents, anti-metabolites, intercalating antibiotics, growth factor inhibitors, cell cycle inhibitors, enzymes, topoisomerase inhibitors, biological response modifiers, antibodies, cytotoxics, anti-hormones, and anti-androgens.

In one embodiment of the present invention the anti-tumor agent used in conjunction with a compound of the present invention and pharmaceutical compositions described herein is an anti-angiogenesis agent, kinase inhibitor, pan kinase inhibitor or growth factor inhibitor. Preferred pan kinase inhibitors include Sutent™ (sunitinib), described in U.S. Patent No. 6,573,293 (Pfizer, Inc, NY, USA). Anti-angiogenesis agents, include but are not limited to the following agents, such as EGF inhibitors, EGFR inhibitors, VEGF inhibitors, VEGFR inhibitors, TIE2 inhibitors, IGF1R inhibitors, COX-II (cyclooxygenase II) inhibitors, MMP-2 (matrix-metalloproteinase 2) inhibitors, and MMP-9 (matrix-metalloproteinase 9) inhibitors.

Preferred VEGF inhibitors, include for example, Avastin (bevacizumab), an anti-VEGF monoclonal antibody of Genentech, Inc. of South San Francisco, California. Additional VEGF inhibitors include CP-547,632 (Pfizer Inc., NY, USA), AG13736 (Pfizer Inc.), ZD-6474 (AstraZeneca), AEE788 (Novartis), AZD-2171, VEGF Trap (Regeneron/Aventis), Vatalanib (also known as PTK-787, ZK-222584: Novartis & Schering AG), Macugen (pegaptanib octasodium, NX-1838, EYE-001, Pfizer Inc./Gilead/Eyetech), IM862 (Cytran Inc. of Kirkland, Washington, USA); and angiozyme, a synthetic ribozyme from Ribozyme (Boulder, Colorado) and Chiron (Emeryville, California) and combinations thereof.

VEGF inhibitors useful in the practice of the present invention are described in US Patent No. 6,534,524 and 6,235,764, both of which are incorporated in their entirety for all purposes. Additional VEGF inhibitors are described in, for example in WO 99/24440, in WO 95/21613, WO 99/61422, U.S. Patent 5,834,504, WO 98/50356, U.S. Patent 5,883,113 U.S. Patent 5,886,020, U.S. Patent 5,792,783, U.S. Patent 6,653,308, WO 99/10349, WO 97/32856, WO 97/22596, WO 98/54093, WO 98/02438, WO 99/16755, and WO 98/02437, all of which are herein incorporated by reference in their entirety.

Other anti-angiogenic compounds include acitretin, fenretinide, thalidomide, zoledronic acid, angiostatin, aplidine, cilengtide, combretastatin A-4, endostatin,

halofuginone, rebimastat, removab, Revlimid, squalamine, ukrain, Vitaxin and combinations thereof.

Other antiproliferative agents that may be used in combination with the compounds of the present invention include inhibitors of the enzyme farnesyl protein transferase and inhibitors of the receptor tyrosine kinase PDGFr, including the compounds disclosed and claimed in the following: U.S. Patent 6,080,769; U.S. Patent 6,194,438; U.S. Patent 6,258,824; U.S. Patent 6,586,447; U.S. Patent 6,071,935; U.S. Patent 6,495,564; and U.S. Patent 6,150,377; U.S. Patent 6,596,735; U.S. Patent 6,479,513; WO 01/40217; U.S. 2003-0166675. Each of the foregoing patents and patent applications is herein incorporated by reference in their entirety.

PDGFr inhibitors include but are not limited to those disclosed in international patent application publication numbers WO01/40217 and WO2004/020431, the contents of which are incorporated in their entirety for all purposes. Preferred PDGFr inhibitors include Pfizer's CP-673,451 and CP-868,596 and its salts.

Preferred GARF inhibitors include Pfizer's AG-2037 (pelitrexol and its salts). GARF inhibitors useful in the practice of the present invention are disclosed in US Patent No. 5,608,082 which is incorporated in its entirety for all purposes.

Examples of useful COX-II inhibitors which can be used in conjunction with a compound of Formula (I) and pharmaceutical compositions disclosed herein include CELEBREX<sup>TM</sup> (celecoxib), parecoxib, deracoxib, ABT-963, MK-663 (etoricoxib), COX-189 (Lumiracoxib), BMS 347070, RS 57067, NS-398, Bextra (valdecoxib), paracoxib, Vioxx (rofecoxib), SD-8381, 4-Methyl-2-(3,4-dimethylphenyl)-1-(4-sulfamoyl-phenyl)-1H-pyrrole, 2-(4-Ethoxyphenyl)-4-methyl-1-(4-sulfamoylphenyl)-1H-pyrrole, T-614, JTE-522, S-2474, SVT-2016, CT-3, SC-58125 and Arcoxia (etoricoxib). Additionally, COX-II inhibitors are disclosed in U.S. Patent Applications US 2005-0148627 and US 2005-0148777, the contents of which are incorporated in their entirety for all purposes.

In a particular embodiment the anti-tumor agent is celecoxib (U.S. Patent No. 5,466,823), valdecoxib (U.S. Patent No. 5,633,272), parecoxib (U.S. Patent No. 5,932,598), deracoxib (U.S. Patent No. 5,521,207), SD-8381 (U.S. Patent No. 6,034,256, Example 175), ABT-963 (WO 2002/24719), rofecoxib (CAS No. 162011-90-7), MK-663 (or etoricoxib) as disclosed in WO 1998/03484, COX-189 (Lumiracoxib) as disclosed in WO 1999/11605, BMS-347070 (U.S. Patent 6,180,651),

NS-398 (CAS 123653-11-2), RS 57067 (CAS 17932-91-3), 4-Methyl-2-(3,4-dimethylphenyl)-1-(4-sulfamoyl-phenyl)-1H-pyrrole, 2-(4-Ethoxyphenyl)-4-methyl-1-(4-sulfamoylphenyl)-1H-pyrrole, or meloxicam.

Other useful inhibitors as anti-tumor agents used in combination with a compound of the present invention and pharmaceutical compositions disclosed herein include aspirin, and non-steroidal anti-inflammatory drugs (NSAIDs) which inhibit the enzyme that makes prostaglandins (cyclooxygenase I and II), resulting in lower levels of prostaglandins, include but are not limited to the following, Salsalate (Amigesic), Diflunisal (Dolobid), Ibuprofen (Motrin), Ketoprofen (Orudis), Nabumetone (Relafen), Piroxicam (Feldene), Naproxen (Aleve, Naprosyn), Diclofenac (Voltaren), Indomethacin (Indocin), Sulindac (Clinoril), Tolmetin (Tolectin), Etodolac (Lodine), Ketorolac (Toradol), Oxaprozin (Daypro) and combinations thereof. Preferred COX-I inhibitors include ibuprofen (Motrin), nuprin, naproxen (Aleve), indomethacin (Indocin), nabumetone (Relafen) and combinations thereof.

Targeted agents used in combination with a compound of the present invention and pharmaceutical compositions disclosed herein include EGFr inhibitors such as Iressa (gefitinib, AstraZeneca), Tarceva (erlotinib or OSI-774, OSI Pharmaceuticals Inc.), Erbitux (cetuximab, Imclone Pharmaceuticals, Inc.), EMD-7200 (Merck AG), ABX-EGF (Amgen Inc. and Abgenix Inc.), HR3 (Cuban Government), IgA antibodies (University of Erlangen-Nuremberg), TP-38 (IVAX), EGFR fusion protein, EGF-vaccine, anti-EGFr immunoliposomes (Hermes Biosciences Inc.) and combinations thereof. Preferred EGFr inhibitors include Iressa, Erbitux, Tarceva and combinations thereof.

Other anti-tumor agents include those selected from pan erb receptor inhibitors or ErbB2 receptor inhibitors, such as CP-724,714 (Pfizer, Inc.), CI-1033 (canertinib, Pfizer, Inc.), Herceptin (trastuzumab, Genentech Inc.), Omitarg (2C4, pertuzumab, Genentech Inc.), TAK-165 (Takeda), GW-572016 (lonafarnib, GlaxoSmithKline), GW-282974 (GlaxoSmithKline), EKB-569 (Wyeth), PKI-166 (Novartis), dHER2 (HER2 Vaccine, Corixa and GlaxoSmithKline), APC8024 (HER2 Vaccine, Dendreon), anti-HER2/neu bispecific antibody (Decof Cancer Center), B7.her2.IgG3 (Agensys), AS HER2 (Research Institute for Rad Biology & Medicine), trifunctional bispecific antibodies (University of Munich) and mAB AR-209 (Aronex Pharmaceuticals Inc) and mAB 2B-1 (Chiron) and combinations thereof.

Preferred erb selective anti-tumor agents include Herceptin, TAK-165, CP-724,714, ABX-EGF, HER3 and combinations thereof. Preferred pan erbb receptor inhibitors include GW572016, CI-1033, EKB-569, and Omitarg and combinations thereof.

5 Additional erBB2 inhibitors include those disclosed in WO 98/02434, WO 99/35146, WO 99/35132, WO 98/02437, WO 97/13760, WO 95/19970, U.S. Patent 5,587,458, and U.S. Patent 5,877,305, each of which is herein incorporated by reference in its entirety. ErbB2 receptor inhibitors useful in the present invention are also disclosed in U.S. Patents 6,465,449, and 6,284,764, and in WO 2001/98277 each of which are  
10 herein incorporated by reference in their entirety.

Additionally, other anti-tumor agents may be selected from the following agents, BAY-43-9006 (Onyx Pharmaceuticals Inc.), Genasense (augmerosen, Genta), Panitumumab (Abgenix/Amgen), Zevalin (Schering), Bexxar (Corixa/GlaxoSmithKline), Abarelix, Alimta, EPO 906 (Novartis), discodermolide (XAA-296), ABT-510 (Abbott),  
15 Neovastat (Aeterna), enzastaurin (Eli Lilly), Combrestatin A4P (Oxigene), ZD-6126 (AstraZeneca), flavopiridol (Aventis), CYC-202 (Cyclacel), AVE-8062 (Aventis), DMXAA (Roche/Antisoma), Thymitaq (Eximias), Temodar (temozolomide, Schering Plough) and Revlimid (Celgene) and combinations thereof.

Other anti-tumor agents may be selected from the following agents, CyPat  
20 (cyproterone acetate), Histerelin (histrelin acetate), Plenaixis (abarelix depot), Atrasentan (ABT-627), Satraplatin (JM-216), thalomid (Thalidomide), Theratope, Temilifene (DPPE), ABI-007 (paclitaxel), Evista (raloxifene), Atamestane (Biomed-777), Xyotax (polyglutamate paclitaxel), Targetin (bexarotene) and combinations thereof.

Additionally, other anti-tumor agents may be selected from the following agents,  
25 Trizaone (tirapazamine), Aposyn (exisulind), Nevastat (AE-941), Ceplene (histamine dihydrochloride), Orathecin (rubitecan), Virulizin, Gastrimmune (G17DT), DX-8951f (exatecan mesylate), Onconase (ranpirnase), BEC2 (mitumoab), Xcytrin (motexafin gadolinium) and combinations thereof.

Further anti-tumor agents may be selected from the following agents, CeaVac (CEA),  
30 NeuTrexin (trimetresate glucuronate) and combinations thereof. Additional anti-tumor agents may be selected from the following agents, OvaRex (oregovomab), Osidem (IDM-1), and combinations thereof. Additional anti-tumor agents may be selected from the following agents, Advexin (ING 201), Tirazone (tirapazamine), and

combinations thereof. Additional anti-tumor agents may be selected from the following agents, RSR13 (efaproxiral), Cotara (131I chTNT 1/b), NBI-3001 (IL-4) and combinations thereof. Additional anti-tumor agents may be selected from the following agents, Canvaxin, GMK vaccine, PEG Interon A, Taxoprexin (DHA/paciltaxel), and combinations thereof.

Other anti-tumor agents include Pfizer's MEK1/2 inhibitor PD325901, Array Biopharm's MEK inhibitor ARRY-142886, Bristol Myers' CDK2 inhibitor BMS-387,032, Pfizer's CDK inhibitor PD0332991 and AstraZeneca's AXD-5438, and combinations thereof.

Additionally, mTOR inhibitors may also be utilized such as CCI-779 (Wyeth) and rapamycin derivatives RAD001 (Novartis) and AP-23573 (Ariad), HDAC inhibitors, SAHA (Merck Inc./Aton Pharmaceuticals) and combinations thereof. Additional anti-tumor agents include aurora 2 inhibitor VX-680 (Vertex), and Chk1/2 inhibitor XL844 (Exelixis).

The following cytotoxic agents, e.g., one or more selected from the group consisting of epirubicin (Ellence), docetaxel (Taxotere), paclitaxel, Zinecard (dexrazoxane), rituximab (Rituxan) imatinib mesylate (Gleevec), and combinations thereof, may be used in combination with a compound of the present invention and pharmaceutical compositions disclosed herein.

The invention also contemplates the use of the compounds of the present invention together with hormonal therapy, including but not limited to, exemestane (Aromasin, Pfizer Inc.), leuporelin (Lupron or Leuplin, TAP/Abbott/Takeda), anastrozole (Arimidex, AstraZeneca), gosrelin (Zoladex, AstraZeneca), doxercalciferol, fadrozole, formestane, tamoxifen citrate (tamoxifen, Nolvadex, AstraZeneca), Casodex (AstraZeneca), Abarelix (Praecis), Trelstar, and combinations thereof.

The invention also relates to the use of the compounds of the present invention together with hormonal therapy agents such as anti-estrogens including, but not limited to fulvestrant, toremifene, raloxifene, lasofoxifene, letrozole (Femara, Novartis), anti-androgens such as bicalutamide, flutamide, mifepristone, nilutamide, Casodex™(4'-cyano-3-(4-fluorophenylsulphonyl)-2-hydroxy-2-methyl-3'-(trifluoromethyl) propionanilide, bicalutamide) and combinations thereof.

Further, the invention provides a compound of the present invention alone or in combination with one or more supportive care products, e.g., a product selected from



the group consisting of Filgrastim (Neupogen), ondansetron (Zofran), Fragmin, Procrit, Aloxi, Emend, or combinations thereof.

Particularly preferred cytotoxic agents include Camptosar, Erbitux, Iressa, Gleevec, Taxotere and combinations thereof.

- 5 The following topoisomerase I inhibitors may be utilized as anti-tumor agents: camptothecin; irinotecan HCl (Camptosar); edotecarin; orathecine (Supergen); exatecan (Daiichi); BN-80915 (Roche); and combinations thereof. Particularly preferred topoisomerase II inhibitors include epirubicin (Ellence).

- 10 Alkylating agents include, but are not limited to, nitrogen mustard N-oxide, cyclophosphamide, ifosfamide, melphalan, busulfan, mitobronitol, carboquone, thiotepa, ranimustine, nimustine, temozolomide, AMD-473, altretamine, AP-5280, apaziquone, brostallicin, bendamustine, carmustine, estramustine, fotemustine, glufosfamide, ifosfamide, KW-2170, mafosfamide, and mitolactol; platinum-coordinated alkylating compounds include but are not limited to, cisplatin, Paraplatin  
15 (carboplatin), eptaplatin, lobaplatin, nedaplatin, Eloxatin (oxaliplatin, Sanofi) or satraplatin and combinations thereof. Particularly preferred alkylating agents include Eloxatin (oxaliplatin).

- Antimetabolites include but are not limited to, methotrexate, 6-mercaptopurine riboside, mercaptopurine, 5-fluorouracil (5-FU) alone or in combination with  
20 leucovorin, tegafur, UFT, doxifluridine, carmofur, cytarabine, cytarabine ocfosphate, enocitabine, S-1, Alimta (premetrexed disodium, LY231514, MTA), Gemzar (gemcitabine, Eli Lilly), fludarabine, 5-azacitidine, capecitabine, cladribine, clofarabine, decitabine, eflornithine, ethynylcytidine, cytosine arabinoside, hydroxyurea, TS-1, melphalan, nelarabine, nolatrexed, ocfosphate, disodium premetrexed, pentostatin,  
25 pelitrexol, raltitrexed, triapine, trimetrexate, vidarabine, vincristine, vinorelbine; or for example, one of the preferred anti-metabolites disclosed in European Patent Application No. 239362 such as N-(5-[N-(3,4-dihydro-2-methyl-4-oxoquinazolin-6-ylmethyl)-N-methylamino]-2-thenoyl)-L-glutamic acid and combinations thereof.

- Antibiotics include intercalating antibiotics and include, but are not limited to:  
30 aclarubicin, actinomycin D, amrubicin, annamycin, adriamycin, bleomycin, daunorubicin, doxorubicin, elsamitrucin, epirubicin, galarubicin, idarubicin, mitomycin C, nemorubicin, neocarzinostatin, peplomycin, pirarubicin, rebeccamycin, stimalamer, streptozocin, valrubicin, zinostatin and combinations thereof.

Plant derived anti-tumor substances include for example those selected from mitotic inhibitors, for example vinblastine, docetaxel (Taxotere), paclitaxel and combinations thereof.

Cytotoxic topoisomerase inhibiting agents include one or more agents selected from the group consisting of aclarubicin, amonafide, belotecan, camptothecin, 10-hydroxycamptothecin, 9-aminocamptothecin, diflomotecan, irinotecan HCl (Camptosar), edotecarin, epirubicin (Ellence), etoposide, exatecan, gimatecan, lurtotecan, mitoxantrone, pirarubicin, pixantrone, rubitecan, sobuzoxane, SN-38, tafluposide, topotecan, and combinations thereof.

Preferred cytotoxic topoisomerase inhibiting agents include one or more agents selected from the group consisting of camptothecin, 10-hydroxycamptothecin, 9-aminocamptothecin, irinotecan HCl (Camptosar), edotecarin, epirubicin (Ellence), etoposide, SN-38, topotecan, and combinations thereof.

Immunologicals include interferons and numerous other immune enhancing agents. Interferons include interferon alpha, interferon alpha-2a, interferon, alpha-2b, interferon beta, interferon gamma-1a, interferon gamma-1b (Actimmune), or interferon gamma-n1 and combinations thereof. Other agents include filgrastim, lentinan, sizofilan, TheraCys, ubenimex, WF-10, aldesleukin, alemtuzumab, BAM-002, dacarbazine, daclizumab, denileukin, gemtuzumab ozogamicin, ibritumomab, imiquimod, lenograstim, lentinan, melanoma vaccine (Corixa), molgramostim, OncoVAX-CL, sargramostim, tasonermin, teceleukin, thymalasin, tositumomab, Virulizin, Z-100, epratuzumab, mitumomab, oregovomab, pentumomab (Y-muHMFG1), Provenge (Dendreon) and combinations thereof.

Biological response modifiers are agents that modify defense mechanisms of living organisms or biological responses, such as survival, growth, or differentiation of tissue cells to direct them to have anti-tumor activity. Such agents include krestin, lentinan, sizofiran, picibanil, ubenimex and combinations thereof.

Other anticancer agents that can be used in combination with a compound of the present invention include alitretinoin, ampligen, atrasentan bexarotene, bortezomib, Bosentan, calcitriol, exisulind, finasteride, fotemustine, ibandronic acid, miltefosine, mitoxantrone, L-asparaginase, procarbazine, dacarbazine, hydroxycarbamide, pegaspargase, pentostatin, tazarotne, Telcyta (TLK-286, Telik Inc.), Velcade (bortemazib, Millenium), tretinoin, and combinations thereof.

Platinum-coordinated compounds include but are not limited to, cisplatin, carboplatin, nedaplatin, oxaliplatin, and combinations thereof.

Camptothecin derivatives include but are not limited to camptothecin, 10-hydroxycamptothecin, 9-aminocamptothecin, irinotecan, SN-38, edotecarin, topotecan and combinations thereof.

Other antitumor agents include mitoxantrone, l-asparaginase, procarbazine, dacarbazine, hydroxycarbamide, pentostatin, tretinoin and combinations thereof.

Anti-tumor agents capable of enhancing antitumor immune responses, such as CTLA4 (cytotoxic lymphocyte antigen 4) antibodies, and other agents capable of blocking CTLA4 may also be utilized, such as MDX-010 (Medarex) and CTLA4 compounds disclosed in U.S. Patent 6,682,736; and anti-proliferative agents such as other farnesyl protein transferase inhibitors, for example the farnesyl protein transferase inhibitors. Additionally, specific CTLA4 antibodies that can be used in combination with compounds of the present invention include those disclosed in U.S. Patents 6,682,736 and 6,682,736 both of which are herein incorporated by reference in their entirety.

Specific IGF1R antibodies that can be used in the combination methods of the present invention include those disclosed in WO 2002/053596, which is herein incorporated by reference in its entirety.

Specific CD40 antibodies that can be used in the present invention include those disclosed in WO 2003/040170 which is herein incorporated by reference in its entirety.

Gene therapy agents may also be employed as anti-tumor agents such as TNFerade (GeneVec), which express TNFalpha in response to radiotherapy.

In one embodiment of the present invention statins may be used in combination with a compound of the present invention and pharmaceutical compositions thereof. Statins (HMG-CoA reductase inhibitors) may be selected from the group consisting of Atorvastatin (Lipitor™, Pfizer Inc.), Pravastatin (Pravachol™, Bristol-Myers Squibb), Lovastatin (Mevacor™, Merck Inc.), Simvastatin (Zocor™, Merck Inc.), Fluvastatin (Lescol™, Novartis), Cerivastatin (Baycol™, Bayer), Rosuvastatin (Crestor™, AstraZeneca), Lovastatin and Niacin (Advicor™, Kos Pharmaceuticals), derivatives and combinations thereof.

In a preferred embodiment the statin is selected from the group consisting of Atorvastatin and Lovastatin, derivatives and combinations thereof. Other agents useful as anti-tumor agents include Caduet.

Inasmuch as it may be desirable to administer a combination of active compounds, for example, for the purpose of treating a particular disease or condition, it is within the scope of the present invention that two or more pharmaceutical compositions, at least one of which contains a compound in accordance with the invention, may conveniently be combined in the form of a kit suitable for coadministration of the compositions. Thus the kit of the invention includes two or more separate pharmaceutical compositions, at least one of which contains a compound of the invention, and means for separately retaining said compositions, such as a container, divided bottle, or divided foil packet. An example of such a kit is the familiar blister pack used for the packaging of tablets, capsules and the like.

The kit of the invention is particularly suitable for administering different dosage forms, for example, oral and parenteral, for administering the separate compositions at different dosage intervals, or for titrating the separate compositions against one another. To assist compliance, the kit typically includes directions for administration and may be provided with a memory aid.

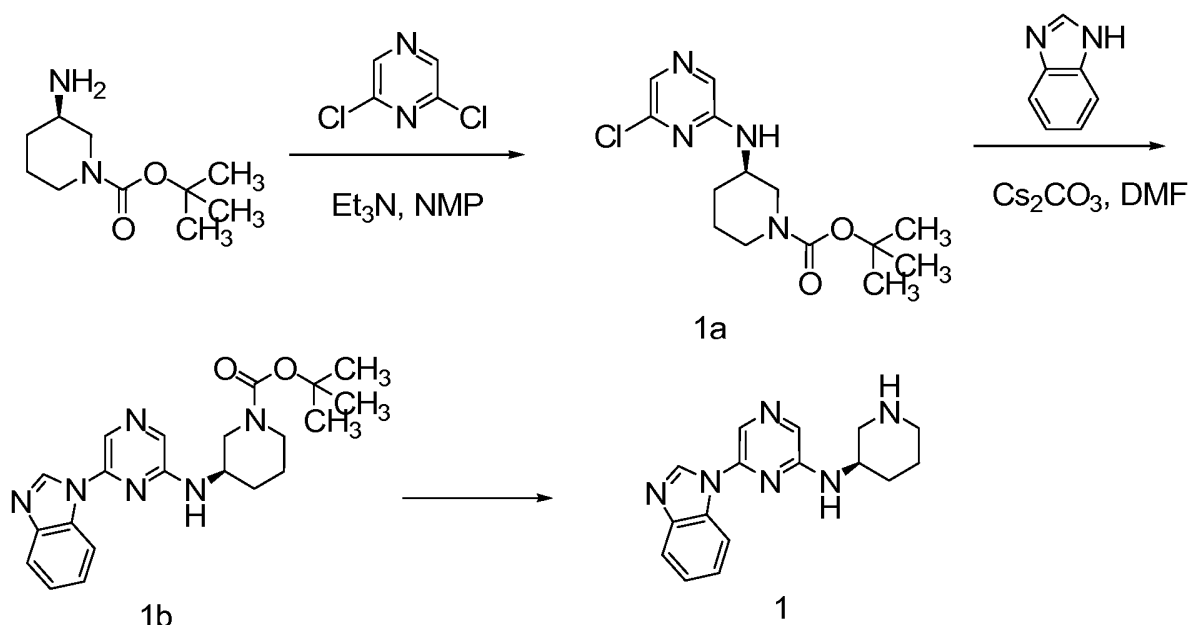
#### Examples

In the following examples and preparations, "BOC", "Boc" or "boc" means *N*-*tert*-butoxycarbonyl, CBZ means carbobenzyloxy, DCM means CH<sub>2</sub>Cl<sub>2</sub>, DIPEA or DIEA means diisopropyl ethyl amine, DMA means *N,N*-dimethylacetamide, "DMF" means dimethylformamide, "DMSO" means dimethylsulfoxide, "DPPP" means 1,3-bis(diphenylphosphino)propane, "HOAc" means acetic acid, "IPA" means isopropyl alcohol, "MTBE" means methyl *t*-butyl ether, "NMP" means 1-methyl 2-pyrrolidinone, TEA means triethyl amine, TFA means trifluoro acetic acid.

#### Specific examples

**Example 1 (Method B): 6-(1H-benzimidazol-1-yl)-N-[(3R)-piperidin-3-yl]pyrazin-2-amine**

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**Preparation of Compound 1a: (R)-Tert-butyl 3-(6-chloropyrazin-2-ylamino)piperidine-1-carboxylate**

A mixture of (R)-1-BOC-3-aminopiperidine (200 mg, 1 mmol), 2,6-dichloropyrazine (149 mg, 1 mmol), and diisopropylethyl amine (129 mg, 1 mmol) in NMP (2 ml) was heated to 80 °C. The reaction mixture was concentrated under reduced pressure, and the crude product was purified by flash chromatography on silica gel (30-100% EtOAc-hexanes) which gave the title compound **1a** as a clear oil (187 mg, 60% yield). <sup>1</sup>H NMR (400 MHz, chloroform-d) δ ppm 7.81 (br. s., 2 H), 5.00 (br. s., 1 H), 3.88 (br. s., 1 H), 3.72 (d, *J* = 12.6 Hz, 1 H), 3.46 (br. s., 1 H), 3.35 (dd, *J* = 18.7, 6.1 Hz, 2 H), 1.94 (br. s., 1 H), 1.53 - 1.79 (m, 3 H), 1.43 (br. s., 9 H). LCMS *M*+1-Boc=213.

**Preparation of Compound 1b: (3R)-Tert-butyl 3-(6-(1H-benzo[d]imidazol-1-yl)pyrazin-2-ylamino)piperidine-1-carboxylate**

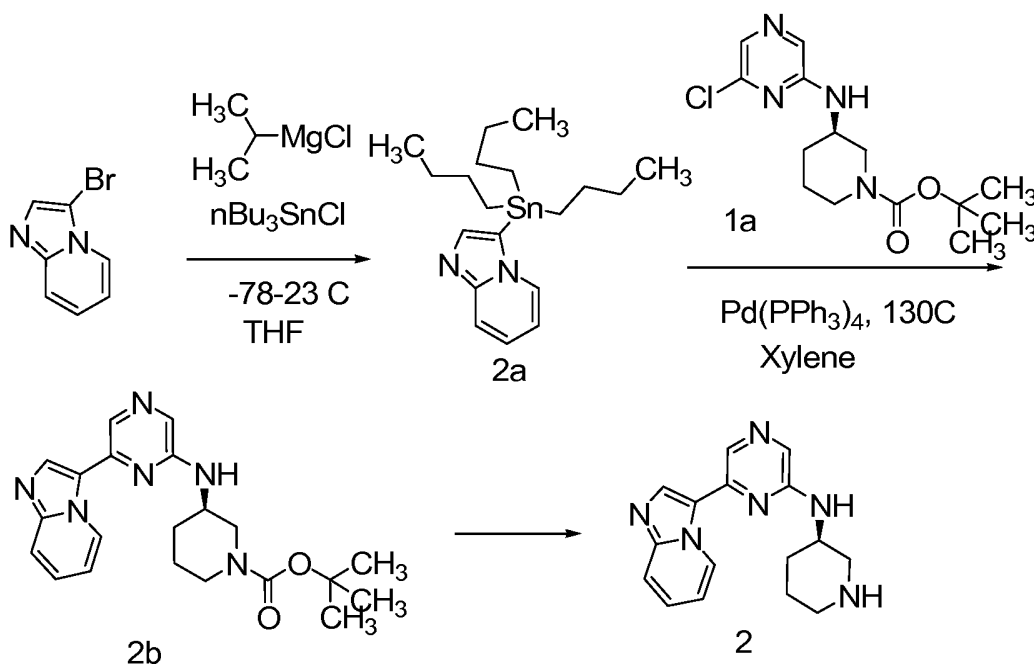
Benzimidazole (76 mg, 0.64 mmol), **1a** (200 mg, 0.639 mmol) and Cs<sub>2</sub>CO<sub>3</sub> (312 mg, 0.959 mmol) were dissolved in DMF (2 mL). The mixture was heated at 80 °C overnight. The reaction mixture was diluted with water (25 mL) and extracted with DCM (2 x 20 mL). The organic layer was concentrated under reduced pressure and the crude product was purified by flash chromatography on silica gel (0-45% ethanol-EtOAc) which gave the title compound **1b** as a clear oil (80 mg, 32% yield). <sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 8.92 (s, 1 H), 8.27 (s, 1 H), 8.20 (s, 1 H), 7.93 - 8.04 (m, 1 H), 7.77 (d, *J* = 7.3 Hz, 1 H), 7.49 - 7.60 (m, 2 H), 7.30 - 7.39 (m, 2 H), 7.18 (t, *J* = 8.6 Hz, 1 H), 3.83 (s, 1 H) 3.44 (qd, *J* = 7.0, 5.0 Hz, 1 H), 2.02 (s, 1 H), 1.82 (s, 1 H),

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1.62 (s, 1 H), 1.49 (d,  $J = 3.8$  Hz, 1 H), 1.46 (s, 1 H), 1.31 - 1.43 (m, 3 H), 1.01 - 1.13 (m, 5 H). LCMS  $m/z$  395 (M+H).

Compound **1b** (80 mg) was dissolved in 1,4-dioxanes (5 mL) and treated with 4M HCl in 1,4-dioxane (2 mL). A yellow precipitate formed after two hours. The solvent was removed under reduced pressure and the resultant yellow solid was dissolved in MeOH (1 mL). The solution was passed thru an SCX column and eluted with 4 N ammonium in MeOH. The methanolic solution was concentrated under reduced pressure which gave the desired compound **1** as a colorless oil (57 mg, 48% yield).  $^1\text{H}$  NMR (400 MHz, MeOD)  $\delta$  ppm 8.82 (s, 1 H), 8.16 (d,  $J = 8.1$  Hz, 1 H), 8.13 (s, 1 H), 7.88 (s, 1 H), 7.76 (d,  $J = 7.8$  Hz, 1 H), 7.44 (t,  $J = 7.4$  Hz, 1 H), 7.38 (t,  $J = 7.6$  Hz, 1 H), 4.01 (dd,  $J = 13.6, 5.6$  Hz, 1 H), 3.09 - 3.22 (m, 2 H), 2.97 (d,  $J = 12.4$  Hz, 1 H), 2.49 - 2.68 (m, 2 H), 2.16 (dd,  $J = 12.0, 3.2$  Hz, 1 H), 1.82 (ddd,  $J = 13.3, 3.8, 3.7$  Hz, 1 H), 1.60 - 1.73 (m, 1 H), 1.48 - 1.60 (m, 1 H). LCMS  $m/z$  295 (M+1).

**Example 2 (Method B): 6-Imidazo[1,2-a]pyridin-3-yl-N-[(3R)-piperidin-3-yl]pyrazin-2-amine**



#### Preparation of Compound 2a: 3-(Tributylstannyl)-imidazo[1,2-a]pyridine

3-Bromoimidazo[1,2-a]pyridine (197 mg, 1 mmol) was dissolved THF (3 mL), cooled to  $-78$  °C, and treated with isopropylmagnesium chloride (108 mg, 1.05 mmol). The mixture was gradually warmed to room temperature. After 1 h, the reaction mixture was cooled to  $-78$  °C, treated with tri-*n*-butyltin chloride (326 mg, 1 mmol), and gradually warmed to room temperature. The reaction mixture was quenched with

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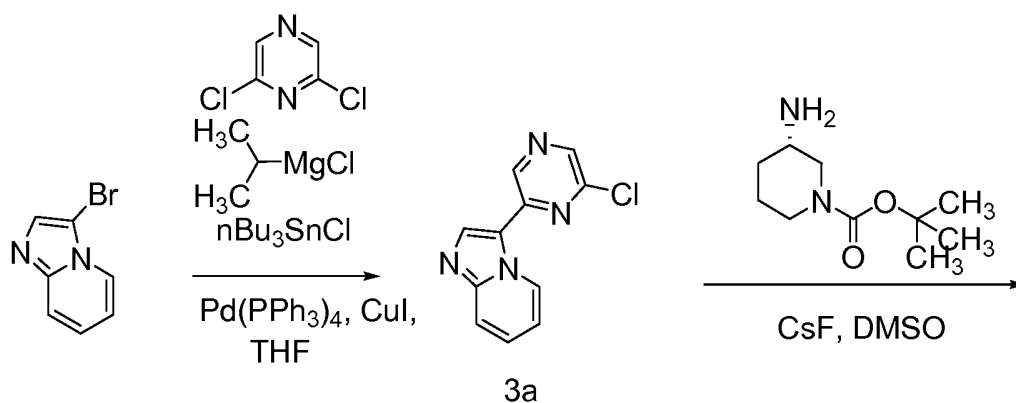
saturated  $\text{NaHCO}_3$ , and the aqueous layer was extracted with EtOAc. The organic layer was washed with brine, dried over  $\text{Na}_2\text{SO}_4$ , decanted and concentrated which gave the title compound **2a** as an oil. The crude product was used in the next step.

**Preparation of Compound 2b: (3R)-Tert-butyl 3-(6-(imidazo[1,2-a]pyridin-3-yl)pyrazin-2-ylamino)piperidine-1-carboxylate**

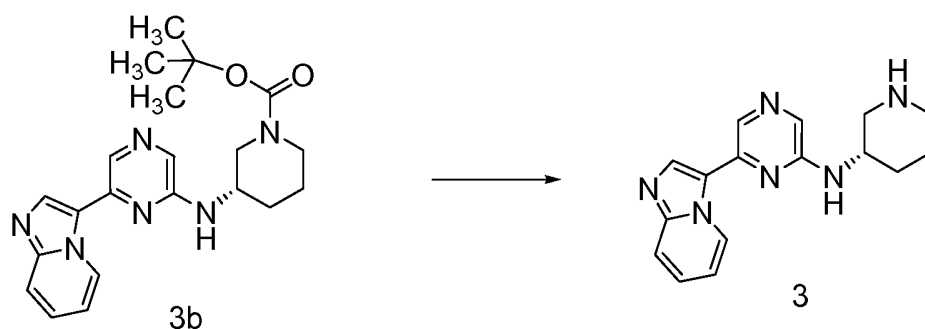
A mixture of **2a** (crude), **1a** (90 mg, 0.29 mmol) and tetrakis(triphenylphosphine) palladium(0) (33 mg, 0.029 mmol) in o-xylene (2 mL) was purged with nitrogen and heated to 130 °C overnight. The reaction mixture was concentrated under reduced pressure, and the crude product was purified by flash chromatography on silica gel (30-100% EtOAc-hexanes then 0-20% MeOH-EtOAc) which gave the title compound **2b** as a greenish oil (89 mg, 78% yield).  $^1\text{H}$  NMR (400 MHz, MeOD)  $\delta$  ppm 9.67 (br. s., 2 H), 8.15 (s, 1 H), 8.13 (s, 1 H), 7.63 - 7.77 (m, 1 H), 7.57 (d,  $J$  = 8.6 Hz, 1 H), 7.35 (t,  $J$  = 7.7 Hz, 1 H), 7.01 (t,  $J$  = 6.9 Hz, 1 H), 3.85 (d,  $J$  = 3.3 Hz, 1 H), 3.34 (d,  $J$  = 7.3 Hz, 1 H), 0.68 - 2.42 (m, 18 H). LCMS  $m/z$  395 ( $M+1$ ).

A mixture of **2b** (89 mg) and 4N HCl in dioxane (2 mL) was stirred at 23 °C for 2 h. The solvent was removed under reduced pressure and the resultant yellow solid was triturated with EtOAc which gave the dihydrochloride title compound **2** as a yellow solid (75 mg, 91% yield).  $^1\text{H}$  NMR (400 MHz, DMSO- $d_6$ )  $\delta$  ppm 9.98 - 10.14 (m, 1 H), 9.93 (d,  $J$  = 7.1 Hz, 1 H), 9.22 (br. s., 1 H), 9.03 (s, 1 H), 8.46 (s, 1 H), 8.00 - 8.13 (m, 3 H), 7.89 (d,  $J$  = 7.1 Hz, 2 H), 4.40 (br. s., 1 H), 3.43 (d,  $J$  = 10.9 Hz, 1 H), 3.17 (d,  $J$  = 3.8 Hz, 1 H), 2.93 (br. s., 1 H), 2.84 (d,  $J$  = 9.8 Hz, 1 H), 2.04 (d,  $J$  = 12.9 Hz, 1 H), 1.85 - 2.00 (m, 2 H), 1.59 (d,  $J$  = 8.8 Hz, 1 H). LCMS  $m/z$  295 ( $M+1$ ).

**Example 3 (Method A): 6-Imidazo[1,2-a]pyridin-3-yl-N-[(3S)-piperidin-3-yl]pyrazin-2-amine**



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### Preparation of 3a: 3-(6-Chloropyrazin-2-yl)-imidazo[1,2-a]pyridine

A solution of 3-bromimidazo[1,2-a]pyridine (10 g, 51 mmol) in THF (100 ml) was cooled to -78 °C, and treated with isopropylmagnesium chloride (26.7 mL, 53.3 mmol) over 10 minutes. The resultant yellow mixture was stirred at -78 °C to -40 °C for 60 minutes, cooled to -78 °C, treated with tri-n-butyltin chloride (13.7 mL, 50.8 mmol) and warmed to room temperature. The reaction mixture became homogenous after 30 min. Next, the crude organostannane was treated with 2,6-dichloropyrazine (15.1 g, 102 mmol), tetrakis(triphenylphosphine) palladium(0) (1.76 g, 1.52 mmol), copper(I) iodide (48 mg, 0.254 mmol) and purged with nitrogen. The reaction mixture was refluxed overnight. The reaction mixture was concentrated under reduced pressure, and the crude product was purified by flash chromatography on silica gel (0-10% MeOH-DCM) which gave the title compound **3a** as yellow solid (10.1 g). <sup>1</sup>H NMR (300 MHz, DMSO-d<sub>6</sub>) δ ppm 9.55 - 9.63 (m, 1 H), 9.33 (s, 1 H), 8.70 (s, 1 H), 8.55 - 8.61 (m, 1H), 7.76 - 7.84 (m, 1 H), 7.46 - 7.59 (m, 1 H), 7.20 - 7.31 (m, 1 H).

### Preparation of 3b: (3S)-Tert-butyl 3-(6-(imidazo[1,2-a]pyridin-3-yl)pyrazin-2-ylamino)piperidine-1-carboxylate

A mixture of cesium fluoride in DMSO (0.9 mL) was treated with 3-(6-chloropyrazin-2-yl)-imidazo[1,2-a]pyridine **3a** (100 mg, 0.434 mmol), (S)-1-BOC-3-aminopiperidine (124 mg, 0.62 mmol) and heated to 120 °C overnight. The crude reaction mixture was poured into 5% aqueous NaHCO<sub>3</sub> and extracted with MTBE. The organic layer was washed with brine, dried over MgSO<sub>4</sub>, filtered and concentrated under reduced pressure which gave a brown oil (250 mg). The crude product was purified by radial chromatography on silica gel (2-6% MeOH-EtOAc with 0.1% NH<sub>4</sub>OH) which gave the title compound **3b** as an off-white solid from MTBE-heptane (100 mg). <sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 9.69 (d, *J* = 6.8 Hz, 1 H), 8.36 (s, 1 H), 8.34 (s, 1 H), 7.85 (s, 1 H), 7.71 (d, *J* = 8.8 Hz, 1 H), 7.39 (ddd, *J* = 8.6, 7.0, 1.3 Hz, 1 H), 7.24 (d, *J* = 6.80

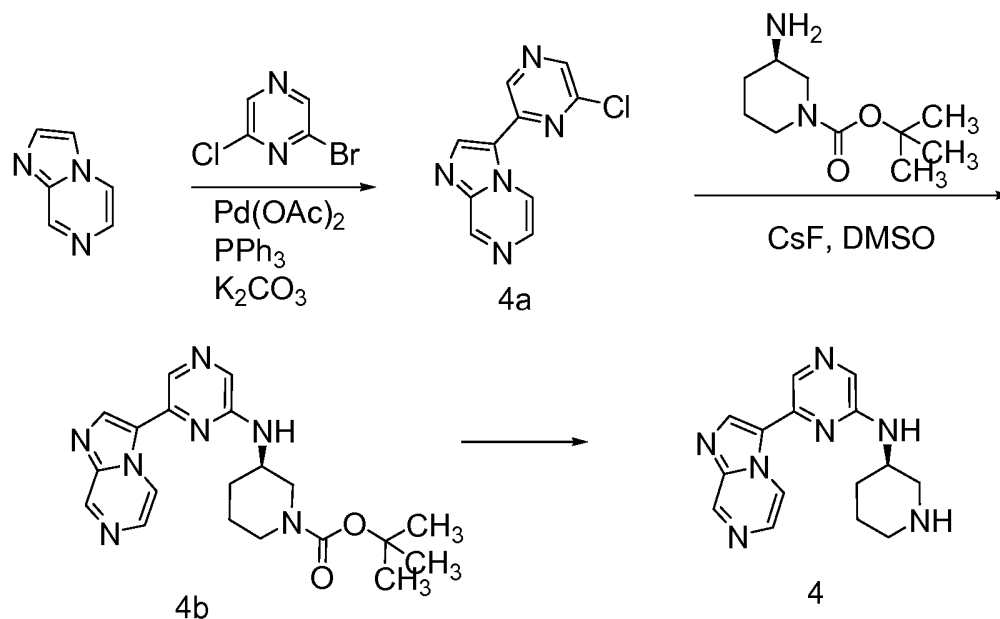


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Hz, 1 H), 7.07 (td,  $J = 6.9, 1.1$  Hz, 1 H), 3.74 - 3.86 (m, 2 H), 1.97 - 2.07 (m, 1 H), 1.81 (s, 1 H), 1.43 (s, 4 H), 1.24 (s, 3 H), 1.17 (s, 1 H), 1.10 (s, 5 H).

A solution of **3b** (75 mg, 0.19 mmol) in DCM (1 mL) was treated with TFA (1 mL). After two hours, the solvent was removed under reduced pressure and the crude product was dissolved in 10% IPA/chloroform, washed with saturated aqueous NaHCO<sub>3</sub>, brine, dried over MgSO<sub>4</sub>, filtered and concentrated under reduced pressure. The crude product was purified by preparative HPLC (water-acetonitrile with TFA), which gave the title compound **3** as a beige solid from MTBE-heptane (25 mg). <sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>)  $\delta$  ppm 9.77 (d,  $J = 7.0$  Hz, 1 H), 8.36 (s, 1 H), 8.31 (s, 1 H), 7.80 (s, 1 H), 7.71 (d,  $J = 9.1$  Hz, 1 H), 7.39 (dd,  $J = 8.3, 7.3$  Hz, 1 H), 7.06 - 7.15 (m, 2 H), 3.78 (s, 1 H), 3.13 (s, 1 H), 3.08 (s, 1 H), 2.78 - 2.88 (m, 1 H), 2.40 - 2.47 (m, 1 H), 2.03 (s, 1 H), 1.68 (s, 1 H), 1.47 (d,  $J = 8.6$  Hz, 2 H). LCMS  $m/z$  295 (M+1).

**Example 4 (Method A): 6-Imidazo[1,2-a]pyrazin-3-yl-N-[(3R)-piperidin-3-yl]pyrazin-2-amine**



**Preparation of compound 4a: 3-(6-Chloropyrazin-2-yl)imidazo[1,2-a]pyrazine**

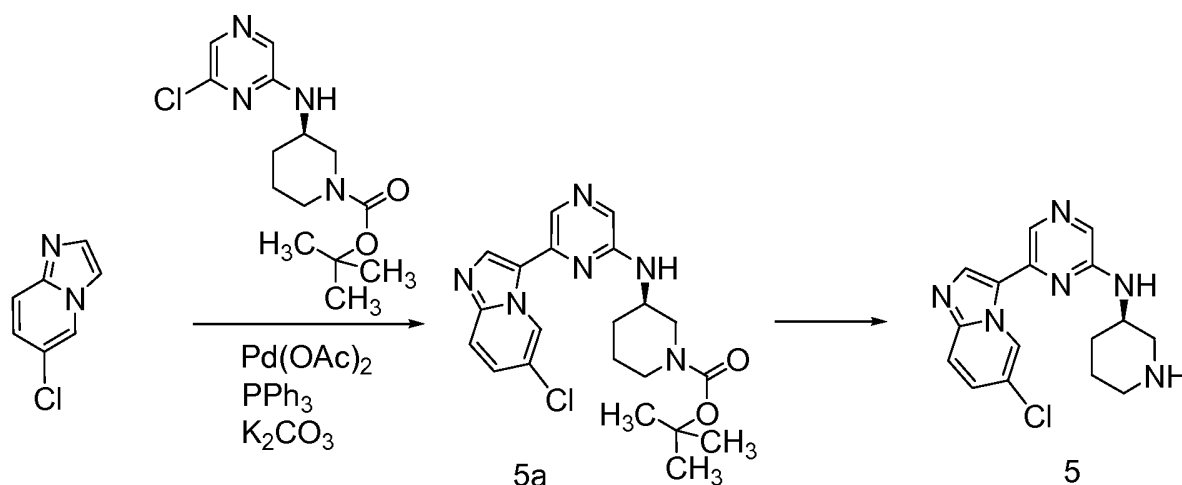
A mixture of imidazo[1,2-a]pyrazine (2.0 g, 16.8 mmol), 2-bromo-6-chloropyrazine (4.9 g, 25.2 mmol), palladium (II) acetate (0.78 g, 3.36 mmol), triphenylphosphine (0.45 g, 1.7 mmol), and potassium carbonate (2.3 g, 16.8 mmol) in dioxane (40 mL) was heated at 75 °C for 24 h. The reaction was filtered hot, rinsed with dioxane, and the filtrate was concentrated under reduced pressure. The product was recrystallized from EtOAc which gave the title compound **4a** as a beige solid (2.2 g, 55% yield). <sup>1</sup>H

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NMR (400 MHz, DMSO-*d*<sub>6</sub>)  $\delta$  ppm 9.43 (s, 2 H), 9.29 (s, 1 H), 8.87 (s, 1 H), 8.72 (s, 1 H), 8.23 (s, 1 H).

A mixture of cesium fluoride (178 mg, 1.17 mmol), **4a** (100 mg, 0.43 mmol) and (R)-tert-butyl 3-aminopiperidine-1-carboxylate (130 mg, 0.65 mmol) in DMSO (0.9 mL) was heated to 120 °C overnight. The crude product was filtered and purified by preparative HPLC (water-acetonitrile with acetic acid). The product **4b** was dissolved in MeOH (2 mL) and treated with 4N HCl in dioxane (3 mL). The reaction mixture was stirred at room temperature for 2 h and concentrated under reduced pressure. The crude product was dissolved in MeOH and passed thru an SCX column which gave the title compound **4** as a yellow solid (56 mg, 44% yield). <sup>1</sup>H NMR (400 MHz, MeOD)  $\delta$  ppm 9.59 (s, 1 H), 9.12 (s, 1 H), 8.47 (br. s., 1 H), 8.37 (s, 1 H), 8.09 (s, 1 H), 7.89 (s, 1 H), 4.19 (br. s., 1 H), 3.48 (br. s., 1 H), 3.21 (br. s., 1 H), 2.90 (br. s., 2 H), 2.22 (br. s., 1 H), 2.03 (br. s., 1 H), 1.85 (br. s., 1 H), 1.69 (br. s., 1 H). LCMS *m/z* 296 (M+1).

**Example 5 (Method B): 6-(6-Chloroimidazo[1,2-*a*]pyridin-3-yl)-N-[(3R)-piperidin-3-yl]pyrazin-2-amine**

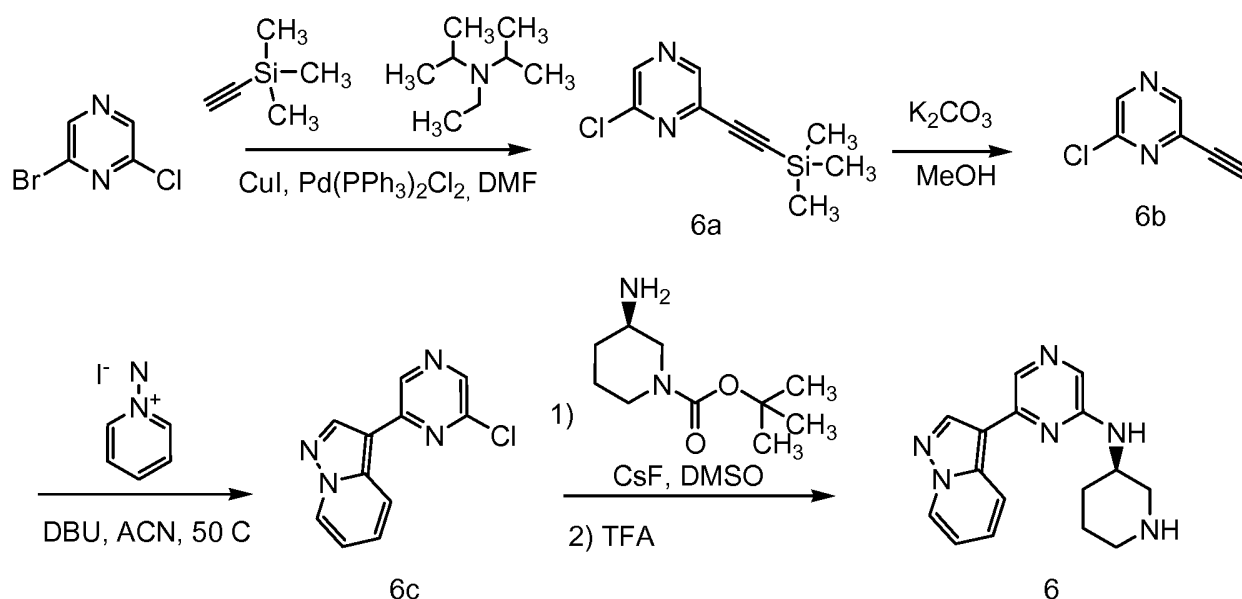


**Preparation of compound 5a: (3R)-Tert-butyl 3-(6-(6-chloroimidazo[1,2-*a*]pyridin-3-yl)pyrazin-2-ylamino)piperidine-1-carboxylate**

A mixture of 6-chloroimidazo[1,2-*a*]pyridine (100 mg, 0.66 mmol), **1a** (308 mg, 0.98 mmol), palladium (II) acetate (30 mg, 0.13 mmol), triphenylphosphine (17 mg, 0.07 mmol), and potassium carbonate (90 mg, 0.66 mmol) in dioxane (1.2 mL) was heated in a microwave at 130 °C for 30 min. The reaction was filtered and purified by preparative reverse phase HPLC (water-acetonitrile with acetic acid), which gave **5a**.

(3R)-Tert-butyl 3-(6-(6-chloroimidazo[1,2-a]pyridin-3-yl)pyrazin-2-ylamino)piperidine-1-carboxylate **5a** was dissolved in MeOH (2 mL) and treated with 4N HCl in dioxane (3 mL). The reaction mixture was stirred at room temperature for 2 h and diluted with 2-MeTHF (30 mL) which gave the title compound **5** as a solid (45 mg, 19% yield). <sup>1</sup>H NMR (400 MHz, MeOD)  $\delta$  ppm 9.98 (br. s., 1 H), 8.78 (s, 1 H), 8.39 (s, 1 H), 8.10 (s, 3 H), 4.30 (br. s., 1 H), 3.54 (br. s., 1 H), 3.36 (br. s., 1 H), 3.18 (br. s., 2 H), 2.29 (br. s., 1 H), 2.15 (br. s., 1 H), 1.97 (br. s., 1 H), 1.81 (br. s., 1 H). LCMS m/z 329 (M+1).

**Example 6 (Method E): N-[(3R)-piperidin-3-yl]-6-pyrazolo[1,5-a]pyridin-3-ylpyrazin-2-amine**



**Preparation of compound 6a: 2-Chloro-6-(2-(trimethylsilyl)ethynyl)pyrazine**

A mixture of 2-bromo-6-chloropyrazine (0.976 g, 5 mmol), Pd(PPh<sub>3</sub>)<sub>2</sub>Cl<sub>2</sub> (0.106 g, 0.15 mmol), DIEA (0.646 g, 5 mmol) and CuI (0.095 g, 0.5 mmol) in DMF was purged with nitrogen and treated with trimethylsilylacetylene (0.491 g, 5 mmol). The resultant mixture was stirred at 23 °C overnight. The reaction mixture was poured into saturated aqueous NaHCO<sub>3</sub> and extracted with EtOAc. The organic layer was washed with brine, dried over Na<sub>2</sub>SO<sub>4</sub>, decanted and concentrated under reduced pressure. The crude product was purified by flash chromatography on silica gel (0-20% EtOAc-hexanes) which gave the title compound **6a** as a clear oil (861 mg, 80% yield). <sup>1</sup>H NMR (400 MHz, MeOD)  $\delta$  ppm 8.62 (s, 1 H), 8.61 (s, 1 H), 0.29 (s, 9 H).

**Preparation of compound 6b: 2-Chloro-6-ethynylpyrazine**

A solution of **6a** (861 mg, 4.09 mmol) in MeOH (10 mL) was cooled to 0 °C treated with potassium carbonate (565 mg, 4.09 mmol). The reaction mixture was stirred at 0

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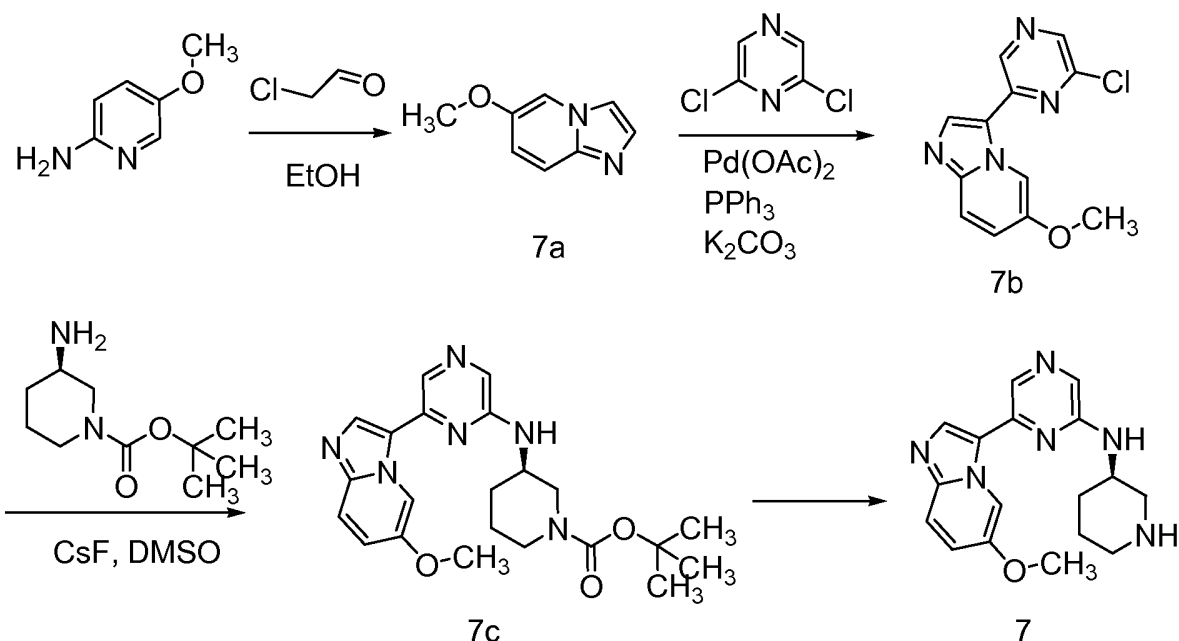
°C for 6 h. The reaction mixture was filtered and the solids washed with methanol. The filtrate was concentrated under reduced pressure. The resultant solid dissolved in ethyl acetate and washed with water, brine, dried over Na<sub>2</sub>SO<sub>4</sub>, decanted and concentrated under reduced pressure. The crude product was purified by flash chromatography on silica gel (0-20% EtOAc-hexanes) which gave the title compound **6b** as a tan solid (91 mg, 16% yield). <sup>1</sup>H NMR (400 MHz, MeOD) δ ppm 8.66 (s, 1 H), 8.64 (s, 1 H), 4.12 (s, 1 H).

**Preparation of compound 6c: 3-(6-Chloropyrazin-2-yl)pyrazolo[1,5-a]pyridine**

A mixture of **6b** (91 mg, 0.66 mmol) and 1-aminopyridinium iodide (146 mg, 0.657 mmol) in acetonitrile (5 mL) was warmed to 50 °C and treated with DBU (200 mg, 1.31 mmol). The reaction mixture turned dark purple. After 4 h, the reaction mixture was poured into saturated aqueous NaHCO<sub>3</sub> and extracted with methanolic EtOAc. The EtOAc layer was washed with brine, dried over Na<sub>2</sub>SO<sub>4</sub>, decanted and concentrated under reduced pressure. The crude product was purified by flash chromatography on silica gel (0-40% EtOAc-hexanes) which gave the title compound **6c** as a yellow solid (48 mg, 32% yield). <sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 9.21 (s, 1 H), 8.91 (s, 1 H), 8.87 (d, *J* = 6.8 Hz, 1 H), 8.50 (s, 1 H), 8.40 (d, *J* = 8.8 Hz, 1 H), 7.55 – 7.57 (m, 1 H), 7.14 (t, *J* = 6.69 Hz, 1 H). LCMS *m/z* 231 (M+1).

A mixture of **6c** (92 mg, 0.4 mmol), (R)-tert-butyl 3-aminopiperidine-1-carboxylate (160 mg, 0.8 mmol) and cesium fluoride (122 mg, 0.8 mmol) in DMSO (0.8 mL) was heated to 80 °C overnight. The reaction was poured into water and extracted with EtOAc. The EtOAc layer was washed with brine, dried over Na<sub>2</sub>SO<sub>4</sub>, decanted and concentrated under reduced pressure to give an oil. The crude product was purified by flash chromatography on silica gel (50-100% EtOAc-hexanes) which gave the Boc protected material (133 mg). A solution of the Boc protected material in DCM (2 mL) and TFA (1 mL) was stirred for 1 h. The solvent was removed under reduced pressure and the crude product was purified by reverse phase preparative HPLC which gave the title compound **6** as a greenish oil (67 mg, 60% yield). <sup>1</sup>H NMR (400 MHz, MeOD) δ ppm 8.61 (d, *J* = 7.1 Hz, 1 H), 8.54 (s, 1 H), 8.37 (d, *J* = 8.8 Hz, 1 H), 8.21 (s, 1 H), 7.73 (s, 1 H), 7.43 (d, *J* = 8.1 Hz, 1 H), 7.02 (t, *J* = 6.6 Hz, 1 H), 4.36 (dq, *J* = 8.5, 4.2 Hz, 1 H), 3.64 (dd, *J* = 12.2, 2.9 Hz, 1 H), 3.37 (s, 1 H), 3.05 - 3.20 (m, 2 H), 2.25 (d, *J* = 12.9 Hz, 1 H), 2.16 (dd, *J* = 9.7, 5.2 Hz, 1 H), 1.96 (ddd, *J* = 14.3, 3.9, 3.8 Hz, 1 H), 1.71 - 1.85 (m, *J* = 13.0, 9.6, 9.6, 3.4 Hz, 1 H). LCMS 295 (M+1).

**Example 7 (Method A): 6-(6-Methoxyimidazo[1,2-a]pyridin-3-yl)-N-[(3R)-piperidin-3-yl]pyrazin-2-amine**



**5 Preparation of compound 7a: 6-Methoxyimidazo[1,2-a]pyridine**

A solution of 5-methoxypyridin-2-amine (5.0 g, 40.3 mmol) and chloroacetaldehyde (~55% solution in water – 32 g, 200 mmol) in ethanol (200 mL) was refluxed overnight. The solvent was removed under reduced pressure and the resultant brown oil was triturated using methanolic MTBE which gave the hydrochloride of the title compound **7a** as a beige solid (5.7 g, 77% yield). <sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 14.62 (br, 1H), 8.70 (d, *J* = 2.3 Hz, 1 H), 8.24 (d, *J* = 1.5 Hz, 1 H), 8.15 (d, *J* = 2.0 Hz, 1 H), 7.90 (d, *J* = 9.8 Hz, 1 H), 7.71 (dd, *J* = 9.8, 2.3 Hz, 1 H), 3.89 (s, 3 H). LCMS 185 (M+1).

**15 Preparation of compound 7b: 3-(6-Chloropyrazin-2-yl)-6-methoxyimidazo[1,2-a]pyridine**

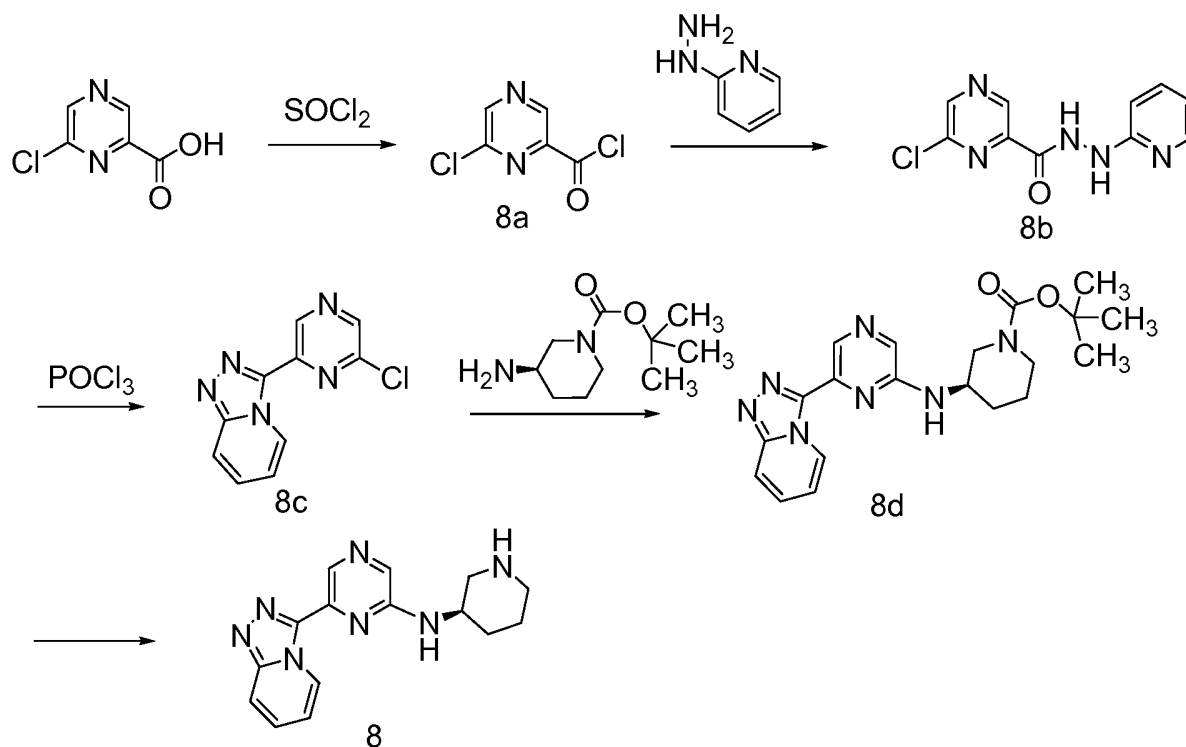
A mixture of **7a** (4.0 g, 20 mmol), 2,6-dichloropyrazine (3.2 g, 22 mmol), palladium(II)acetate (0.2 g, 0.87 mmol), triphenylphosphine (0.59 g, 2.2 mmol), and potassium carbonate (3.0 g, 22 mmol) in dioxane (43 mL) was degassed, purged with nitrogen and heated at 100 °C overnight. The crude reaction mixture was filtered hot and the solids were washed with dioxane. The filtrate was concentrated under reduced pressure and the crude product was purified by flash chromatography on silica gel (0-10% methanol in 1:1 EtOAc-heptane) which gave the title compound **7b**

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as a solid (2.5 g, 40% yield). <sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 9.33 (s, 2 H), 8.65 (s, 1 H), 8.59 (s, 1 H), 7.75 (s, 1 H), 7.35 (s, 1 H), 3.88 (s, 3 H). LCMS m/z 261 (M+1).

A mixture of cesium fluoride (110 mg, 0.72 mmol), **7b** (75 mg, 0.29 mmol), (R)-tert-butyl 3-aminopiperidine-1-carboxylate (86.5mg, 0.432mmol) in DMF (1 mL) was heated to 120 °C overnight. The crude product was filtered and purified by reverse phase preparative HPLC (water-acetonitrile with acetic acid) to obtain **7c**. The BOC protected compound **7c** was dissolved in MeOH (3 mL) and 4N HCl dioxane (3 mL) and stirred at room temperature for 2 h. The solvent was removed under reduced pressure and the crude product was dissolved in MeOH. The methanolic solution was passed thru an SCX column, and the filtrate was concentrated under reduced pressure which gave the title compound **7** as a solid (34 mg, 37% yield). <sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 9.41 (d, *J* = 2.8 Hz, 1 H), 8.29 (d, *J* = 5.0 Hz, 2 H), 7.80 (s, 1 H), 7.63 (d, *J* = 9.3 Hz, 1 H), 7.18 (dd, *J* = 9.8, 2.5 Hz, 2 H), 4.10 (br. s., 1 H), 3.94 (s, 4 H), 3.17 (d, *J* = 4.8 Hz, 3 H), 2.80 (br. s., 1 H), 2.33 (d, *J* = 2.0 Hz, 2 H), 1.95 (br. s., 1 H), 1.69 (br. s., 1 H), 1.42 (br. s., 2 H). LCMS m/z 325 (M+1).

**Example 8 (Method A): N-[(3R)-piperidin-3-yl]-6-[1,2,4]triazolo[4,3-a]pyridin-3-ylpyrazin-2-amine**



**Preparation of compound 8a: 6-Chloropyrazine-2-carbonyl chloride**

A mixture of 2-chloro-6-carboxy-pyrazine (1000 mg, 6.3 mmol) in ACN (20 mL) was treated with thionyl chloride (800  $\mu$ L). The resulting mixture, which became homogeneous upon heating, was refluxed for 2 h. The solvent was removed under reduced pressure which gave an oil. The crude product was used in the next step.

**Preparation of compound 8b: 6-Chloro-N'-(pyridin-2-yl)pyrazine-2-carbohydrazide**

The crude product **8a** was dissolved ACN (10 mL) and treated with a solution of 2-hydrazino pyridine (688 mg, 6.3 mmol) in ACN (10 mL). The reaction mixture was stirred at room temperature for 18 h and the solids were collected and washed with acetonitrile which gave the title compound **8b** as an orange solid (1.2 g, 77% yield). <sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>)  $\delta$  ppm 11.38 (br. s., 1 H), 10.95 (br. s., 1 H), 9.21 (s, 1 H), 9.13 (s, 1 H), 8.01 - 8.10 (m, 2 H), 7.25 (br. s., 1 H), 7.07 (t, *J* = 6.5 Hz, 1 H). LCMS *m/z* 250 (M+H).

**Preparation of compound 8c: 3-(6-Chloropyrazin-2-yl)-[1,2,4]triazolo[4,3-a]pyridine**

A solution of **8b** (120 mg, 0.48 mmol) and POCl<sub>3</sub> (1 mL) was refluxed for 8 h. The mixture was removed from heat and allowed to stand at RT for 72 h. The solvent was removed under reduced pressure and the crude product was treated with water. The mixture was extracted with DCM. The organic layer was concentrated under reduced pressure which gave the title compound **8c** as an off-white solid. <sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>)  $\delta$  ppm 9.69 (br. s., 1 H) 8.89 (d, *J* = 1.3 Hz, 1 H), 8.36 (d, *J* = 5.8 Hz, 1 H), 8.13 (br. s., 1 H), 7.73 (br. s., 1 H), 7.26 (br. s., 1 H). LCMS *m/z* 232 (M+H).

**Preparation of compound 8d: Tert-butyl (3R)-3-[(6-[1,2,4]triazolo[4,3-a]pyridin-3-yl)pyrazin-2-yl]amino]piperidine-1-carboxylate**

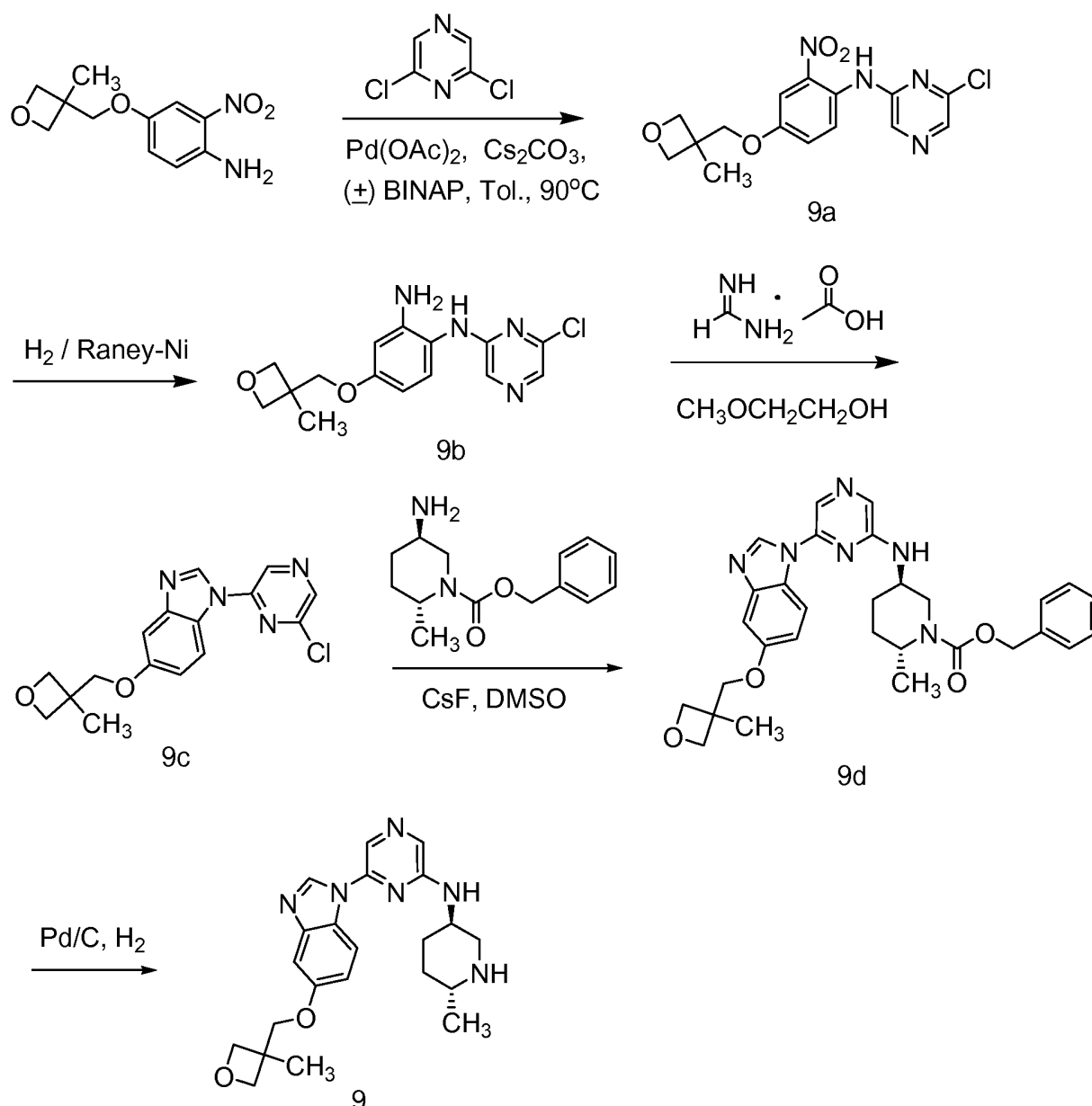
A mixture of **8c** (30 mg, 0.13 mmol), (R)-tert-butyl 3-aminopiperidine-1-carboxylate (39 mg, 0.20 mmol) and cesium fluoride (52 mg, 0.26 mmol) in DMSO (1 mL) was heated at 120 °C for 6 h. The crude reaction mixture was filtered and the filtrate was diluted with DCM (50 mL) and washed with water (25 mL). The crude product was purified by flash chromatography on silica gel (0-45% ethanol-EtOAc) which gave the title compound **8d** as an amber oil. LCMS *m/z* of 396 (M+H).

A solution of **8d** (65 mg, 0.16 mmol), 4N HCl in dioxane (2 mL) and dioxane (2.5 mL) was stirred for 2 h.. The solvent was removed under reduced pressure and the resultant yellow solid was dissolved in methanol. The methanolic solution was

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passed thru an SCX column and eluted with 4N ammonium in MeOH. The solvent was removed under reduced pressure, which gave rise to the title compound **8** as a brown solid (27 mg, 70% yield). <sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 9.32 (br. s., 2 H), 8.45 (br. s., 3 H), 3.40 (d, *J* = 7.0 Hz, 2 H), 3.20 (br. s., 1 H), 2.67 - 2.93 (m, 2 H), 1.98 - 2.08 (m, 1 H), 1.81 - 1.90 (m, 1 H), 1.50 - 1.74 (m, 2 H). LCMS *m/z* 296 (M+1).

**Example 9 (Method C): 6-{5-[(3-Methyloxetan-3-yl)methoxy]-1H-benzimidazol-1-yl}-N-[(3R,6R)-6-methylpiperidin-3-yl]pyrazin-2-amine**



**Preparation of compound 9a: 6-Chloro-N-(4-((3-methyloxetan-3-yl)methoxy)-2-nitrophenyl)pyrazin-2-amine**

A mixture of 2,6-dichloropyrazine (25 g, 168 mmol), 4-((3-methyloxetan-3-yl)methoxy)-2-nitrobenzenamine (Tom, Norma Jacqueline; Ripin, David Harold



Brown; Castaldi, Michael James PCT Int. Appl. (2004), WO 2004113322 A1) (40 g, 168 mmol), palladium (II) acetate (1.5 g, 6.72 mmol), ( $\pm$ )-2,2-bis(diphenylphosphino)-1,1'-binaphthyl [( $\pm$ )-BINAP] (4.18 g, 6.72 mmol) and cesium carbonate (76.7 g, 235.2 mmol) in toluene (800 mL) was stirred at 90 °C under N<sub>2</sub> for 23 h. The mixture was  
5 filtered through a pad of Celite and washed with EtOAc. The filtrate was evaporated under reduced pressure and the crude product was purified by flash chromatography on silica (EtOAc: petroleum ether = 1:5) which gave the title compound **9a** as a red solid (22.4 g, 37% yield).

**Preparation of compound 9b: N1-(6-chloropyrazin-2-yl)-4-((3-methyloxetan-3-yl)methoxy)benzene-1,2-diamine**

A suspension of **9a** (30 g, 86 mmol) and Raney-Ni (60 g) in MeOH (90 mL) was stirred under 1 PSI of hydrogen at room temperature for 2 h. The reaction mixture was filtered through a pad of Celite with MeOH rinses. The filtrate was evaporated under reduced pressure which gave the title compound **9b** as a white solid (27 g,  
15 98% yield).

**Preparation of compound 9c: 1-(6-Chloropyrazin-2-yl)-5-((3-methyloxetan-3-yl)methoxy)-1H-benzo[d]imidazole**

A solution of **9b** (27 g, 84 mmol) and formamidine acetate (17.6 g, 168 mmol) in 2-methoxyethanol (350 mL) was heated at reflux for 3 h. After removal of the solvent under reduced pressure, the residue was dissolved in EtOAc (2 L), and the solution  
20 was washed with water (1 L $\times$ 2), dried over anhydrous Na<sub>2</sub>SO<sub>4</sub> and concentrated under reduced pressure which gave the title compound **9c** as a grey solid (23 g, 83%).

**Preparation of compound 9d: (2R,5R)-Benzyl 2-methyl-5-(6-(5-((3-methyloxetan-3-yl)methoxy)-1H-benzo[d]imidazol-1-yl)pyrazin-2-ylamino)piperidine-1-carboxylate**

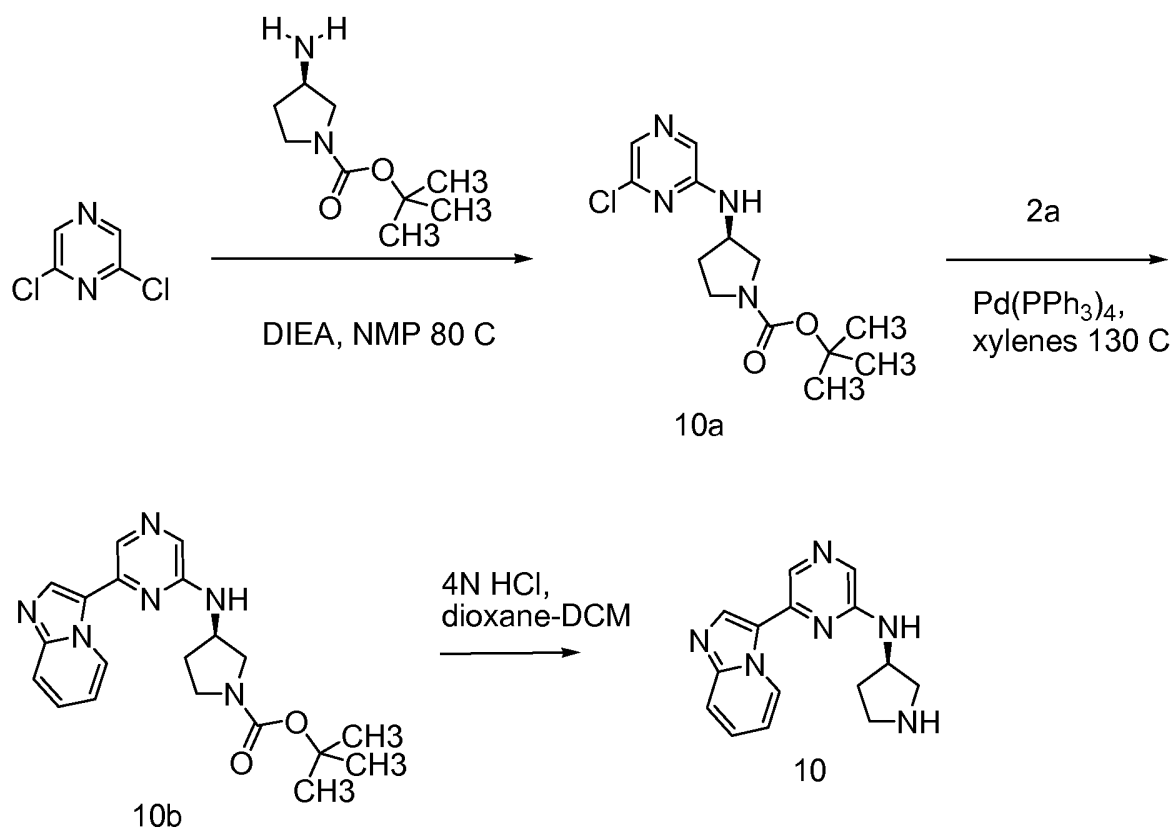
A mixture of **9c** (150 mg, 0.45 mmol), (2R,5R)-benzyl 5-amino-2-methylpiperidine-1-carboxylate (255 mg, 10.9 mmol) and cesium fluoride (138 mg, 0.91 mmol) in DMSO (0.9 mL) was heated to 120 °C for 2.5 h. The reaction was poured into water and  
30 extracted with EtOAc. The organic layer was washed with brine, dried over Na<sub>2</sub>SO<sub>4</sub>, decanted and concentrated which gave an oil. The crude product was purified by flash chromatography on silica (0-100% EtOAc-hexanes) which gave the title compound **9d** as an oil (100 mg, 40% yield).

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A solution of **9d** (100 mg, 0.18 mmol) in MeOH (1.5 mL), was purge with argon and treated with palladium on carbon (10%). The reaction mixture was stirred under an atmosphere of hydrogen at ambient temperature and pressure for 24 h. The reaction mixture was filtered thru celite and the solvent was removed under reduced pressure.

5 The crude product was purified on MS triggered reverse phase preparative HPLC which gave the title compound **9** as white solid (25 mg, 33%). <sup>1</sup>H NMR (400 MHz, DMSO-*d*<sub>6</sub>) δ ppm 8.91 (s, 1 H), 8.23 (s, 1 H), 8.17 (d, *J* = 9.1 Hz, 1 H), 7.88 (s, 1 H), 7.43 (d, *J* = 7.6 Hz, 1 H), 7.37 (d, *J* = 2.5 Hz, 1 H), 7.05 (dd, *J* = 9.0, 2.4 Hz, 1 H), 4.54 (d, *J* = 5.8 Hz, 2 H), 4.34 (d, *J* = 5.6 Hz, 2 H), 4.13 (s, 2 H), 3.77 (br s, 1 H), 2.54 - 2.65 (m, 1 H), 2.37 - 2.45 (m, 1 H), 2.04 - 2.12 (m, 1 H), 1.66 - 1.75 (m, 1 H), 1.41 (s, 3 H), 1.37-1.40 (m, 1H), 1.30 - 1.36 (m, 1 H), 1.18 - 1.29 (m, 1 H), 1.05 (d, *J* = 8.0 Hz, 3 H). LCMS *m/z* 409 (M+1).

**Example 10 (Method B): 6-Imidazo[1,2-*a*]pyridin-3-yl-N-[(3*R*)-pyrrolidin-3-yl]pyrazin-2-amine**



**Preparation of compound 10a: (R)-Tert-butyl 3-(6-chloropyrazin-2-ylamino)pyrrolidine-1-carboxylate**

A mixture of 2,6-dichloropyrazine (0.149 mg, 1 mmol), (R)-3-Amino-pyrrolidine-1-carboxylic acid tert-butyl ester (0.205 g, 1.1 mmol) and diisopropylethylamine (0.19

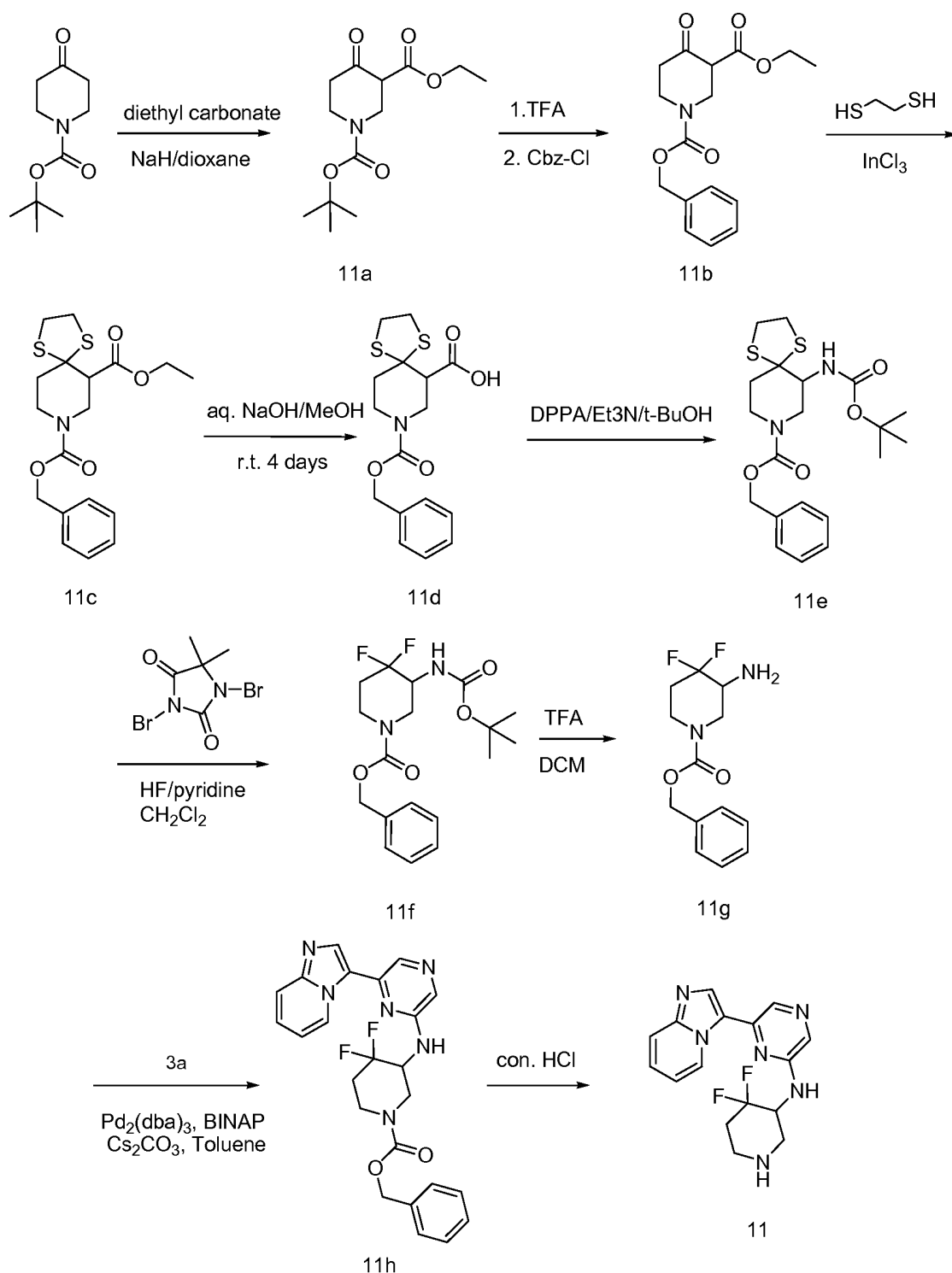
mL, 1.1 mmol) in NMP (2 mL) was heated to 120 °C in a microwave reactor for 1 h. The crude reaction mixture was partitioned between EtOAc and water. The organic phase was washed with brine, dried over sodium sulfate, filtered and concentrated under reduced pressure which gave an oil. The crude product was purified by flash chromatography on silica gel (0-100% EtOAc-hexanes) which gave the title compound **10a** as an oil (200 mg). LCMS m/z 199 (M+1-BOC).

**6-Imidazo[1,2-a]pyridin-3-yl-N-[(3R)-pyrrolidin-3-yl]pyrazin-2-amine**

A mixture of **2a** (0.204 g, 0.5 mmol), (R)-3-(6-chloro-pyrazin-2-ylamino)-pyrrolidine-1-carboxylic acid tert-butyl ester (75 mg, 0.25 mmol) and palladiumtetrakis(triphenylphosphine) (0) (29 mg, 0.025 mmol) in o-xylene (2 mL) was vacuum flushed with nitrogen then heated to 130 °C. Once the reaction was completed the reaction mixture was concentrated and purified by flash chromatography on silica gel (0-100% EtOAc-hexanes then 0-20% MeOH-EtOAc) which gave the title compound **10b** as a greenish oil. LCMS gave purity ~85%. The green oil **10b** was dissolved in DCM (1 mL) and 4N HCl in dioxane (1 mL) and stirred at 23 °C until the reaction was determined to be complete by LCMS. The crude product was purified by reverse phase HPLC (water-acetonitrile with AcOH) and the pooled pure fractions were concentrated under reduced pressure. The product was dissolved in methanol (3 mL) and neutralized with Sili-bond Carbonate which gave the title compound **10** as an oil (26 mg). <sup>1</sup>H NMR (400 MHz, MeOD) δ ppm 9.82 (d, *J* = 7.1 Hz, 1 H), 8.28 (s, 1 H), 8.25 (s, 1 H), 7.77 (s, 1 H), 7.68 (d, *J* = 9.1 Hz, 1 H), 7.48 (d, *J* = 6.8 Hz, 1 H), 7.11 (t, *J* = 6.4 Hz, 1 H), 4.46 - 4.58 (m, 1 H), 3.34 - 3.40 (m, 1 H) 3.06 - 3.23 (m, 2 H), 3.01 (dd, *J* = 11.8, 4.2 Hz, 1 H), 2.31 (dd, *J* = 13.3, 7.7 Hz, 1 H), 1.94 (ddd, *J* = 12.8, 4.9, 2.8 Hz, 1 H). LCMS m/z 281 (M+H).

**Example 11 (Method A): N-(4,4-difluoropiperidin-3-yl)-6-(imidazo[1,2-a]pyridin-3-yl)pyrazin-2-amine**

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### Preparation of compound 11a: 1-*tert*-butyl 3-ethyl 4-oxopiperidine-1,3-dicarboxylate

NaH (60%, 60 g, 1.5 mol) was suspended in dry dioxane (500 mL) and diethyl carbonate (151 mL, 1.25 mol) was added. The mixture was heated to 90 °C, then a solution of *tert*-butyl 4-oxopiperidine-1-carboxylate (100 g, 0.5 mol) in dry dioxane (300 mL) was added dropwise over 2 h. After addition, the mixture was continually

stirred for 1 h. The cooled mixture was poured into an ice-water with stirring. The mixture was extracted with EtOAc (1L x 2). The combined extracts were washed with water (1 L), brine (500 mL), dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated in vacuo. The residue was purified by column chromatography (EtOAc/petrol ether = 1: 200 to 1:80) which gave the title compound **11a** as a light yellow oil (115 g, 85%).

**Preparation of compound 11b: 1-benzyl 3-ethyl 4-oxopiperidine-1,3-dicarboxylate**

To a stirred solution of **11a** (115 g, 0.42 mol) in anhydrous CH<sub>2</sub>Cl<sub>2</sub> (300 mL) was added dropwise TFA (485 g, 4.2 mol) at 5~10 °C. After addition, the mixture was stirred for 1 h at that temperature. The mixture was concentrated *in vacuo* and the residue was used for next step without any purification. The residue (71.8 g, 0.42 mol) was dissolved in dry CH<sub>2</sub>Cl<sub>2</sub> (300 mL), then dry TEA (129 g, 1.26 mol) was added. After that, Cbz-Cl (80 g, 0.49 mol) was added dropwise at 0 °C. The mixture was stirred at r.t. for 2 h. The mixture was washed with 2 N HCl (500 mL x 2), aq. NaHCO<sub>3</sub> (800 mL), brine (800 mL), dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated *in vacuo* to give a yellow oil, which was purified by column chromatography (EtOAc/petroleum ether = 1:20) which gave the title compound **11b** as light yellow oil (115 g, 89.8% in two steps). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>): δ ppm 1.31-1.28 (m, 3H), 12.09 (s, 1H), 2.39 (s, 2H), 3.66-3.63 (m, 2H), 4.27-4.19 (m, 2H), 5.17 (s, 2H), 7.38-7.30 (m, 5H).

**Preparation of compound 11c: 8-benzyl 6-ethyl 1,4-dithia-8-azaspiro[4.5]decane-6,8-dicarboxylate**

To a stirred solution of compound **11b** (64 g, 0.21 mol) and 1,2-Ethanedithiol (21 mL, 0.25 mol) in dry CH<sub>2</sub>Cl<sub>2</sub> (800 mL) was added quickly anhydrous InCl<sub>3</sub> (28 g, 0.127 mol) in one portion. The mixture was stirred at room temperature for 40 h. The mixture was directly purified by column chromatography (EtOAc/petrol ether = 1: 30 to 1:10) which gave the title compound **11c** as a colorless liquid (40 g, 50%).

**Preparation of compound 11d: 8-[(benzyloxy)carbonyl]-1,4-dithia-8-azaspiro[4.5]decane-6-carboxylic acid**

To a stirred solution of **11c** (39 g, 0.1 mol) in MeOH (400 mL) was added dropwise aq. NaOH (40 g, 1.0 mol in 400 mL of H<sub>2</sub>O) below 40 °C. The mixture was stirred at r.t. (30 °C) for 4 days. The mixture was concentrated *in vacuo* to remove methanol. The residue was acidified to pH=5 with 2 N HCl and extracted with EtOAc (500 mL x 4). The combined extracts were dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated *in vacuo* which

gave the title compound **11d** as yellow oil (26.3 g, 74.6%). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>): δ ppm 1.931 (s, 1H), 2.79 (s, 1H), 2.951 (s, 1H), 3.271-3.251 (m, 1H), 3.291 (s, 4H), 3.731-3.571 (m, 2H), 4.011-3.981 (m, 2H), 4.311-4.191 (m, 1H), 5.11 (s, 2H), 7.36-7.28 (m, 5H).

**Preparation of compound 11e: benzyl 6-[(*tert*-butoxycarbonyl)amino]-1,4-dithia-8-azaspiro[4.5]decane-8-carboxylate**

To a stirred solution of compound **11d** (19.2 g, 54 mmol) in *t*-BuOH (250 mL) was added DPPA (18 g, 65 mmol) and Et<sub>3</sub>N (6.6 g, 65 mmol) dropwise at room temperature. The resulting mixture was stirred for 3 h, then heated to 85 °C and stirred overnight. The reaction mixture was concentrated to remove most of the solvent. The residue was purified by column chromatography (Petroleum Ether: EtOAc = 50:1 to 10:1) which gave the title compound **11e** as yellow oil (12.3 g, 54%). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) 1.380 (s, 9H), 2.096-2.049 (m, 2H), 2.850 (m, 1H), 3.269-3.155 (m, 1H), 3.874-3.856 (m, 1H), 4.000 (m, 1H), 4.899-4.876 (d, 1H), 5.080-5.035 (m, 2H), 7.291-7.227 (m, 5H).

**Preparation of compound 11f: benzyl 3-[(*tert*-butoxycarbonyl)amino]-4,4-difluoropiperidine-1-carboxylate**

1,3-dibromo-5,5-dimethylimidazolidine-2,4-dione (4.8 g, 17 mmol) was dissolved in dry CH<sub>2</sub>Cl<sub>2</sub> (100 mL) and allowed to stir under nitrogen. The mixture was cooled to -78 °C and pyridinium poly(hydrogen fluoride) (13 mL) was added via polyethylene syringe, followed by the dropwise addition of compound **11e** (6.5 g, 15.3 mmol). After 10 min, the reaction mixture, which was deep red, was diluted with hexane (1 L) and filtered through a column of basic alumina. The organic was washed with NaHCO<sub>3</sub>, brine, concentrated and purified by column chromatography (Petroleum Ether: EtOAc = 50:1) which gave the title compound **11f** as a colorless oil (1.2 g, 12.5%). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) 1.380 (s, 9H), 2.133-1.874 (m, 2H), 3.159-3.101 (m, 1H), 4.078-3.927 (m, 3H), 4.687-4.670 (d, 1H), 5.274-5.030 (m, 2H), 7.300-7.210 (m, 5H).

**Preparation of compound 11g: benzyl 3-amino-4,4-difluoropiperidine-1-carboxylate**

To a solution of compound **11f** (2.0 g, 5.4 mmol) in CH<sub>2</sub>Cl<sub>2</sub> (40 mL) was added TFA (10 mL) at 0 °C. The resulting mixture was stirred at room temperature for 2 h. The reaction solution was diluted with CH<sub>2</sub>Cl<sub>2</sub> (400 mL), washed with NaHCO<sub>3</sub> (sat., aq.). The organic phase was washed with brine, dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated. The

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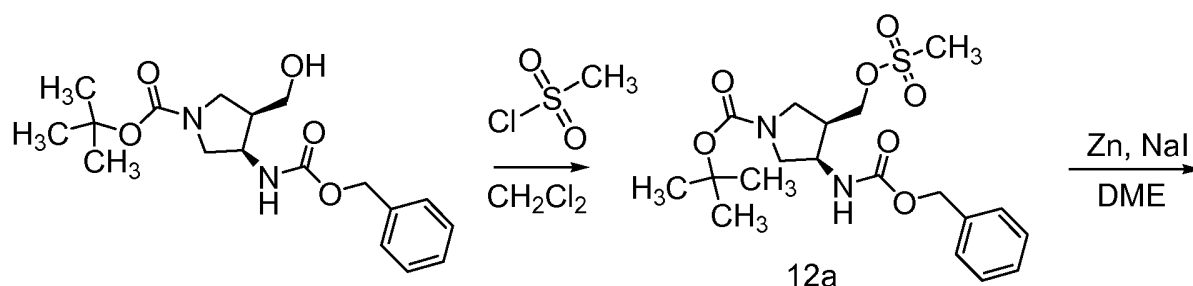
residue was purified by Chem-Flush which gave the title compound **11g** as colorless oil (1.3 g, 89%). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) 0.676-0.717 (m, 2H), 0.931-0.979 (m, 2H), 2.880-2.891 (d, 3H), 2.983-3.052 (m, 3H), 3.770-3.799 (t, 2H), 4.613-4.652 (m, 3H), 6.214 (s, 1H), 6.385-6.399 (d, 1H), 7.314-7.356 (t, 1H), 7.559-7.641 (m, 2H), 8.170-8.191 (d, 1H), 8.216-8.245 (t, 2H).

**Preparation of compound 11h: benzyl 4,4-difluoro-3-[[6-(imidazo[1,2-a]pyridin-3-yl)pyrazin-2-yl]amino]piperidine-1-carboxylate**

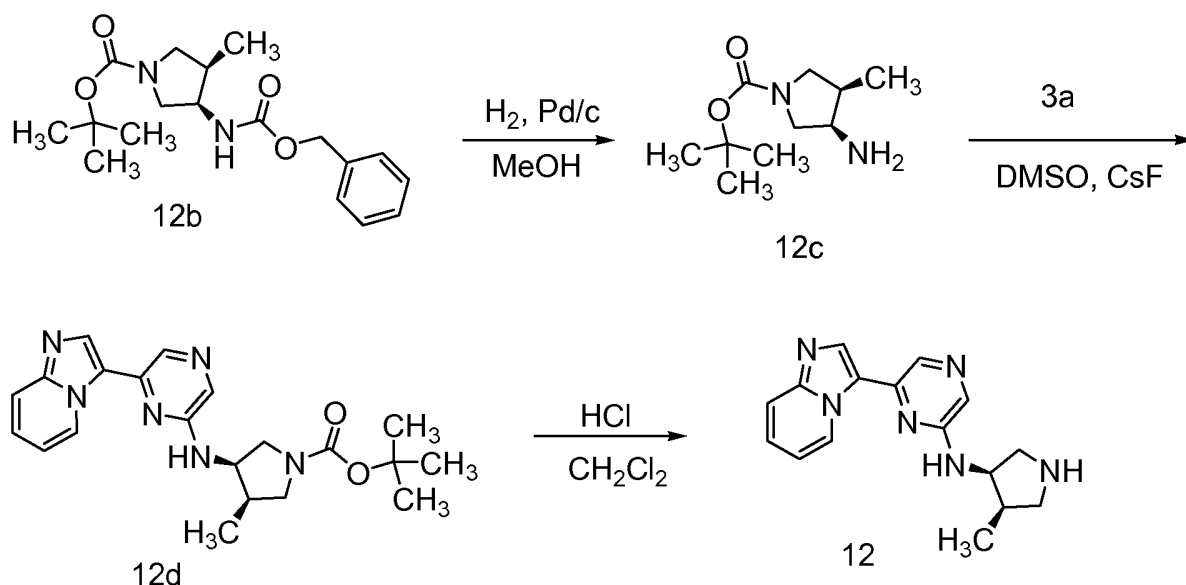
A mixture of **11g** (0.24 g, 0.89 mmol), compound **3a** (0.218 g, 0.98 mmol), Pd<sub>2</sub>(dba)<sub>3</sub> (32 mg, 0.056 mmol), BINAP (38 mg, 0.06 mmol) and Cs<sub>2</sub>CO<sub>3</sub> (1.0 g, 3 mmol) in anhydrous toluene (12 mL) was heated rapidly to 120 °C and stirred for 90 min. The mixture was cooled to room temperature and was filtered. The filtrate was concentrated in vacuo and purified by pre-HPLC which gave the title compound **11h** as a brown solid (0.35 g, 86%). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) 2.321-2.194 (m, 2H), 3.161 (m, 1H), 3.441-3.332 (m, 2H), 4.545-4.497 (m, 1H), 5.160-4.850 (m, 2H), 7.133-7.005 (m, 2H), 7.392-7.359 (m, 3H), 7.942 (brs, 1H), 8.150 (s, 1H), 8.441 (s, 1H), 8.770 (s, 1H), 8.841-8.804 (m, 2H), 9.702-9.685 (d, 1H).

A solution of compound **11h** (0.2 g, 0.43 mmol) in con. HCl (4 mL) was stirred at room temperature overnight. The mixture was concentrated to dryness which gave the title compound **11** hydrochloride salt as yellow solid (140 mg, 75%). <sup>1</sup>H NMR (400 MHz, D<sub>2</sub>O) 2.373-2.294 (m, 1H), 2.531-2.509 (1, 1H), 3.265-3.157 (m, 2H), 3.597-3.497 (m, 2H), 4.898-4.818 (m, 1H), 7.446-7.412 (t, 1H), 7.928-8.847 (m, 3H), 8.122 (s, 1H), 8.300 (s, 1H), 9.349-9.332 (d, 1H).

**Example 12 (Method A): 6-Imidazo[1,2-a]pyridin-3-yl-N-[(3R,4R)-4-methylpyrrolidin-3-yl]pyrazin-2-amine**



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**Preparation of compound 12a: (3R,4R)-Tert-butyl 3-(benzyloxycarbonyl)-4-((methylsulfonyl)methyl)pyrrolidine-1-carboxylate**

To a solution of (3R,4R)-tert-butyl 3-(benzyloxycarbonyl)-4-(hydroxymethyl)pyrrolidine-1-carboxylate (1 g, 2.8 mmol) and Et<sub>3</sub>N (0.4 g, 4.2 mmol) in anhydrous CH<sub>2</sub>Cl<sub>2</sub> (20 mL) was added MsCl (0.38 g, 3.36 mmol) dropwise at 0 °C under nitrogen. After the addition, the mixture was stirred at room temperature for 3 h. The crude reaction mixture was poured into water (100 mL) and extracted with CH<sub>2</sub>Cl<sub>2</sub> (20 mL x 3). The combined organic extracts were dried over Na<sub>2</sub>SO<sub>4</sub>, filtered and concentrated under reduced pressure which gave the title compound **12a** (1.1 g, 92%) as a light yellow oil, which was directly utilized for the next reaction without further purification.

**Preparation of compound 12b: (3R,4R)-Tert-butyl 3-(benzyloxycarbonyl)-4-methylpyrrolidine-1-carboxylate**

To a solution of compound **12a** (1 g, 2.3 mmol) in DME (50 mL) was sequentially treated with NaI (3.5 g, 23 mmol) and Zn powder (1.5 g, 23 mmol) at room temperature under nitrogen. After the addition, the mixture was heated to reflux under nitrogen for 1 h and cooled to room temperature. The mixture was filtered thru Celite and the filtrate was partitioned between EtOAc (50 mL) and H<sub>2</sub>O (50 mL). The organic layer was washed with saturated aqueous Na<sub>2</sub>SO<sub>3</sub>, brine, dried over anhydrous Na<sub>2</sub>SO<sub>4</sub>, filtered and concentrated under reduced pressure which gave the title compound **12b** as a light yellow oil (0.6 g, 77.9%).



**Preparation of compound 12c: (3R,4R)-Tert-butyl 3-amino-4-methylpyrrolidine-1-carboxylate**

A Parr reaction vessel was charged with compound **12b** (0.6 g, 1.8 mmol), HOAc (0.5 g, 9 mmol), MeOH (20 mL) and 10% Pd/C (0.2 g). The reaction vessel was flushed with hydrogen (50 PSI) at room temperature for 24 h. The mixture was filtered thru Celite and the filter cake rinsed with MeOH (20 mL). The filtrate was concentrated under reduced pressure which gave the title compound **12c** as a light yellow oil (0.3 g, 83%), which was used for the next reaction without further purification.

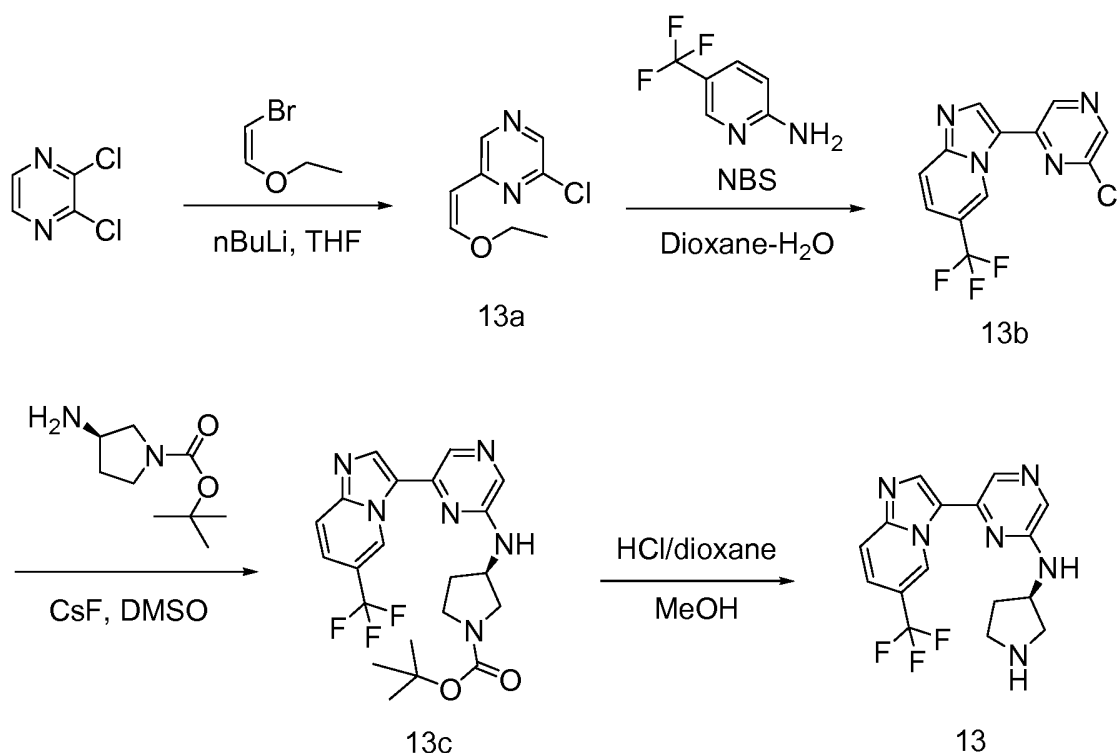
**Preparation of compound 12d: (3R,4R)-Tert-butyl 3-(6-(H-imidazo[1,2-a]pyridin-3-yl)pyrazin-2-ylamino)-4-methylpyrrolidine-1-carboxylate**

A mixture of compound **12c** (0.3 g, 1.5 mmol), compound **3a** (0.35 g, 1.5 mmol) and cesium fluoride (0.45 g, 3 mmol) in anhydrous DMSO (2 mL) was heated at 80 °C under N<sub>2</sub> overnight. The reaction mixture was cooled to room temperature and diluted with water (10 mL). The mixture was extracted with EtOAc (20 mL X 3) and the combined organic extracts were dried over Na<sub>2</sub>SO<sub>4</sub>, filtered and concentrated under reduced pressure. The crude product was purified by column chromatography on silica gel (petroleum ether-EtOAc, 2: 1) which provided the title compound **12d** as a light yellow oil (0.4 g, 67%).

To a solution of compound **12d** (0.25 g, 0.63 mmol) in CH<sub>2</sub>Cl<sub>2</sub> (20 mL) was added 5 M HCl in CH<sub>2</sub>Cl<sub>2</sub> (0.6 mL, 3.1 mmol) dropwise at 0 °C under nitrogen. After the addition, the mixture was stirred at room temperature for 1 h. The mixture was concentrated under reduced pressure and the residue was dissolved in saturated aqueous Na<sub>2</sub>CO<sub>3</sub> (5 mL) and MeOH (100 mL). The solvent was removed under reduced pressure and the resultant residue was treated with CH<sub>2</sub>Cl<sub>2</sub> (100 mL). The mixture was filtered and the filtrate was concentrated under reduced pressure. The crude product was purified by preparative supercritical fluid chromatography, which gave the title compound **12** as a yellow oil (0.15 g, 81%). <sup>1</sup>H NMR (400 MHz, DMSO) δ ppm 9.76 (d, *J* = 6.80 Hz, 1 H), 8.35 (s, 1 H), 8.31 (s, 1 H), 7.90 (s, 1 H), 7.70 (d, *J* = 8.8 Hz, 1 H), 7.38 (dd, *J* = 8.0, 7.6 Hz, 1 H), 7.32 (d, *J* = 7.2 Hz, 1H), 7.11 (dd, *J* = 6.8, 6.8 Hz, 1 H), 4.38 (m, 1 H), 3.55 - 3.27 (m, 4 H), 2.45 – 2.50 (m, 1 H), 0.91 (d, *J* = 6.8 Hz, 3 H). LCMS *m/z* 295 (M+1).

**Example 13 (Method D): N-[(3R)-pyrrolidin-3-yl]-6-[6-(trifluoromethyl)imidazo[1,2-a]pyridin-3-yl]pyrazin-2-amine**

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#### Preparation of compound 13a: 2-chloro-6-[(Z)-2-ethoxyethenyl]pyrazine

To a solution of (Z)-1-bromo-2-ethoxy-ethene (11.6 mL, 92.6 mmol, 1.1 eq) in THF (150 mL) at -78 °C was added nBuLi (37 mL, 2.5 M in hexane, 92.6 mmol, 1.1 eq).

The mixture was stirred at -78 °C for 30 min to form a colorless solution. A solution of 2,3-dichloropyrazine (12.8 g, 84 mmol, 1.0 eq) in THF (50 mL) was added slowly.

The resulting brown solution was stirred at -78 °C for 25 min to reach completion. The reaction was quenched by water and warmed to rt. The mixture was diluted with EtOAc and washed with water. The organic layer was collected and dried over

Na<sub>2</sub>SO<sub>4</sub>. The crude product was purified by flash chromatography (15-30 % EtOAc/Heptane) on silica gel which gave the title compound **13a** (8.0 g, 51%). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ ppm 1.41 (t, J=7.18 Hz, 3 H) 4.12 (q, J=7.13 Hz, 2 H) 5.44 (d, J=7.05 Hz, 1 H) 6.59 (d, J=7.05 Hz, 1 H) 8.28 (s, 1 H) 9.12 (s, 1 H).

#### Preparation of compound 13b: 3-(6-chloropyrazin-2-yl)-6-(trifluoromethyl)imidazo[1,2-a]pyridine

**13a** (328 mg, 1.92 mmol) was dissolved in dioxane-water (6 mL:3 mL) and treated with NBS (285 mg, 1.60 mmol) in one portion which gave a light yellow solution.

Solution stirred for 10 min at room temperature. 2-amino-5-(trifluoromethyl)pyridine (260 mg, 1.60 mmol) was added and the reaction mixture was heated in the microwave for 10 min at 100 °C. The crude reaction was diluted with EtOAc (35

mL) and NaHCO<sub>3</sub> (sat, aq) (20 mL). The aqueous phase was back extracted with EtOAc (25 mL). The combined extracts were washed with brine (35 mL) then dried (MgSO<sub>4</sub>) filtered and concentrated. The crude product was purified by column chromatography (EtOAc/MeOH) which gave the title compound **13b** as a beige solid (265 mg, 45%). <sup>1</sup>H NMR (300 MHz, DMSO-*d*<sub>6</sub>) δ ppm 7.76 (dd, *J*=9.4, 1.9 Hz, 1 H) 8.00 (d, *J*=9.4 Hz, 1 H) 8.67 (s, 1 H) 8.83 (s, 1 H) 9.39 (s, 1 H) 10.04 (s, 1 H).

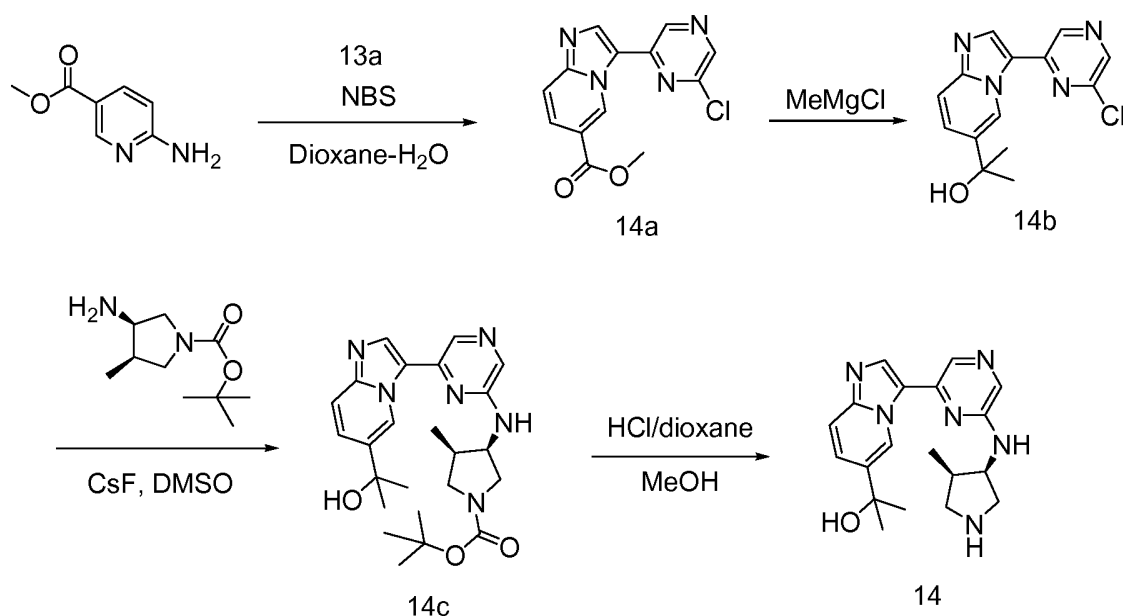
**Preparation of compound 13c: tert-butyl (3R)-3-({6-[6-(trifluoromethyl)imidazo[1,2-*a*]pyridin-3-yl]pyrazin-2-yl}amino)pyrrolidine-1-carboxylate**

To a solution of **13b** (75 mg, 0.25 mmol) and CsF (77 mg, 0.50 mmol) in DMSO (0.5 mL) was added tert-butyl (3R)-3-aminopyrrolidine-1-carboxylate (47 mg, 0.25 mmol) and the red slurry was heated in a 120 °C oil bath for 2 h. The crude reaction mixture was diluted with NaHCO<sub>3</sub> (15 mL) and EtOAc (20 mL). The layers were separated and the aqueous phase was back extracted with EtOAc (2 x 15 mL). The combined organic extracts were washed with brine (25 mL) then dried (MgSO<sub>4</sub>), filtered and concentrated. The crude product was purified by column chromatography (EtOAc/MeOH) which gave the title compound **13c** as a dark green solid (76 mg, 67%). <sup>1</sup>H NMR (300 MHz, DMSO-*d*<sub>6</sub>) δ ppm 1.39 (d, *J*=11.5 Hz, 9 H) 1.88 - 2.06 (m, 1 H) 2.09 - 2.37 (m, 1 H) 3.00 - 3.54 (m, 3 H) 3.56 - 3.81 (m, 1 H) 4.41 (br. s., 1 H) 7.56 - 7.73 (m, 2 H) 7.88 (s, 1 H) 7.92 (d, *J*=9.4 Hz, 1 H) 8.44 (s, 1 H) 8.57 (s, 1 H) 10.30 (d, *J*=11.3 Hz, 1 H).

**13c** (76 mg, 0.17 mmol) was dissolved in methanol (1.5 mL) to give a dark green solution. 4N HCl-dioxane solution (0.5 mL) was added and the solution quickly changed to a yellow-orange color. Stirring was continued at RT for 3 h and the crude reaction was concentrated and dried. The crude solid was taken up in MTBE and a small amount of MeOH and the solid collected which gave the title compound **13** as an orange solid (29 mg). <sup>1</sup>H NMR (300 MHz, DMSO-*d*<sub>6</sub>) δ ppm 2.01 - 2.17 (m, 1 H) 2.18 - 2.35 (m, 1 H) 3.24 - 3.50 (m, 4 H) 4.53 (br. s., 1 H) 7.84 (dd, *J*=9.4, 1.7 Hz, 1 H) 7.98 (s, 1 H) 8.05 (d, *J*=9.4 Hz, 1 H) 8.49 (s, 1 H) 8.74 (s, 1 H) 9.44 (br. s., 2 H) 10.22 (s, 1 H).

**Example 14 (Method A): 2-[3-(6-{{(3R,4R)-4-methylpyrrolidin-3-yl}amino}pyrazin-2-yl)imidazo[1,2-*a*]pyridin-6-yl]propan-2-ol**

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**Preparation of compound 14a: methyl 3-(6-chloropyrazin-2-yl)imidazo[1,2-a]pyridine-6-carboxylate**

14a (2.62 g, 15.4 mmol) was dissolved in dioxane-water (8 mL:4 mL) and treated with NBS (2.28 g, 12.8 mmol). The reaction mixture was stirred at room temperature for 10 min. Methyl 6-aminopyridine-3-carboxylate (1.95 g, 12.8 mmol) was added and the reaction mixture was heated in the microwave for 10 min at 100 °C. The crude reaction mixture was diluted with EtOAc and NaHCO<sub>3</sub>(sat, aq). The aqueous phase was back extracted with EtOAc. The combined extracts were washed with brine then dried (MgSO<sub>4</sub>) filtered and concentrated. The crude product was purified by column chromatography (EtOAc/MeOH) which gave the title compound **14a** as a brown solid (2.7 g, 76%). <sup>1</sup>H NMR (300 MHz, DMSO-*d*<sub>6</sub>) δ ppm 7.76 (dd, *J*=9.4, 1.9 Hz, 1 H) 8.00 (d, *J*=9.4 Hz, 1 H) 8.67 (s, 1 H) 8.83 (s, 1 H) 9.39 (s, 1 H) 10.04 (s, 1 H).

**Preparation of compound 14b: 2-[3-(6-chloropyrazin-2-yl)imidazo[1,2-a]pyridin-6-yl]propan-2-ol**

To a 0 °C heterogenous yellow solution of **14a** (528 mg, 1.83 mmol) in anhydrous THF (36 mL) was added methylmagnesium chloride (3.0M in THF, 3.04 mL, 9.14 mmol) dropwise. The rxn mixture was warmed up to rt and allowed to stir for 2.5 h. The rxn mixture was slowly quenched with NH<sub>4</sub>Cl (sat., aq.), then extracted with EtOAc (3x). Organic layer was washed with water and brine then dried over Na<sub>2</sub>SO<sub>4</sub>. The crude product was purified by column chromatography (EtOAc/MeOH) which gave the title compound **14b** as a yellow solid (224 mg, 42%). <sup>1</sup>H NMR (300 MHz,

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CHLOROFORM-*d*)  $\delta$  ppm 1.72 (s, 6 H) 7.53 - 7.61 (m, 1 H) 7.74 (d, *J*=9.42 Hz, 1 H) 8.33 (s, 1 H) 8.39 (s, 1 H) 8.96 (s, 1 H) 9.82 - 9.92 (m, 1 H).

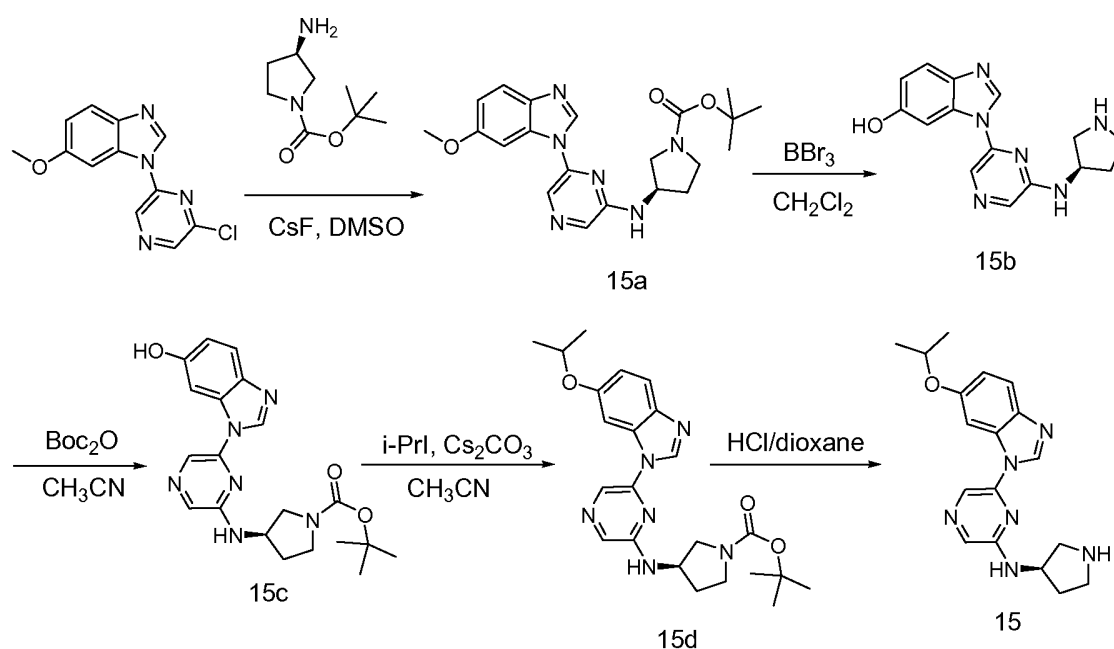
**Preparation of compound 14c: *tert*-butyl (3*R*,4*R*)-3-({6-[6-(2-hydroxypropan-2-yl)imidazo[1,2-*a*]pyridin-3-yl]pyrazin-2-yl}amino)-4-methylpyrrolidine-1-carboxylate**

To a solution of **14b** (88.6 mg, 0.307 mmol) and CsF (93.7 mg, 0.614 mmol) in DMSO (1 mL) was added *tert*-butyl (3*R*,4*R*)-3-amino-4-methylpyrrolidine-1-carboxylate (61.5 mg, 0.307 mmol) and the mixture was heated in a 120 °C oil bath for 4 h. The crude reaction mixture was diluted with NaHCO<sub>3</sub> and EtOAc. The layers were separated and the aqueous phase was back extracted with EtOAc. The combined organic extracts were washed with brine then dried (MgSO<sub>4</sub>), filtered and concentrated. The crude product was purified by column chromatography (EtOAc/MeOH) which gave the title compound **14c** as a yellow solid (76 mg, 54% yield). <sup>1</sup>H NMR (300 MHz, MeOD)  $\delta$  ppm 1.06 (d, *J*=6.78 Hz, 3 H) 1.47 (d, *J*=7.72 Hz, 9 H) 1.61 (d, *J*=3.39 Hz, 6 H) 7.50 - 7.57 (m, 1 H) 7.59 - 7.65 (m, 1 H) 7.82 (s, 1 H) 8.24 (s, 1 H) 8.27 (s, 1 H) 10.11 (br. s., 1 H).

**14c** (75 mg, 0.17 mmol) was dissolved in methanol (2 mL) to give a green solution. 4N HCl-dioxane solution (0.4 mL) was added and the solution quickly changed to a yellow-orange color. Stirring was continued at RT for 3 h and the crude reaction mixture was concentrated and dried. The crude solid was triturated with EtOAc and the solid collected which gave the title compound **14** as a yellow solid (70 mg). <sup>1</sup>H NMR (300 MHz, DMSO-*d*<sub>6</sub>)  $\delta$  ppm 1.01 (d, *J*=6.78 Hz, 3 H) 1.55 (d, *J*=4.90 Hz, 6 H) 2.58 - 3.76 (m, 5 H) 4.83 (br. s., 1 H) 7.88 - 8.17 (m, 4 H) 8.48 (br. s., 1 H) 8.97 (s, 1 H) 9.50 (br. s., 2 H) 10.20 (s, 1 H).

**Example 15 (Method A): 6-[6-(propan-2-yloxy)-1*H*-benzimidazol-1-yl]-*N*-[(3*R*)-pyrrolidin-3-yl]pyrazin-2-amine**

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**Preparation of compound 15a: *tert*-butyl (3*R*)-3-[[6-(6-methoxy-1*H*-benzimidazol-1-yl)pyrazin-2-yl]amino}pyrrolidine-1-carboxylate**

To a solution of 1-(6-chloropyrazin-2-yl)-6-methoxy-1*H*-benzimidazole (4.00 g, 15.3 mmol) and *tert*-butyl (3*R*)-3-aminopyrrolidine-1-carboxylate (4.00 g, 21.5 mmol) in DMSO (70 mL) was added CsF (8.0 g, 50 mmol). The mixture was stirred at 90 °C for 12 h. The mixture was quenched with water, diluted with EtOAc (400 mL). The separated organic layer was washed with brine, dried with Na<sub>2</sub>SO<sub>4</sub> and concentrated. The residue was purified by column chromatography (CH<sub>2</sub>Cl<sub>2</sub> / MeOH = 30:1) which gave the title compound **15a** as a yellow solid (4.0 g, 65%).

**Preparation of compound 15b: 1-{6-[(3*R*)-pyrrolidin-3-ylamino]pyrazin-2-yl}-1*H*-benzimidazol-6-ol**

BBr<sub>3</sub> (8 mL) was added to a solution of **15a** (4.0 g, 9.6 mmol) in CH<sub>2</sub>Cl<sub>2</sub> (200 mL) at 0 °C. The mixture was stirred at room temperature for 12 h. The mixture was quenched with ice-water (100 mL), basified with Na<sub>2</sub>CO<sub>3</sub> (aq.) to pH=10, filtered and separated, with **15b** residing in the water phase and used in the next step directly.

**Preparation of compound 15c: *tert*-butyl (3*R*)-3-[[6-(6-hydroxy-1*H*-benzimidazol-1-yl)pyrazin-2-yl]amino}pyrrolidine-1-carboxylate**

A solution of (Boc)<sub>2</sub>O (2.0 g, 9.6 mmol) in CH<sub>3</sub>CN (25 mL) was added to the water solution of compound. The mixture **15b** was stirred at room temperature for 12 h, then filtered and the filter cake was washed with MeOH which gave the title compound **15c** as a white solid (1.4 g, 35%). <sup>1</sup>H NMR (400 MHz, DMSO): δ ppm

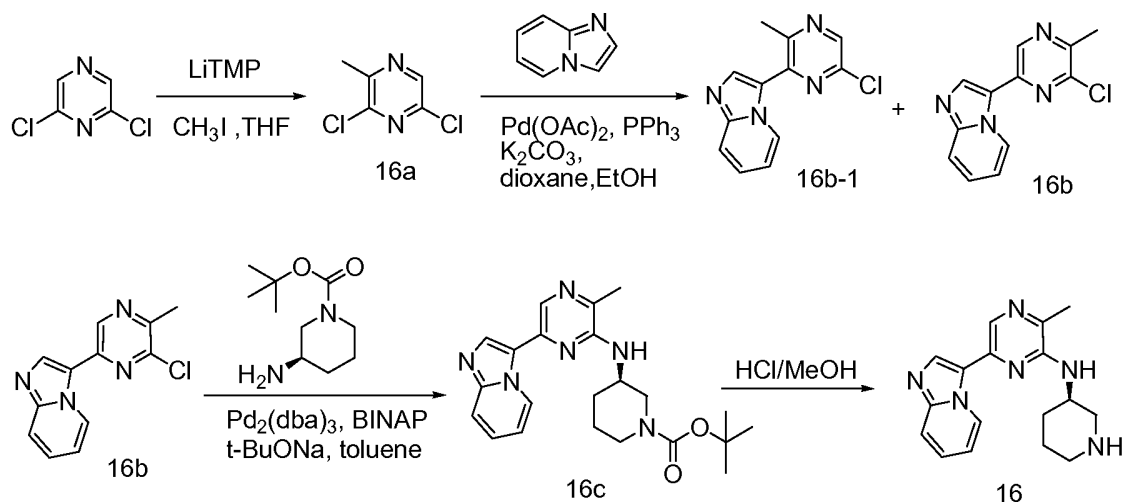
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8.716 (s, 1H), 8.224(s, 1H), 7.921 (s, 1H), 7.776 (d, 1H), 7.610 (s, 1H), 7.523(d, 1H), 6.825 (d, 1H), 4.487 (s, 1H), 3.615 (t, 1H), 2.228 (t, 1H), 1.935 (t, 1H), 1.416 (d, 9H).

**Preparation of compound 15d: *tert*-butyl (3*R*)-3-({6-[6-(propan-2-yloxy)-1*H*-benzimidazol-1-yl]pyrazin-2-yl}amino)pyrrolidine-1-carboxylate**

- 5 A mixture of **15c** (0.2 g, 0.5 mmol), *i*-PrI (111 mg, 0.650 mmol), Cs<sub>2</sub>CO<sub>3</sub> (0.493 g, 1.5 mmol) in CH<sub>3</sub>CN (10 mL) was heated at 65 °C for 12 h. The resulting mixture was cooled to room temperature and filtered, the filtrate was concentrated *in vacuo*, the residue was purified by column chromatography (methanol/dichloromethane =1:20) which gave the title compound **15d** as an oil (180 mg, 81.4%).
- 10 To a mixture of **15d** (180 mg, 0.41 mmol) in dioxane (5 mL) was added HCl(g)/dioxane (10 mL) dropwise at room temperature, the resulting mixture was stirred for 1 h. The mixture was concentrated *in vacuo*, the residue was purified by prep-HPLC which gave the title compound **15** as a light yellow solid (98 mg, 70.6%).
- 15 <sup>1</sup>H NMR (400 MHz, DMSO): δ ppm 8.38 (s, 1H), 8.08 (s, 1H), 7.91 (s, 1H), 7.59-7.61 (m, 1H), 7.32 (m, 2H), 6.88-6.90 (d, 1H), 4.77 (m, 1H), 4.44 (m, 1H), 3.35-3.51 (m, 4H), 2.24-2.32 (m, 2H), 1.27 (d, 6H).

**Example 16 (Method A): 6-(imidazo[1,2-*a*]pyridin-3-yl)-3-methyl-*N*-[(3*R*)-piperidin-3-yl]pyrazin-2-amine**



**Preparation of compound 16a: 3,5-dichloro-2-methylpyrazine**

- 20 To a solution of *n*-BuLi (78 mL, 0.195 mol) in dry THF (1.5 L) was added TMP (27.5 g, 0.195 mol) at -65 °C. After the addition, the mixture was warmed to 0 °C and stirred for 30 min at this temperature, the reaction mixture was then re-cooled to -78 °C and 2,6-dichloropyrazine (20 g, 0.13 mol) in THF (50 mL) was added into the mixture
- 25 dropwise. The mixture was stirred for 30 min at -78 °C, then CH<sub>3</sub>I (65 g, 0.68 mol)

was added and the reaction mixture was slowly warmed to rt and stirred for 3 h. The mixture was concentrated and diluted with H<sub>2</sub>O (300 mL), extracted with DCM (4x100 mL). The combined organic layer was washed with saturated NH<sub>4</sub>Cl aqueous and water, dried over Na<sub>2</sub>SO<sub>4</sub>, concentrated and the residue was purified by chromatography which gave the title compound **16a** (10 g, 47.6%).

**Preparation of compound 16b: 3-(6-chloro-5-methylpyrazin-2-yl)imidazo[1,2-a]pyridine**

A mixture of **16a** (0.5 g, 3.07 mmol), imidazo[1,2-a]pyridine (0.36 g, 3.07 mmol), K<sub>2</sub>CO<sub>3</sub> (1.48 g, 10.71 mmol), PPh<sub>3</sub> (80 mg, 0.30 mmol) and Pd(OAc)<sub>2</sub> (50 mg) in 5 mL of dioxane was heated at 120 °C under microwave irradiation for 30 min. The reaction mixture was filtered and the filtrate was concentrated *in vacuo*. The residue was purified by chromatography via silica gel (CH<sub>2</sub>Cl<sub>2</sub>: MeOH=80: 1) to give a mixture of **16b** and it's regioisomer, which were separated by prep-HPLC which gave the title compound **16b** as yellow solid (0.12 g, 10 %).

**Preparation of compound 16c: *tert*-butyl (3*R*)-3-[[6-(imidazo[1,2-a]pyridin-3-yl)-3-methylpyrazin-2-yl]amino]piperidine-1-carboxylate**

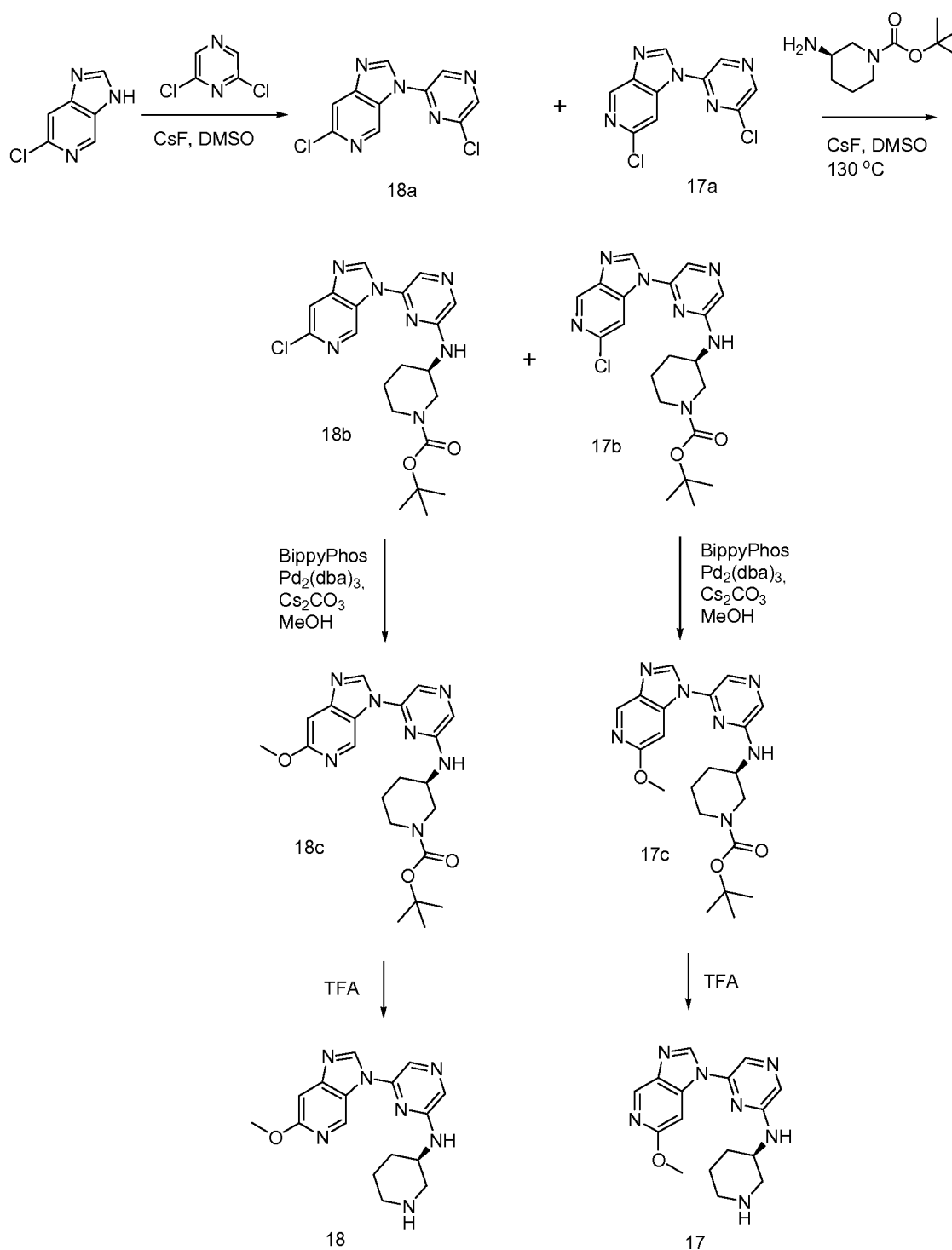
A mixture of **16b** (0.26 g, 1.06 mmol), *tert*-butyl (3*R*)-3-aminopiperidine-1-carboxylate (0.29 g, 1.59 mmol), *t*-BuONa (0.20 g, 2.12 mmol), Pd<sub>2</sub>(dba)<sub>3</sub> (100 mg), and BINAP (150 mg) in 100 mL of toluene was refluxed overnight. The solvent was removed *in vacuo* and the residue was purified by chromatography via silica gel (CH<sub>2</sub>Cl<sub>2</sub>: MeOH=50: 1) which gave the title compound **16c** as a yellow oil (0.18 g, 42 %).

**16c** (0.18 g, 0.44 mmol) in HCl(g)/MeOH (30 mL) was stirred overnight at room temperature. The solvent was removed *in vacuo* and the residue was purified by prep-HPLC which gave the title compound **16** as yellow solid (50 mg, 37 %). <sup>1</sup>H NMR (400 MHz, MeOD): δ ppm 9.476 (d, 1H), 8.104 (d, 2H), 7.582 (d, 1H), 7.354 (t, 1H), 7.023 (t, 1H), 4.280 (m, 1H), 3.408 (d, 1H), 3.162 (d, 1H), 2.886 (m, 2H), 2.336 (s, 3H), 2.147 (d, 1H), 1.926 (m, 1H), 1.688 (m, 2H).

**Example 17/ 18 (Method A): 6-(6-methoxy-3*H*-imidazo[4,5-*c*]pyridin-3-yl)-*N*-[(3*R*)-piperidin-3-yl]pyrazin-2-amine/ 6-(6-methoxy-1*H*-imidazo[4,5-*c*]pyridin-1-yl)-*N*-[(3*R*)-piperidin-3-yl]pyrazin-2-amine**



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**Preparation of compound 18a/ 17a: 6-chloro-3-(6-chloropyrazin-2-yl)-3H-imidazo[4,5-c]pyridine/ 6-chloro-1-(6-chloropyrazin-2-yl)-1H-imidazo[4,5-c]pyridine**

- 5 A mixture of 6-chloro-3H-imidazo[4,5-c]pyridine (4.6 g, 30 mmol), 2,6-dichloropyrazine (6 g, 40.5 mmol) and CsF (9.1 g, 60 mmol) in dry DMSO (80 mL) was stirred at room temperature for 20 h under N<sub>2</sub>. The mixture was poured into

water (50 mL) with stirring. The formed precipitate was collected by filtration. The filter cake was suspended in MeOH (20 mL) and filtered again. The filter cake was collected and dried in vacuum which gave a mixture of title compounds **18a & 17a** as a white solid (5.0 g, 62.9%).

5 **Preparation of compound 18b/ 17b: *tert*-butyl (3*R*)-3-[[6-(6-chloro-3*H*-imidazo[4,5-*c*]pyridin-3-yl)pyrazin-2-yl]amino}piperidine-1-carboxylate/ *tert*-butyl (3*R*)-3-[[6-(6-chloro-1*H*-imidazo[4,5-*c*]pyridin-1-yl)pyrazin-2-yl]amino}piperidine-1-carboxylate**

A mixture of **18a & 17a** (4.0 g, 15 mmol), compound *tert*-butyl (3*R*)-3-aminopiperidine-1-carboxylate (citric acid salt) (8.8 g, 22.6 mmol) and CsF (6.8 g, 45 mmol) in dry DMSO (100 mL) was heated to 130~140 °C under N<sub>2</sub> for 20 h. The cold reaction mixture was poured into ice-water (200 mL) and extracted with EtOAc (100 mL x3). The combined extracts were washed with water (100 mL x2), brine (100 mL), dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated *in vacuo*. The residue was purified by preparative HPLC which gave the title compound **18b** as a yellow solid (1.6 g, 24.5%) and **17b** as a red solid (2.15 g, 33.8%). **18b**: <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>): δ ppm 1.385 (br, 9H), 1.554 (m, 1H), 1.775 (m, 2H), 1.905 (m, 1H), 3.361 (m, 1H), 3.444 (m, 2H), 3.627 (m, 1H), 3.978 (m, 1H) 5.066 (br, 1H), 7.738 (s, 1H), 7.869 (s, 1H), 8.157 (s, 1H), 8.620 (s, 1H), 9.182 (s, 1H); **17b**: <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>): δ ppm 1.382 (br, 9H), 1.561 (m, 1H), 1.738 (m, 2H), 1.993 (m, 1H), 3.400 (br, 3H), 3.789 (m, 3H), 3.938 (m, 1H) 5.069 (br, 1H), 7.880 (s, 1H), 7.931 (s, 1H), 8.165 (s, 1H), 8.536 (s, 1H), 8.884 (s, 1H).

**Preparation of compound 18c: *tert*-butyl (3*R*)-3-[[6-(6-methoxy-3*H*-imidazo[4,5-*c*]pyridin-3-yl)pyrazin-2-yl]amino}piperidine-1-carboxylate**

25 A mixture of **18b** (180 mg, 0.42 mmol), Pd<sub>2</sub>(dba)<sub>3</sub> (15.3 mg, 0.017 mmol), Bippyphos (10.6 mg, 0.02 mmol) and Cs<sub>2</sub>CO<sub>3</sub> (136.9 mg, 0.42 mmol) in anhydrous MeOH (3 mL) was stirred at 100 °C under microwave irradiation for 1 h. The mixture was concentrated and the residue was purified by prep. HPLC which gave the title compound **18c** as a yellow solid (100 mg, 56%).

30 TFA (0.6 ml) was added dropwise to a solution of **18c** (100 mg, 0.235 mmol) in anhydrous CH<sub>2</sub>Cl<sub>2</sub> (10 ml) at 0 °C under N<sub>2</sub>. Then the solution was stirred at room temperature for 3 h. The solution was concentrated under reduced pressure. The residue was dissolved in water (50 mL) and washed with EtOAc (40 mL). The

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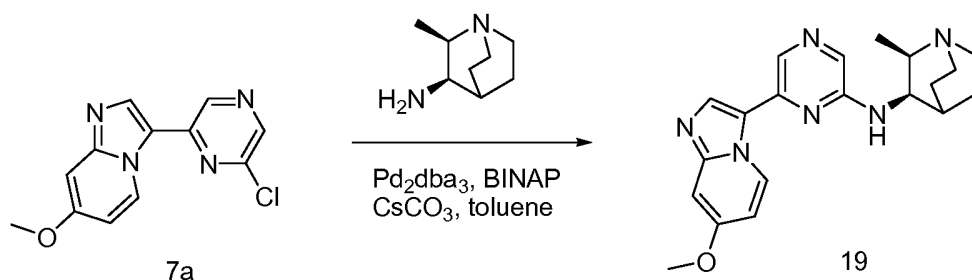
aqueous solution was basified with  $\text{Na}_2\text{CO}_3$  (aq) to pH= 8-9. The solution was then extracted with  $\text{CH}_2\text{Cl}_2$  (30 mL $\times$ 3). The combined organic layers were washed with brine (50 mL), dried over  $\text{Na}_2\text{SO}_4$  and concentrated which gave the title compound **18** as a light yellow solid (72 mg, 94.3%).  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ ):  $\delta$  ppm 1.549 (m, 1H), 1.739 (m, 2H), 1.826 (m, 1H), 2.838 (m, 2H), 3.111 (m, 1H), 3.946 (s, 3H), 4.026 (d, 1H), 5.487 (s, 1H), 7.083 (s, 1H), 7.812 (s, 1H), 8.031 (s, 1H), 8.535 (s, 1H), 8.992 (s, 1H).

**Preparation of compound 271c: *tert*-butyl (3R)-3-[[6-(6-methoxy-1H-imidazo[4,5-c]pyridin-1-yl)pyrazin-2-yl]amino]piperidine-1-carboxylate**

A mixture of **17b** (150 mg, 0.35 mmol),  $\text{Pd}_2(\text{dba})_3$  (13 mg, 0.014 mmol), Bippyphos (9 mg, 0.0175 mmol) and  $\text{Cs}_2\text{CO}_3$  (342 mg, 1.05 mmol) in anhydrous MeOH (3 mL) was heated at 100 °C under microwave irradiation for 1 h. The mixture was concentrated and the residue was purified by preparative HPLC which gave the title compound **17c** as a light yellow solid (50 mg, 33.7%).

To a stirred solution of **17c** (50 mg, 0.12 mmol) in dry  $\text{CH}_2\text{Cl}_2$  (5 mL) was added dropwise TFA (0.3 mL) at 0 °C under  $\text{N}_2$ . After addition, the mixture was stirred at the same temperature for 3 h. The reaction mixture was concentrated *in vacuo*. The residue was dissolved in water (40 mL) and extracted with EtOAc (20 mL). The aqueous phase was basified to pH=10 with  $\text{K}_2\text{CO}_3$  and extracted with  $\text{CHCl}_3/\text{MeOH}$  (ratio 1:10, 30 mL  $\times$ 3). The combined extracts were dried over  $\text{Na}_2\text{SO}_4$  and concentrated in vacuum which gave the title compound **17** as a yellow solid (25 mg, 65.8%).  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  ppm 1.536-1.495 (m, 1H), 1.703 (m, 2H), 1.796 (m, 1H), 2.786-2.706 (m, 3H), 3.101-3.066 (m, 1H), 3.935 (s, 3H), 3.950 (m, 1H), 5.486-5.471 (br, 1H), 7.229 (s, 1H), 7.798 (s, 1H), 7.972 (s, 1H), 8.376 (s, 1H), 8.634 (s, 1H).

**Example 19 (Method A): (2R,3R)-N-[6-(7-methoxyimidazo[1,2-a]pyridin-3-yl)pyrazin-2-yl]-2-methyl-1-azabicyclo[2.2.2]octan-3-amine**



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To a sealed tube was added **7a** (50 mg, 0.19 mmol), (2*R*,3*R*)-2-methyl-1-azabicyclo[2.2.2]octan-3-amine (49 mg, 0.23 mmol), Cs<sub>2</sub>CO<sub>3</sub> (313 mg, 0.96 mmol), Pd<sub>2</sub>(dba)<sub>3</sub> (11 mg, 0.012 mmol), BINAP (12 mg, 0.019 mmol) and toluene (2 mL).

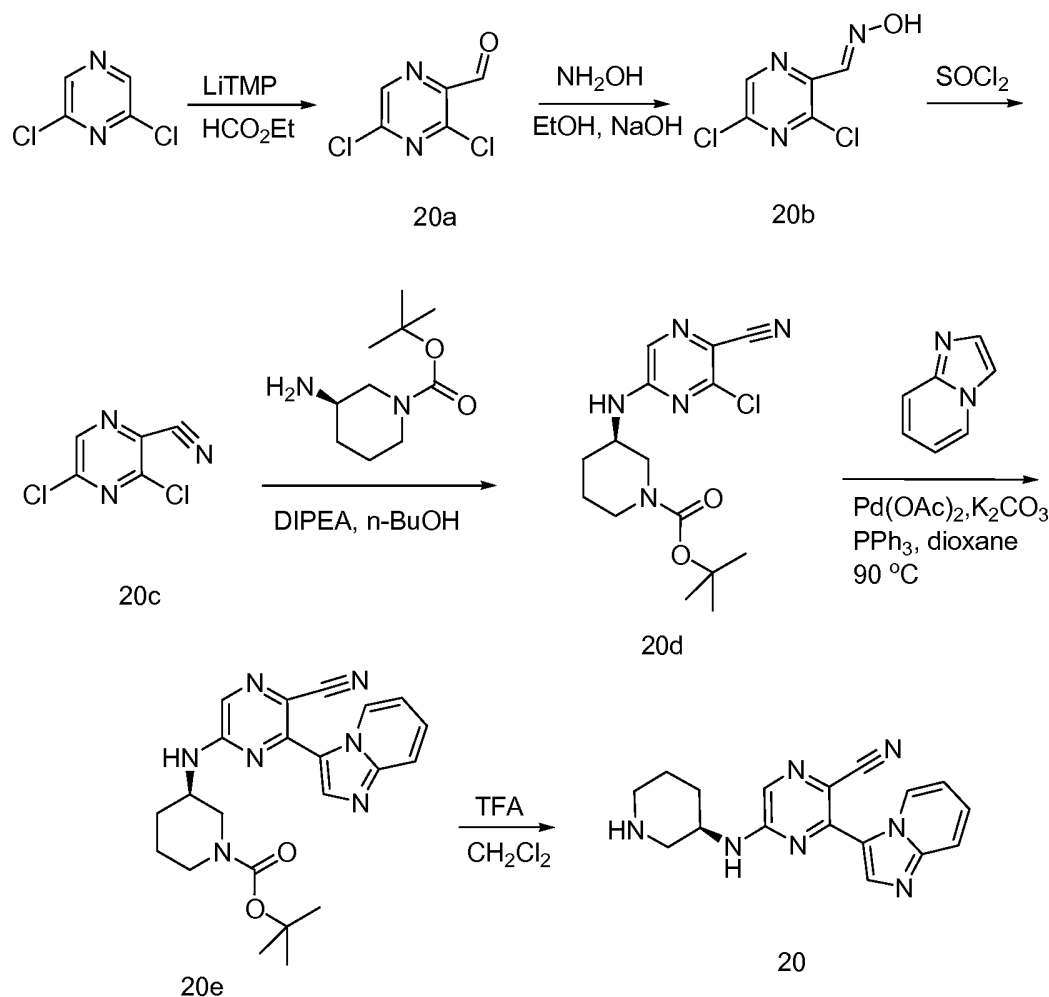
The brown slurry was placed in a 120 °C oil bath and heated for 16 h. The crude reaction

concentrated and purified by prep HPLC which gave the title compound **19** as a tan solid (12 mg, 17%). <sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 1.05 (d, J=7.07 Hz, 3 H)

1.25 - 1.35 (m, 1 H) 1.62 - 1.70 (m, 2 H) 1.79 - 1.90 (m, 2 H) 2.54 - 2.63 (m, 1 H) 2.74 - 2.86 (m, 1 H) 2.96 - 3.04 (m, 1 H) 3.20 - 3.25 (m, 1 H) 3.88 (s, 3 H) 4.07 - 4.16 (m, 1 H) 6.84 (dd, J=7.58, 2.27 Hz, 1 H) 7.10 (d, J=1.77 Hz, 1 H) 7.17 (d, J=8.08 Hz, 1 H)

7.90 (s, 1 H) 8.20 (s, 1 H) 8.24 (s, 1 H) 9.56 (d, J=7.58 Hz, 1 H).

**Example 20 (Method B): 3-(imidazo[1,2-*a*]pyridin-3-yl)-5-[(3*R*)-piperidin-3-ylamino]pyrazine-2-carbonitrile**



**Preparation of compound 20a: 3,5-dichloropyrazine-2-carbaldehyde**

To THF (100 mL) was added *n*-BuLi (4 mL, 10 mmol) at -30 °C under N<sub>2</sub>. 2,2,6,6-tetramethylpiperidine (1.26 mL, 10.2 mmol) was added dropwise. The mixture was

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stirred at room temperature for 15 min. Then a solution of 2,6-dichloropyrazine (1.3 g, 8.3 mmol) in THF (20 mL) was added dropwise at -78 °C. The mixture was stirred at -78 °C for 1.5 h. Ethyl formate (1 mL, 12 mmol) was added and the reaction mixture was stirred at -78 °C for an additional 2 h. The reaction was quenched with saturated NH<sub>4</sub>Cl (20 mL), warmed to room temperature, and diluted with ethyl acetate (150 mL). The organic layer was separated and dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated to dryness. The residue was purified by column chromatography (PE: EA from 30:1 to 5:1) which gave the title compound **20a** as an oil (0.8 g, 54%).

**Preparation of compound 20b: (E)-1-(3,5-dichloropyrazin-2-yl)-N-hydroxymethanimine**

To a solution of **20a** (4.2 g, 23.7 mmol) in EtOH (100 mL) was added NH<sub>2</sub>OH.HCl (1.88 g, 27 mmol) and aqueous NaOH (16 mL, 3 M). The resulting mixture was stirred at room temperature for 2 h. The mixture was concentrated to remove EtOH. Then the solid was collected by filtration, washed with ethyl acetate (15 mL) and dried *in vacuo* which gave the title compound **20b** as yellow solid (1.6 g, 35%).

**Preparation of compound 20c: 3,5-dichloropyrazine-2-carbonitrile**

The solution of **20b** (0.8 g, 4.1 mmol) in SOCl<sub>2</sub> (20 mL) was stirred at 80 °C for 2 h. Then the resulting mixture was stirred at room temperature for 2 h. The mixture was concentrated to dryness. The which gave the title compound **20c** as light yellow solid (0.4 g, 56%).

**Preparation of compound 20d: tert-butyl (3R)-3-[(6-chloro-5-cyanopyrazin-2-yl)amino]piperidine-1-carboxylate**

To a solution of **20c** (0.6 g, 3.46 mmol) and *tert*-butyl (3R)-3-aminopiperidine-1-carboxylate (0.41 g, 2 mmol) in *n*-BuOH (20 mL) was added DIPEA (1.2 mL, 6.9 mmol) at room temperature. The resulting mixture was stirred at 50 °C for 5 h. The mixture was concentrated to dryness. The residue was purified by column chromatography (CH<sub>2</sub>Cl<sub>2</sub>: CH<sub>3</sub>OH from 500:1 to 100:1) which gave the title compound **20d** as yellow solid (0.7 g, 60%). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ ppm 1.37 (s, 9H), 1.56 (m, 1H), 1.70 (m, 2H), 1.86 (s, 1H), 3.36 (s, 3H), 3.57 (s, 1H), 3.96 (s, 1H), 5.78 (br, 1H), 7.76 (s, 1H).

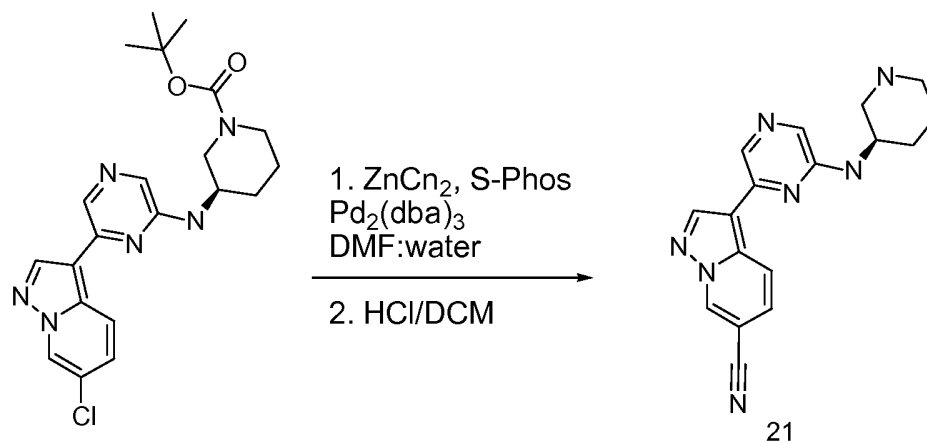
**Preparation of compound 20e: tert-butyl (3R)-3-[[5-cyano-6-(imidazo[1,2-a]pyridin-3-yl)pyrazin-2-yl]amino}piperidine-1-carboxylate**

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The mixture of **20d** (0.3 g, 0.89 mmol), imidazo[1,2-*a*]pyridine (0.115 g, 0.98 mmol), PPh<sub>3</sub> (0.024 g, 0.089 mmol), K<sub>2</sub>CO<sub>3</sub> (0.43 g, 3.1 mmol) and Pd(OAc)<sub>2</sub> (0.03 g, 0.13 mmol) in dioxane (35 mL) was stirred at 90 °C under N<sub>2</sub> overnight. The reaction mixture was filtered and the filtrate was concentrated to dryness. The residue was purified by column chromatography (CH<sub>2</sub>Cl<sub>2</sub>: CH<sub>3</sub>OH from 200:1 to 50:1) which gave the title compound **20e** as light yellow solid (0.28 g, 75%).

To a solution of **20e** (0.3 g, 0.7 mmol) in DCM (10 mL) was added TFA (2 mL) at 0 °C. The resulting mixture was stirred at room temperature for 5 h. The mixture was concentrated to dryness. The residue was purified by prep-HPLC which gave the title compound **20** as yellow solid (HCOOH salt, 0.1 g, 45%). <sup>1</sup>H NMR (400 MHz, DMSO) δ ppm 1.68-1.57 (m, 2H), 1.89 (m, 1H), 2.04 (m, 1H), 2.86 (m, 2H), 3.11 (d, 2H), 4.16 (br, 1H), 7.15 (m, 1H), 7.53 (m, 1H), 7.82 (d, 1H), 7.96 (s, 1H), 8.45 (s, 2H), 9.30 (s, 1H).

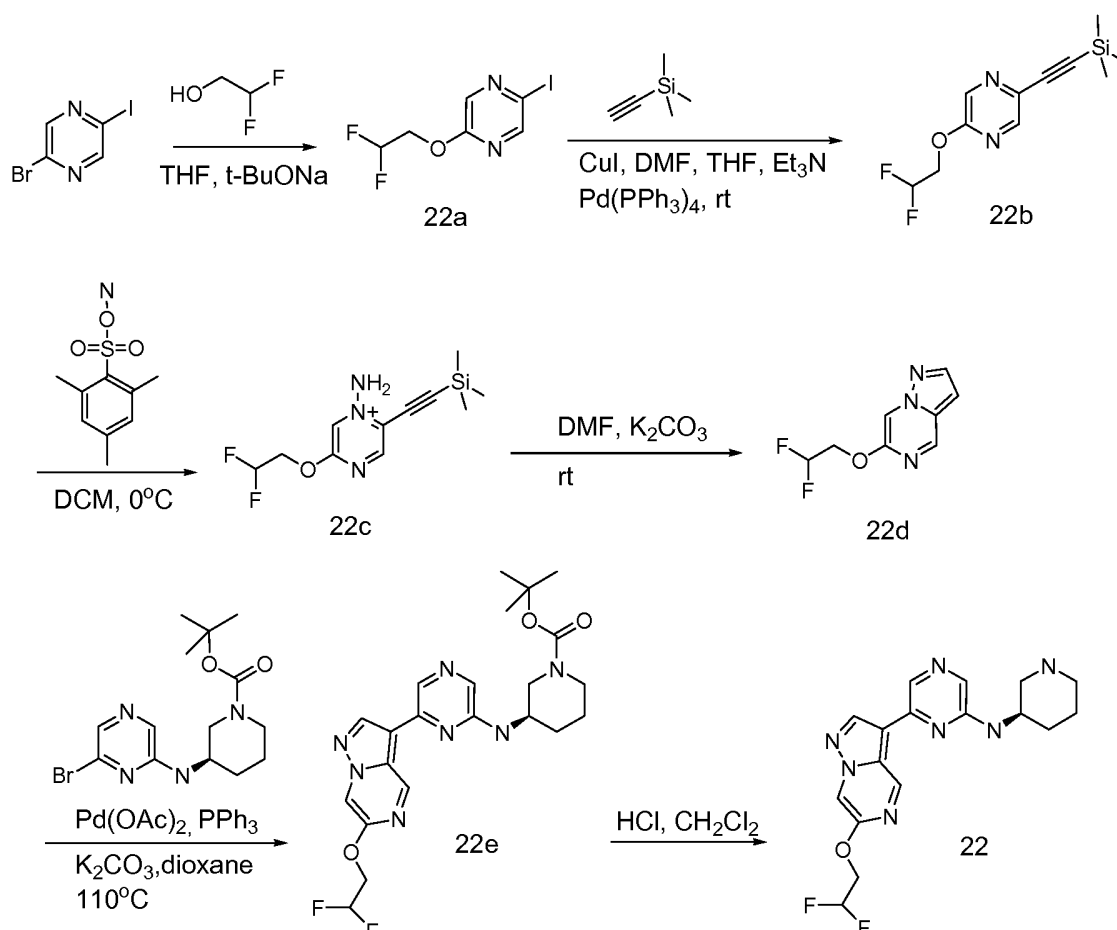
**Example 21 (Method A): 3-{6-[(3R)-piperidin-3-ylamino]pyrazin-2-yl}pyrazolo[1,5-*a*]pyridine-6-carbonitrile**



A mixture of (R)-3-[6-(6-Chloro-pyrazolo[1,5-*a*]pyridin-3-yl)-pyrazin-2-ylamino]-piperidine-1-carboxylic acid tert-butyl ester (129 mg, 0.3 mmol), zinc cyanide (40 mg, 0.342 mmol), S-Phos (11.1 mg, 0.027 mmol) and Pd<sub>2</sub>(dba)<sub>3</sub> (11 mg, 0.012 mmol) in DMF-water (1.36 mL, 99:1 DMF:water) was degassed for 5 min then back filled with nitrogen. The reaction mixture was then heated to 150 °C in a microwave reactor for 30 min. The crude reaction mixture was diluted with 2N NaOH (1 mL) and ethyl acetate (10 mL). The aqueous layer was back extracted with ethyl acetate (10 mL), then the pooled ethyl acetate phases were washed with brine and dried with sodium sulfate and concentrated *in vacuo* to an oil. The crude oil was purified by column chromatography (0-100% ethyl acetate in heptane) which gave (R)-3-[6-(6-cyano-

pyrazolo[1,5-a]pyridin-3-yl)-pyrazin-2-ylamino]-piperidine-1-carboxylic acid tert-butyl ester as a greenish oil (70 mg). (R)-3-[6-(6-cyano-pyrazolo[1,5-a]pyridin-3-yl)-pyrazin-2-ylamino]-piperidine-1-carboxylic acid tert-butyl ester (70 mg, 0.167 mmol) was dissolved in anhydrous DCM (2 ml) then 4 N HCl in dioxane (0.417 mL, 10 eq.) was added. The resulting mixture was capped and stirred at 23 °C. After 4 h the reaction mixture was concentrated which gave the title compound **21** as a light yellow solid (64 mg). <sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 1.54 - 1.68 (m, 1 H) 1.79 - 2.01 (m, 2 H) 2.01 - 2.16 (m, 1 H) 2.78 - 3.05 (m, 2 H) 3.19 - 3.30 (m, 1 H) 3.44 (none, 1 H) 4.27 (br. s., 1 H) 7.68 (d, J=8.59 Hz, 1 H) 7.84 (s, 1 H) 8.38 (s, 1 H) 8.54 (d, J=9.35 Hz, 1 H) 8.98 (s, 1 H) 9.67 (s, 1 H); LCMS M + 1 320.2.

**Example 22 (Method E): 6-[6-(2,2-difluoroethoxy)pyrazolo[1,5-a]pyrazin-3-yl]-N-[(3R)-piperidin-3-yl]pyrazin-2-amine**



**Preparation of compound 22a: 2-(2,2-difluoroethoxy)-5-iodopyrazine**

To a solution of 2,2-difluoroethanol (0.74 g, 8.7 mmol) in THF (50mL) at room temperature was added sodium butoxide (1.13 g, 11.4 mmol) and stirred for 15 min. The reaction mixture was cooled to 0 °C and a solution of 2-bromo-5-iodopyrazine

(2.5 g, 8.7 mmol) in THF (50 mL) was added slowly over 5 min. The reaction mixture was allowed to warm to room temperature and stirred for 16 h. The mixture was diluted with ethyl acetate and washed with sat.NH<sub>4</sub>Cl. The organic layer was dried over MgSO<sub>4</sub>, filtered and concentrated which gave the title compound **22a** (2.3 g, 90%).

**Preparation of compound 22b: 2-(2,2-difluoroethoxy)-5-[(trimethylsilyl)ethynyl]pyrazine**

To a solution of **22a** (2.3 g, 8.04 mmol), (trimethylsilyl)acetylene (1.4 mL, 9.65 mmol) and copper iodide (0.15 g, 0.8 mmol) in a mixture of THF (25 mL), DMF (25 mL) and triethylamine (10 mL) was added Pd(PPh<sub>3</sub>)<sub>4</sub> (0.28 g, 0.24 mmol) at room temperature. After 30 min. the reaction mixture was diluted with ethyl acetate and washed with water. The organic layer was dried over MgSO<sub>4</sub>, filtered and concentrated. The crude product was purified by flash chromatography (0-15% EtOAc/Heptane) which gave the title compound **22b** (2.2g, 98%); LCMS: M + 1 257.

**Preparation of compound 22c: 1-amino-5-(2,2-difluoroethoxy)-2-[(trimethylsilyl)ethynyl]pyrazin-1-ium**

To a solution of **22b** (2.2 g, 6.9 mmol) in dichloromethane (10 mL) at 0 °C was added 2-[(aminooxy)sulfonyl]-1,3,5-trimethylbenzene (1.77 g, 8.24 mmol). The reaction mixture was stirred at 0 °C and warmed gradually to room temperature. After 3 h, the solution was concentrated which gave the title compound **22c**. LCMS: M + 1 272.

**Preparation of 22d: 6-(2,2-difluoroethoxy)pyrazolo[1,5-a]pyrazine**

A mixture of **22c** (1.9 g, 5.6 mmol) and potassium carbonate (1.55 g, 11.2 mmol) in DMF (80 mL) was stirred at room temperature for 18 h. The reaction mixture was diluted with ethyl acetate and washed with water. The organic layer was dried over MgSO<sub>4</sub>, filtered and concentrated. The crude product was purified by flash chromatography (0-30% EtOAc/Heptane) on silica gel which gave the title compound **22d** (0.29 g, 26%) <sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 4.57 (td, J=14.91, 3.54 Hz, 2 H) .6.42 (m, 1 H) 6.98 (d, J=1.52 Hz, 1 H) 8.08 (d, J=2.27 Hz, 1 H) 8.59 (s, 1 H) 9.01 (d, J=1.01 Hz, 1 H); LCMS: M + 1 200.

**Preparation of compound 22e: tert-butyl (3R)-3-({6-[6-(2,2-difluoroethoxy)pyrazolo[1,5-a]pyrazin-3-yl]pyrazin-2-yl}amino)piperidine-1-carboxylate**

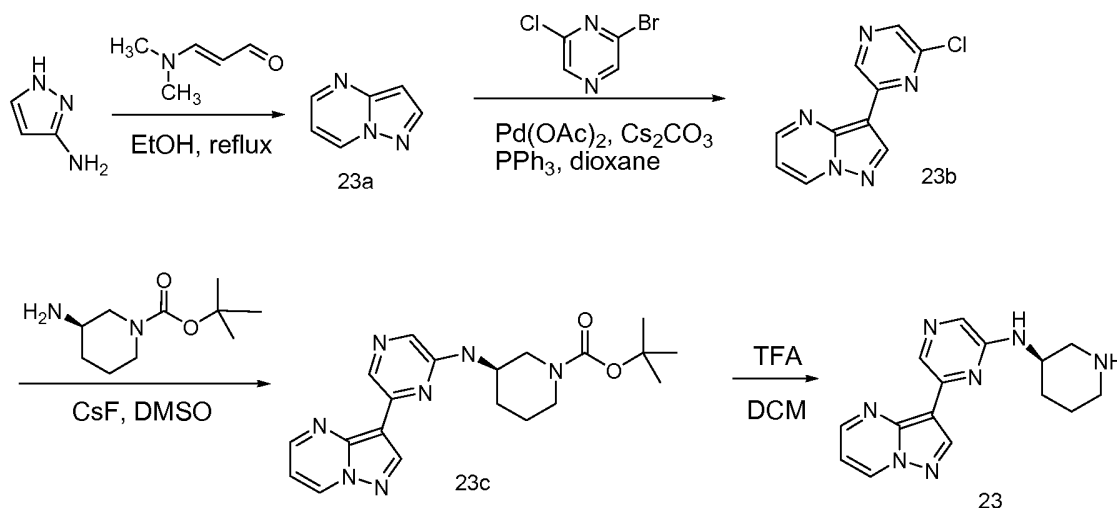


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A mixture of **22d** (135 mg, 0.68 mmol), tert-butyl (3R)-3-[(6-bromopyrazin-2-yl)amino]piperidine-1-carboxylate (243 mg, 0.68 mmol), potassium carbonate (188 mg, 1.36 mmol), triphenylphosphine (18.4 mg, 0.068 mmol) and palladium acetate (7.9 mg, 0.034 mmol) in anhydrous 1,4-dioxane (1.5 mL, 0.5M) was heated at 110 °C for 3 h. The reaction mixture was diluted with ethyl acetate and washed with water. The organic layer was dried over MgSO<sub>4</sub>, filtered and concentrated. The crude product was purified by flash chromatography (0-100% EtOAc/Heptane) on silica gel which gave the title compound **22e**. LCMS: M + 1 476.

To a solution of **22e** (50 mg) in dichloromethane (2 mL) was added 4M HCl in 1,4-dioxane (1 mL). The reaction mixture was stirred at room temperature for 5 min. Water was added and washed with ethyl acetate. The aqueous layer was concentrated and the crude product was purified by reverse phase HPLC which gave the title compound **22**. <sup>1</sup>H NMR (400 MHz, MeOD) δ ppm 1.71 (m, 1 H) 1.88 (m, 1 H) 2.10 (m, 1 H) 2.27 (m, 1 H) 2.98 (m, 2 H) 3.57 (m, 1 H) 4.33 (m, 1 H) 4.65 (td, J=13.89, 4.04 Hz, 3 H) 6.28 (m, 1 H) 7.81 (s, 1 H) 8.31 (s, 1 H) 8.42 (s, 1 H) 8.62 (s, 1 H) 9.61 (s, 1 H); LCMS M + 1 376.

**Example 23 (Method A): N-[(3R)-piperidin-3-yl]-6-pyrazolo[1,5-a]pyrimidin-3-ylpyrazin-2-amine**



**Preparation of compound 23a: pyrazolo[1,5-a]pyrimidine**

A mixture of 1H-pyrazol-3-ylamine (32 g, 0.386 mol) and (E)-3-dimethylamino-propenal (38.2 g, 0.386 mol) in EtOH (500 mL) was refluxed for 6 h. The solvent was removed *in vacuo* and the residue was purified via column chromatography (petroleum ether/EtOAc = 10:1~2:1) which gave the title compound **23a** as a white solid (30 g, 65%).

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**Preparation of compound 23b: 3-(6-Chloro-pyrazin-2-yl)-pyrazolo[1,5-a]pyrimidine**

To a stirred solution of **23a** (30 g, 0.252 mol), 2-bromo-6-chloro-pyrazine (58.5 g, 0.302 mol) and PPh<sub>3</sub> (6.6 g, 0.0252 mol) in dioxane (300 mL) was added Cs<sub>2</sub>CO<sub>3</sub> (82.1 g, 0.252 mol) and Pd(OAc)<sub>2</sub> (11.3 g, 0.0504 mol). The mixture was purged with N<sub>2</sub> x3 and stirred at reflux for 3 days. The reaction mixture was cooled to room temperature and filtered. The filtrate was concentrated, and the resulting residue was purified via preparative HPLC which gave the title compound **23b** as a yellow solid (3.01 g, 5%).

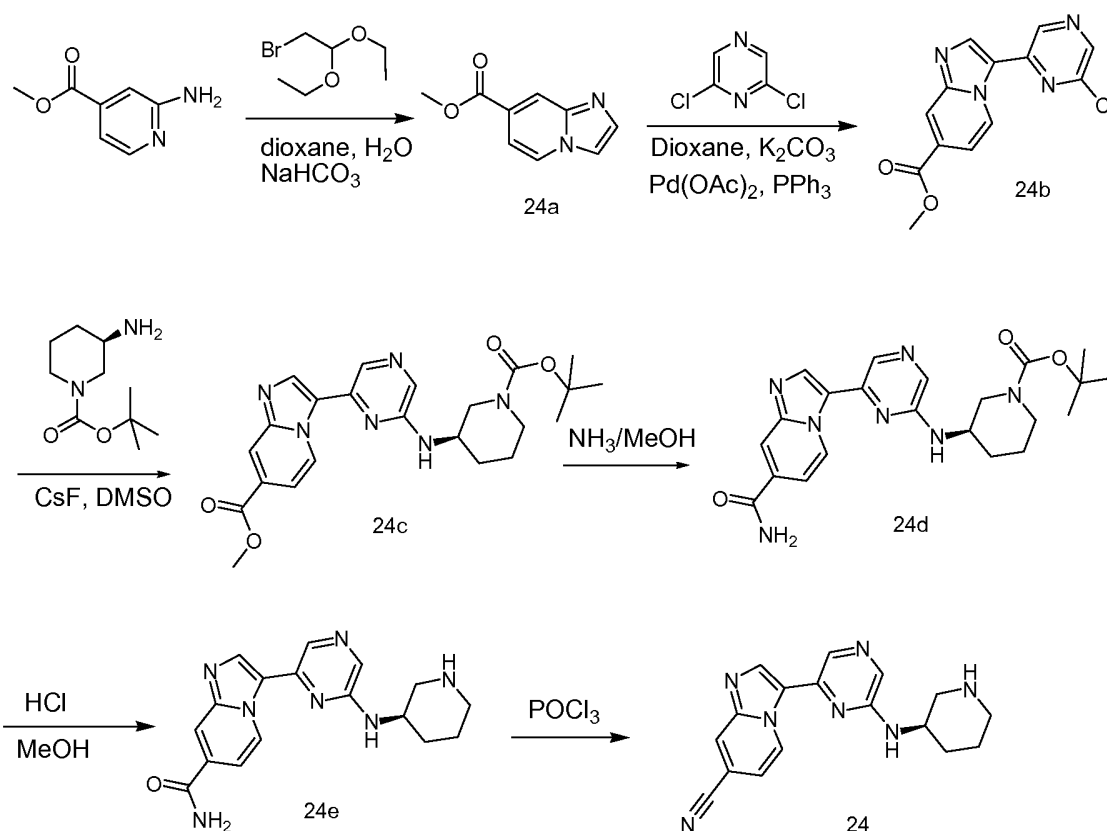
**Preparation of compound 23c: (R)-3-(6-Pyrazolo[1,5-a]pyrimidin-3-yl-pyrazin-2-ylamino)-piperidine-1-carboxylic acid tert-butyl ester**

A mixture of **23b** (300 mg, 1.3 mmol), (R)-3-amino-piperidine-1-carboxylic acid tert-butyl ester (310 mg, 1.3 mmol) and CsF (235.4 mg, 1.55 mmol) in anhydrous DMSO (10 mL) was heated at 80 °C under N<sub>2</sub> and stirred overnight. The mixture was cooled to room temperature, diluted with water (20 mL) and extracted with EtOAc (15 mL x 3). The combined organic layers were dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated. The residue was purified via column chromatography (petroleum ether/EtOAc = 3:1 ~1:1) which gave the title compound **23c** as a yellow solid (150 mg, 29%).

To a stirred solution of **23c** (150 mg, 0.379 mmol) in DCM (10 mL) was added dropwise TFA (0.3 mL) at 0 °C. The reaction mixture was stirred for 3 h at room temperature. The mixture was concentrated. The resulting residue was dissolved in water (10 mL) and extracted with Et<sub>2</sub>O (5 mL x 3). Then the aqueous layer was basified to a pH~10 by 10N Na<sub>2</sub>CO<sub>3</sub> and extracted with CHCl<sub>3</sub>/IPA (3:1) (10 mL x 3). Combined organic layers were washed with brine (10 mL), dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated. The residue was purified via preparative HPLC which gave the title compound **23** as a yellow solid (HCOOH salt, 23 mg, 21%). <sup>1</sup>H NMR (400MHz, DMSO): δ ppm 1.623-1.509 (m, 2H), 1.784-1.773 (m, 1H), 1.996-1.986 (m, 1H), 2.094-2.062 (m, 1H), 3.011-2.981 (m, 4H), 4.018 (m, 1H), 7.025-7.108 (d, 1H), 7.196-7.168 (m, 1H), 7.789 (s, 1H), 8.709 (s, 1H), 8.758-8.748 (m, 1H), 8.808 (s, 1H), 9.242-9.220 (m, 1H).

**Example 24 (Method F): 3-{6-[(3R)-piperidin-3-ylamino]pyrazin-2-yl}imidazo[1,2-a]pyridine-7-carbonitrile**

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#### Preparation of compound 24a: imidazo[1,2-a]pyridine-7-carboxylic acid methyl ester

To a solution of 2-Bromo-1,1-diethoxy-ethane (18.62 g, 0.095 mol) in H<sub>2</sub>O (80 ml) was added aq. HBr (2 ml). The resulting mixture was heated to 80 °C for 1.5 h and then was cooled to 40 °C. Then a solution of 2-Amino-isonicotinic acid methyl ester (9.61 g, 0.063 mol) and NaHCO<sub>3</sub> (6.615 g, 0.0788 mol) in CH<sub>3</sub>OH/ H<sub>2</sub>O (3:1 400 ml) was added dropwise to the above mixture. The resulting mixture was heated to 80 °C for 18 h. The mixture was concentrated and cooled to room temperature, and the solid was collected by filtration and dried *in vacuo* which gave the title compound **24a** as a yellow solid (9.5 g, 85.7%).

#### Preparation of compound 24b: 3-(6-Chloro-pyrazin-2-yl)-imidazo[1,2-a]pyridine-7-carboxylic acid methyl ester

To a solution of **24a** (2.6 g, 14.8 mmol) and 2,6-Dichloro-pyrazine (2.2 g, 14.8 mmol) in dioxane (60 mL) was added K<sub>2</sub>CO<sub>3</sub> (2.04 g, 14.8 mmol) and PPh<sub>3</sub> (0.388 g, 1.48 mmol). The mixture was degassed under N<sub>2</sub> x 3. Then Pd(OAc)<sub>2</sub> (0.26 g) was added, the resulting mixture was then degassed again and was allowed to reflux overnight. The mixture was concentrated to give crude product, which was purified by column chromatography which gave the title compound **24b** as a yellow solid (1.9 g, 44.2%).

**Preparation of compound 24c: methyl 3-(6-[(3*R*)-1-(*tert*-butoxycarbonyl)piperidin-3-yl]amino)pyrazin-2-yl)imidazo[1,2-*a*]pyridine-7-carboxylate**

To a solution of **24b** (0.814 g, 2.82 mmol) and *tert*-butyl (3*R*)-3-aminopiperidine-1-carboxylate (0.57 g, 2.82 mmol) in DMSO (10 ml) was added CsF (0.43 g, 2.82 mmol). The resulting mixture was heated to 80~100 °C overnight. H<sub>2</sub>O (50 mL) was added and the mixture was extracted with ethyl acetate (20 mL x 3). The combined organic layers were dried over Na<sub>2</sub>SO<sub>4</sub> and filtered. The filtrate was concentrated to give crude product, which was purified on Al<sub>2</sub>O<sub>3</sub> which gave the title compound **24c** as a yellow solid (0.56 g, 43.8%).

**Preparation of compound 24d: *tert*-butyl (3*R*)-3-{[6-(7-carbamoylimidazo[1,2-*a*]pyridin-3-yl)pyrazin-2-yl]amino}piperidine-1-carboxylate**

**24c** (0.56 g, 1.2 mmol) was dissolved in a saturated solution of NH<sub>3</sub> in CH<sub>3</sub>OH (60 mL), and the mixture was heated to 80~100 °C for 24 h. Then the mixture was concentrated which gave the title compound **24d**.

**Preparation of compound 24e: 3-{6-[(3*R*)-piperidin-3-ylamino]pyrazin-2-yl}imidazo[1,2-*a*]pyridine-7-carboxamide**

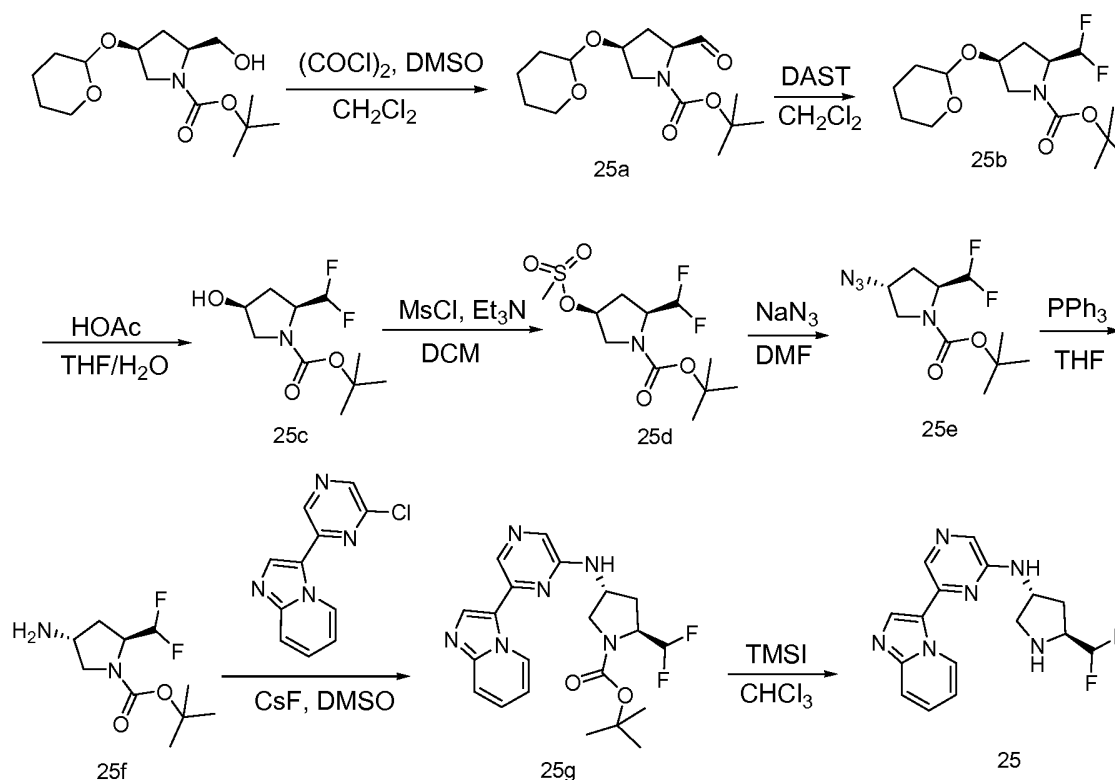
Crude **24d** (0.56 g), was dissolved in a solution of 4N HCl/CH<sub>3</sub>OH (5 ml), and the mixture was stirred at rt overnight. Then aq. Na<sub>2</sub>CO<sub>3</sub> (5 ml) was added to the mixture, the layers were separated. The aqueous layer was extracted with CH<sub>2</sub>Cl<sub>2</sub> (50 mL x 4), and the combined organic layers were dried over Na<sub>2</sub>SO<sub>4</sub> and filtered. The filtrate was concentrated to give crude product, which was purified via prep. HPLC which gave the title compound **24e** as a white solid (78 mg, 18.7% for two steps). <sup>1</sup>H NMR (400 MHz, MeOD) δ ppm 1.801-1.727 (m, 1H), 1.975-1.860 (m, 1H), 2.162-2.2.113 (m, 1H) 2.277-2.245 (m, 1H), 3.105-3.040 (m, 2H), 3.350-3.326 (m, 1H), 3.606-3.576 (d, 3H), 4.327-4.281 (m, 1H), 7.601-7.579 (m, 1H), 7.882 (s, 1H), 8.224 (s, 1H), 8.365-8.355 (d, 2H), 8.508 (s, 1H), 9.67 (d, 1H).

A suspension of **24e** (0.223 g, 0.51 mmol) in of POCl<sub>3</sub> (5 mL) was refluxed for 6 h. The mixture was cooled and concentrated to remove POCl<sub>3</sub>. The resulting mixture was adjusted to pH=8 with 1N aq. NaOH. The resulting mixture was lyophilized and purified via prep. HPLC which gave the title compound **24** (77 mg, yield 48.1%). <sup>1</sup>H NMR (400 MHz, DMSO) δ ppm 1.560-1.552 (m, 1H), 1.775-1.760 (m, 1H), 1.962-1.913 (m, 1H) 2.177-2.145 (m, 1H), 2.875-2.740 (m, 2H), 3.350-3.326 (m, 1H), 3.406-

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3.386 (m, 1H), 4.127-4.081 (m, 1H), 7.375-7.354 (m, 1H), 7.882 (s, 1H), 8.331 (s, 1H), 8.409 (d, 2H), 8.733 (s, 1H), 9.816-9.693 (d, 1H).

**Example 25 (Method A): *N*-[(3*R*,5*S*)-5-(difluoromethyl)pyrrolidin-3-yl]-6-(imidazo[1,2-*a*]pyridin-3-yl)pyrazin-2-amine**



**Preparation of compound 25a: *tert*-butyl (2*S*,4*S*)-2-formyl-4-(tetrahydro-2*H*-pyran-2-yloxy)pyrrolidine-1-carboxylate**

To a solution of oxalyl dichloride (19.0 g, 0.15 mol) in dry dichloromethane (180 mL) was added dropwise a solution of dry DMSO (22.0 g, 0.30 mol) in dry dichloromethane (60 mL) at -70 °C under nitrogen gas. After the mixture was stirred at this temperature for 30 min, a solution of *tert*-butyl (2*S*,4*S*)-2-(hydroxymethyl)-4-(tetrahydro-2*H*-pyran-2-yloxy)pyrrolidine-1-carboxylate (30.0 g, 0.1 mol) in dry dichloromethane (120 mL) was added. The mixture was stirred for at -70 °C for 1.5 h and then dry Et<sub>3</sub>N (60 mL) was added. Stirring was maintained at -70 °C for about 1.5 h. The reaction mixture was quenched with water (50 mL) at -70 °C and then allowed to warm to room temperature. The aqueous layer was extracted with dichloromethane (200 mL ×3). The combined organic layers were washed with 5% aqueous citric acid (400 mL ×3), 5% aqueous Na<sub>2</sub>CO<sub>3</sub> (400 mL ×3) and brine (400 mL ×3) in sequence, dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated *in vacuo* which gave the title compound **25a** as brown liquid (29.0 g, 97%).

**Preparation of compound 25b: *tert*-butyl (2S,4S)-2-(difluoromethyl)-4-(tetrahydro-2H-pyran-2-yloxy)pyrrolidine-1-carboxylate**

To a solution of **25a** (30.0 g, 0.099 mol) in dry dichloromethane (450 mL) was added dropwise DAST (27.69.2 mL, 0.21 mol) at -63 °C. The resulting mixture was stirred at room temperature overnight. The reaction mixture was quenched with 5% aqueous Na<sub>2</sub>CO<sub>3</sub> (500 mL) at 0 °C. The dichloromethane layer was separated. The aqueous layer was extracted with dichloromethane (150 mL×3). The combined dichloromethane layers were washed with brine (300 mL×3), dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated *in vacuo*. The crude residue was purified by column chromatography (petroleum ether/EtOAc 20:1) which gave the title compound **25b** as yellow oil (6.0 g, 19%).

**Preparation of compound 25c: *tert*-butyl (2S,4S)-2-(difluoromethyl)-4-hydroxypyrrolidine-1-carboxylate**

A solution of **25b** (3.0 g, 0.0093 mol) in HOAc/THF/H<sub>2</sub>O (1:1:1, 150 mL) was refluxed for 4 h. The reaction mixture was basified with solid NaHCO<sub>3</sub> to pH ~ 8 and then extracted with EtOAc (100 mL×3). The combined organic layers were washed with brine (100 mL×3), dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated *in vacuo*. The crude residue was purified by column chromatography (petroleum ether/EtOAc 4:1) which gave the title compound **25c** as a white solid (1.0 g, 45%).

**Preparation of compound 25d: *tert*-butyl (2S,4S)-2-(difluoromethyl)-4-[(methylsulfonyl)oxy]pyrrolidine-1-carboxylate**

To a solution of **25c** (1.5 g, 0.006 mol) and Et<sub>3</sub>N (1.6 g, 0.016 mol) in dry DCM (6 mL) was added dropwise MsCl (1.5 g, 0.015 mol) at 0 °C under N<sub>2</sub> gas. After the addition, the reaction mixture was stirred at room temperature overnight. The reaction mixture was diluted with EtOAc (50 mL), washed with 5% aqueous citric acid (50 mL×2), 5% aqueous Na<sub>2</sub>CO<sub>3</sub> (50 mL×2) and brine (50 mL×2) in sequence. Then the organic layer was dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated *in vacuo* which gave the title compound **25d** as brown oil (1.8 g, 90%).

**Preparation of compound 25e: *tert*-butyl (2S,4R)-4-azido-2-(difluoromethyl)pyrrolidine-1-carboxylate**

A solution of **25d** (1.8 g, 0.0057 mol) and NaN<sub>3</sub> (0.6 g, 0.0086 mol) in DMF (60 mL) was stirred at 70 °C under N<sub>2</sub> gas for 3 h. The reaction mixture was poured into 10% aqueous NaHCO<sub>3</sub> (200 mL). The mixture was extracted with methyl t-butyl ether (100

mL×3). The combined organic layers were washed with brine (50 mL×3), dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated *in vacuo* which gave the title compound **25e** as an orange oil (1.5 g, 95%).

**Preparation of compound 25f: *tert*-butyl (2*S*,4*R*)-4-amino-2-(difluoromethyl)pyrrolidine-1-carboxylate**

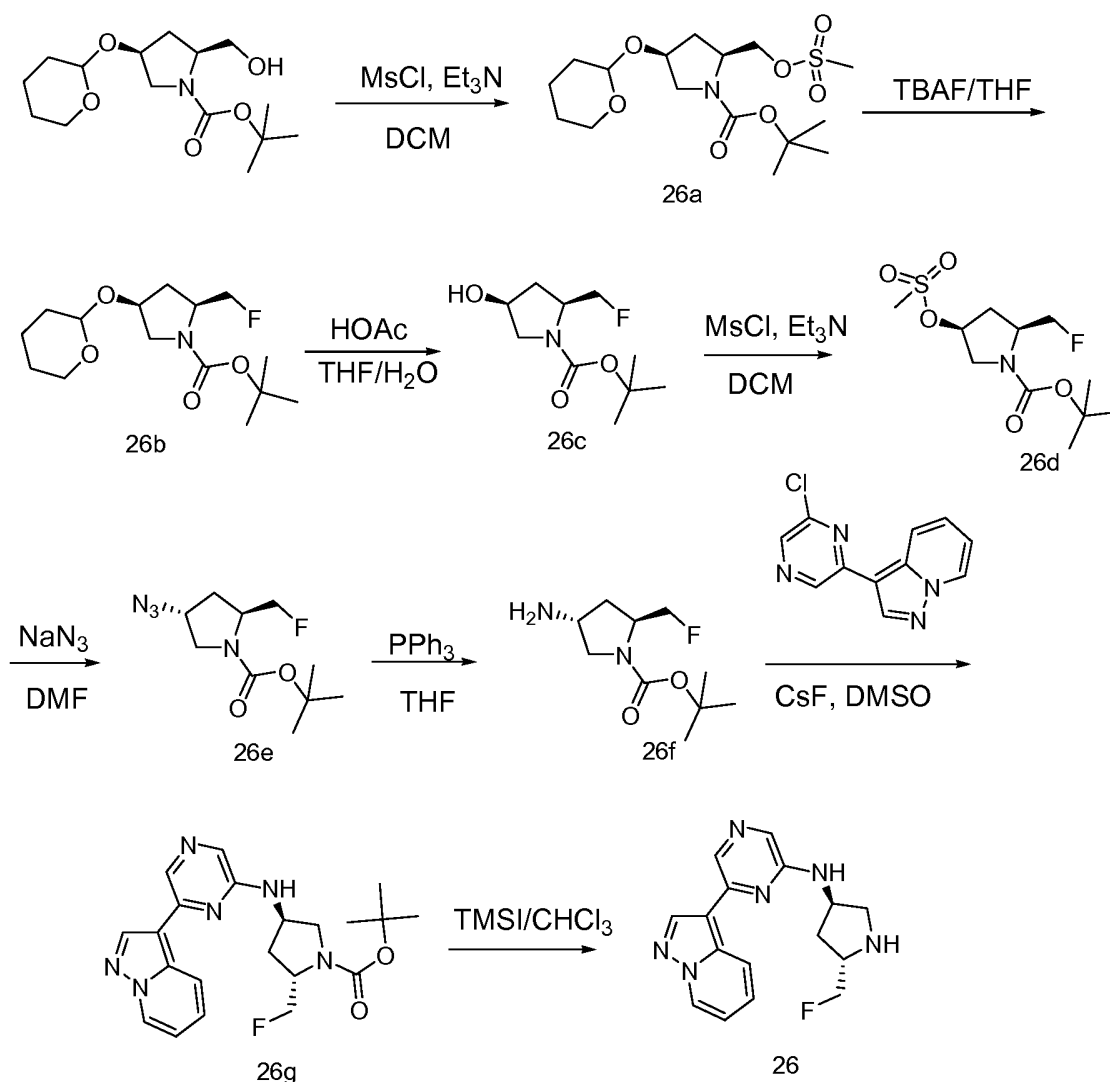
A solution of **25e** (1.5 g, 0.0057 mol) and PPh<sub>3</sub> (3.0 g, 0.0114 mol) in THF (50 mL) and water (5 mL) was stirred at room temperature for 72 h. The reaction mixture was concentrated *in vacuo* to give residue, which was dissolved in EtOAc (50 mL). The EtOAc layer was acidified with 5% aqueous citric acid to pH ~ 4. The separated aqueous layer was extracted with EtOAc (50 mL×3) and then basified with solid NaHCO<sub>3</sub> to pH ~8, The basified aqueous layer was extracted with dichloromethane (50 mL×3). The combined dichloromethane layers were dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated *in vacuo* which gave the title compound **25f** as yellow oil (1.0 g, 76%).

**Preparation of compound 25g: *tert*-butyl (2*S*,4*R*)-2-(difluoromethyl)-4-{[6-(imidazo[1,2-*a*]pyridin-3-yl)pyrazin-2-yl]amino}pyrrolidine-1-carboxylate**

A mixture of 3-(6-chloropyrazin-2-yl)imidazo[1,2-*a*]pyridine (0.15 g, 0.65 mmol), **25f** (0.2 g, 0.85 mmol) and CsF (0.13 g, 0.85 mmol) in dry DMSO (1.3 mL) was refluxed overnight. The reaction mixture was cooled to room temperature and then poured into water (50 mL). The mixture was extracted with EtOAc (20 mL×3). The combined organic layers were washed with brine (30 mL×3), dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated *in vacuo*. The residue was purified by column chromatography (petroleum ether/EtOAc 1:1) which gave the title compound **25g** as a yellow solid (0.11 g, 39%).

To a solution of **25g** (0.11 g, 0.26 mmol) in CHCl<sub>3</sub> (3.0 mL) was added dropwise TMSI (0.1 mL) at room temperature. The resulting mixture was stirred at room temperature overnight. The reaction mixture was acidified with 1 N aq. HCl to pH ~3 and diluted with water (10 mL). The separated aqueous layer was extracted with EtOAc (1:2, 30 mL×3). The aqueous layer was lyophilized to give residue, which was purified by preparative HPLC which gave the title compound **25** as a yellow syrup (16.1 mg, 19%). <sup>1</sup>H NMR (400 MHz, MeOD): δ ppm 2.10-2.01 (m, 1H), 2.31-2.23 (m, 1H), 3.10-3.02 (m, 1H), 3.23-3.21 (m, 1H), 3.79-3.62 (m, 1H), 4.58-4.50 (m, 1H), 5.96-5.644 (m, 1H), 7.12-7.07 (t, 1H), 7.50-7.45 (t, 1H), 7.69-7.67 (d, 1H), 7.77 (s, 1H), 8.28 (s, 1H), 8.29 (s, 1H), 9.87-9.85 (d, 1H).

**Example 26 (Method A): N-[(3R,5S)-5-(fluoromethyl)pyrrolidin-3-yl]-6-pyrazolo[1,5-a]pyridin-3-ylpyrazin-2-amine**



**Preparation of compound 26a: (2S,4S)-2-Methanesulfonyloxymethyl-4-(tetrahydro-pyran-2-yloxy)-pyrrolidine-1-carboxylic acid tert-butyl ester**

To a solution of (2S,4S)-2-Hydroxymethyl-4-(tetrahydro-pyran-2-yloxy)-pyrrolidine-1-carboxylic acid tert-butyl ester (20.0 g, 0.066 mol) and  $\text{Et}_3\text{N}$  (13.42 g, 0.133 mol) in dry  $\text{DCM}$  (50 mL) was added dropwise  $\text{MsCl}$  (11.4 g, 0.10 mol) at 0 °C under  $\text{N}_2$  gas. After the addition, the reaction mixture was stirred at room temperature for 1 h. The reaction mixture was diluted with dichloromethane (300 mL) and then washed with 5% aqueous citric acid (200 mL×3), 5% aqueous  $\text{Na}_2\text{CO}_3$  (200 mL×3) and brine (200 mL×3) in sequence. The organic layer was dried over  $\text{Na}_2\text{SO}_4$  and concentrated in vacuum which gave the title compound **26a** as a white solid (21.0 g, 50 %).



**Preparation of compound 26b: (2S,4S)-2-Fluoromethyl-4-(tetrahydro-pyran-2-yloxy)-pyrrolidine-1-carboxylic acid tert-butyl ester**

A solution of **26a** (21.0 g, 0.060 mol) in TBAF/THF (1.0 M, 200 mL) was refluxed for 2 h. The reaction mixture was concentrated *in vacuo*. The residue was diluted with EtOAc (300 mL). The organic layer was washed with water (100 mL×3), 5% aqueous citric acid (100 mL×3), 5% aqueous Na<sub>2</sub>CO<sub>3</sub> (100 mL×3) and brine (100 mL×3) in sequence, dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated *in vacuo*. The residue was purified by column chromatography (petroleum ether/EtOAc 10:1) which gave the title compound **26b** as yellow oil (10.0 g, 55%).

**Preparation of compound 26c: (2S,4S)-2-Fluoromethyl-4-hydroxy-pyrrolidine-1-carboxylic acid tert-butyl ester**

A solution of **26b** (10.0 g, 0.033 mol) in HOAc/THF/H<sub>2</sub>O (1:1:1, 300 mL) was refluxed for 4 h. The reaction mixture was basified with solid NaHCO<sub>3</sub> to pH ~8 and then extracted with EtOAc (100 mL×3). The combined organic layers were washed with brine (100 mL×3), dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated *in vacuo*. The residue was purified by crystallization from petroleum ether (15 mL) which gave the title compound **26c** as an off-white solid (5.0 g, 69%).

**Preparation of compound 26d: (2S,4S)-2-Fluoromethyl-4-methanesulfonyloxy-pyrrolidine-1-carboxylic acid tert-butyl ester**

To a solution of **26c** (1.33 g, 0.006 mol) and Et<sub>3</sub>N (1.5 g, 0.015 mol) in dry DCM (6 mL) was added dropwise MsCl (1.3 g, 0.012 mol) at 0 °C under N<sub>2</sub> gas. After the addition, the reaction mixture was stirred at room temperature overnight. The reaction mixture was diluted with EtOAc (50 mL), washed with 5% aqueous citric acid (50 mL×3), 5% aqueous Na<sub>2</sub>CO<sub>3</sub> (50 mL×3) and brine (50 mL×3) in sequence. Then the organic layer was dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated *in vacuo* which gave the title compound **26d** as an orange oil (1.8 g, 94 %).

**Preparation of compound 26e: (2S,4R)-4-Azido-2-fluoromethyl-pyrrolidine-1-carboxylic acid tert-butyl ester**

A solution of **26d** (1.8 g, 0.006 mol) and NaN<sub>3</sub> (0.6 g, 0.009 mol) in DMF (6 mL) was stirred at 80 °C under N<sub>2</sub> gas for 3 h. The reaction mixture was poured into 10% aqueous NaHCO<sub>3</sub> (200 mL). The mixture was extracted with methyl t-butyl ether (100 mL×3). The combined organic layers were washed with brine (50 mL×3), dried over

Na<sub>2</sub>SO<sub>4</sub> and concentrated *in vacuo* which gave the title compound **26e** as an orange oil (1.5 g, 95 %).

**Preparation of compound 26f: (2S,4R)-4-Amino-2-fluoromethyl-pyrrolidine-1-carboxylic acid tert-butyl ester**

- 5 A solution of **26e** (1.5 g, 0.006 mol) and PPh<sub>3</sub> (3.2 g, 0.012 mol) in THF (50 mL) and water (2 mL) was stirred at room temperature for 48 h. The reaction mixture was concentrated in vacuum to give a residue, which was dissolved in EtOAc (100 mL). The EtOAc layer was acidified with 10% aqueous citric acid to pH ~ 4. The aqueous layer was extracted with EtOAc (100 mL×3) and then basified with solid NaHCO<sub>3</sub> to  
10 pH ~ 8. The aqueous layer was extracted with dichloromethane (100 mL×3). The combined dichloromethane layers were dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated *in vacuo* which gave the title compound **26f** as a yellow oil (0.9 g, 67 %).

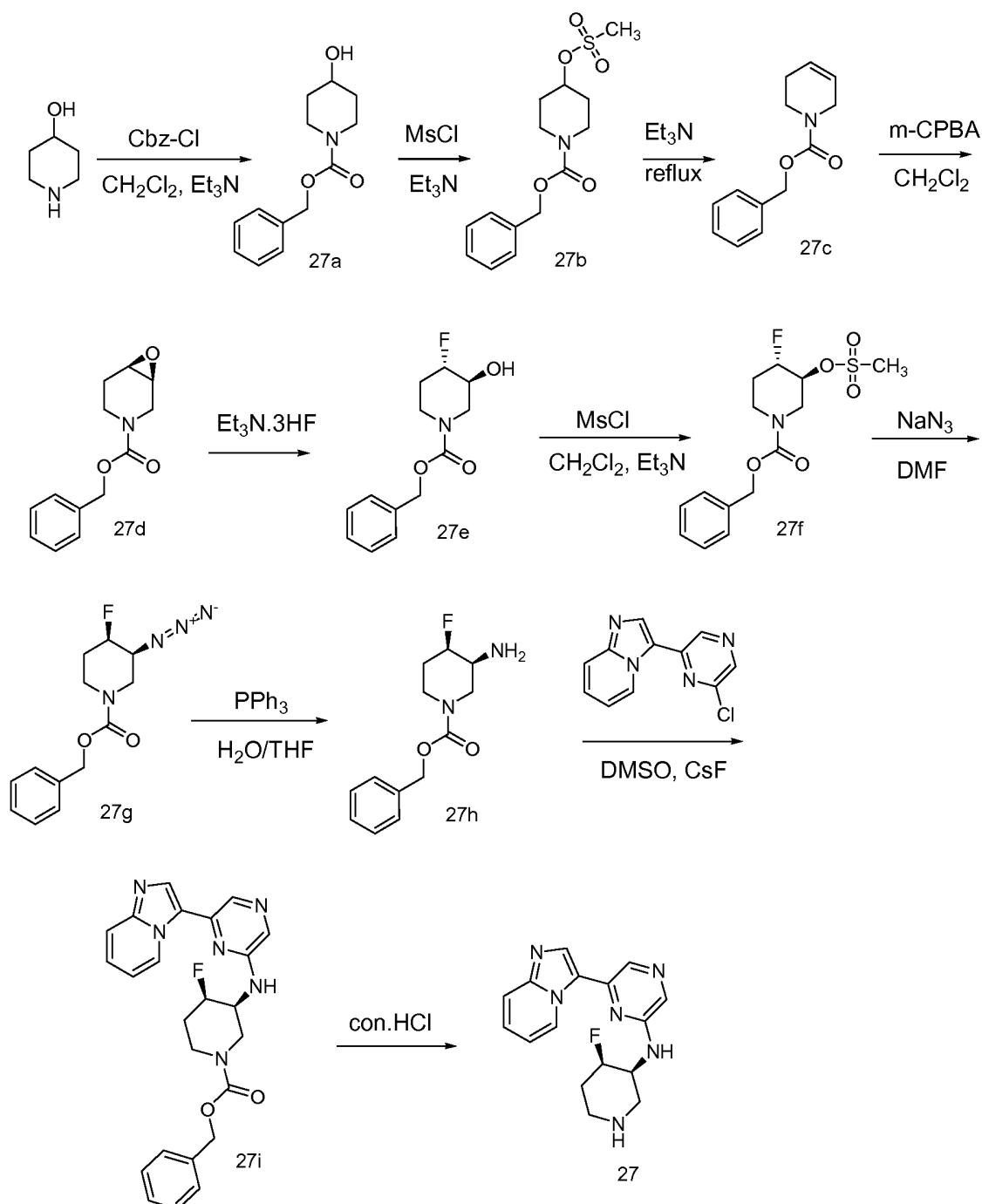
**Preparation of compound 26g: tert-butyl (2S,4R)-2-(fluoromethyl)-4-{[6-(pyrazolo[1,5-a]pyridin-3-yl)pyrazin-2-yl]amino}pyrrolidine-1-carboxylate**

- 15 A mixture of 3-(6-chloropyrazin-2-yl)pyrazolo[1,5-a]pyridine (0.15 g, 0.65 mmol), **26f** (0.21 g, 0.97 mmol) and CsF (0.15 g, 0.97 mmol) in dry DMSO (1.2 mL) was stirred at 80 °C under N<sub>2</sub> gas overnight. The reaction mixture was cooled to room temperature and then poured into water (50 mL). The mixture was extracted with EtOAc (20 mL×3). The combined organic layers were washed with brine (30 mL×3), dried over  
20 Na<sub>2</sub>SO<sub>4</sub> and concentrated *in vacuo*. The residue was purified by column chromatography (petroleum ether/EtOAc 1:1) which gave the title compound **26g** as a yellow solid (0.200 g, 77%).

- To a solution of **26g** (0.16 g, 0.39 mmol) in CHCl<sub>3</sub> (3.0 mL) was added dropwise TMSI (0.093 g, 0.46 mmol) at room temperature. The resulting mixture was stirred at  
25 room temperature overnight. The reaction mixture was concentrated to give residue, which was dissolved with water (10 mL) and acidified with 1 N HCl to pH~3. The aqueous layer was extracted with EtOAc (30 mL×3), then the aqueous layer was basified with 5% aqueous Na<sub>2</sub>CO<sub>3</sub> to pH~9 and extracted with a mixed solvent of CHCl<sub>3</sub> and IPA (3:1, 30 mL×3). The combined organic layers were washed with brine  
30 (30 mL×3), dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated which gave the title compound **26** as a brown syrup (100 mg, 83%). <sup>1</sup>H NMR (400 MHz, MeOD): δ ppm 2.12-1.98 (m, 2H), 3.06-2.98 (m, 1H), 3.41-3.35 (m, 1H), 3.80-3.62 (m, 1H), 4.60-4.41 (m, 3H), 7.03-6.98 (t, 1H), 7.42-7.37 (t, 1H), 7.66 (s, 1H), 8.16, (s, 1H), 8.60-8.52 (m, 3H).

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**Example 27 (Method A): *N*-[(3*S*,4*R*)-4-fluoropiperidin-3-yl]-6-(imidazo[1,2-*a*]pyridin-3-yl)pyrazin-2-amine**



**Preparation of compound 27a: 4-Hydroxy-piperidine-1-carboxylic acid benzyl ester**

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To a stirred solution of piperidin-4-ol (50 g, 0.495 mol) in THF (200 mL) was added 2 M aqueous NaOH (1000 mL), and then CbzCl (84.16 g, 0.495 mol) was added dropwise to the above mixture at 0 °C. The reaction mixture was stirred for 5 h, then extracted with EtOAc (300 mL × 3). The combined organic phases were washed with

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saturated citric acid (100 mL), saturated  $\text{NaHCO}_3$  (50 mL) and brine (100 mL), dried over  $\text{Na}_2\text{SO}_4$  and concentrated which gave the title compound **27a** as a colorless oil (123 g, >100%).

**Preparation of compound 27b: 4-Methanesulfonyloxy-piperidine-1-carboxylic acid benzyl ester**

To a stirred solution of **27a** (90 g, 0.38 mol) in  $\text{CH}_2\text{Cl}_2$  (1.2 L) was added  $\text{Et}_3\text{N}$  (46.4 g, 0.459 mol), then methanesulfonyl chloride (43.6 g, 0.459 mol) was added dropwise at 0 °C. The mixture was stirred at 0 °C for 2.5 h, and then the mixture was washed with water (200 mL), saturated aqueous  $\text{NH}_4\text{Cl}$  (200 mL) and brine (200 mL), dried over  $\text{Na}_2\text{SO}_4$  and concentrated which gave the title compound **27b** as a yellow oil (105 g, 87.6%).

**Preparation of compound 27c: 3,6-Dihydro-2H-pyridine-1-carboxylic acid benzyl ester**

A stirred solution of **27b** (210 g, 0.67 mol) in  $\text{Et}_3\text{N}$  (1500 mL) was refluxed for 72 h. The mixture was concentrated, the residue was dissolved with  $\text{CH}_2\text{Cl}_2$  (1000 mL), washed with 1 mol/L aq. HCl (300 mL) and brine (200 mL), dried over  $\text{Na}_2\text{SO}_4$  and concentrated. The residue was purified by column chromatography (petroleum ether/ $\text{EtOAc}$  = 200:1 to 50:1) which gave the title compound **27c** as yellow liquid (50 g, 35%).

**Preparation of compound 27d: (1S,6R)-7-Oxa-3-aza-bicyclo[4.1.0]heptane-3-carboxylic acid benzyl ester**

m-CPBA (102.8 g, 0.52 mol) was added portion wise to a solution of **27c** (100 g, 0.46 mol) in anhydrous  $\text{CH}_2\text{Cl}_2$  (1.0 L) at -15 °C. After addition, the reaction mixture was stirred at rt for 6 h. The mixture was washed with saturated aqueous  $\text{Na}_2\text{SO}_3$  (300 mL) and saturated aqueous  $\text{NaHCO}_3$  (300 mL), then concentrated *in vacuo*. The residue was purified by column chromatography (THF: petroleum ether = 1:10) which gave the title compound **27d** as off-yellow liquid (86 g, 80%).

**Preparation of compound 27e: (3S,4S)-4-Fluoro-3-hydroxy-piperidine-1-carboxylic acid benzyl ester**

A mixture of **27d** (20 g, 85.8 mmol) and  $\text{Et}_3\text{N} \cdot 3\text{HF}$  (13.8 g, 85.8 mmol) was heated to 100 °C for 3 h. 20%  $\text{BF}_3$ .ether (30 mL) was added at room temperature, then the mixture was washed with saturated aqueous  $\text{NaHCO}_3$  (20 mL) and extracted with  $\text{CH}_2\text{Cl}_2$  (50 mL x 2). The combined extracts were washed with brine (20 mL), dried

over Na<sub>2</sub>SO<sub>4</sub> and concentrated. The residue was purified by column chromatography (THF: petroleum ether = 1:10) which gave the title compound **27e** as a white oil (17 g, 79%).

**Preparation of compound 27f: (3S,4S)-4-Fluoro-3-methanesulfonyloxy-piperidine-1-carboxylic acid benzyl ester**

To a stirred solution of **27e** (1.8 g, 0.0071 mol) and triethylamine (1.45 g, 0.0142 mol) in anhydrous CH<sub>2</sub>Cl<sub>2</sub> (20 mL) was added methanesulfonyl chloride (1.22 g, 0.0107 mol) dropwise at 0 °C. After the addition, the reaction mixture was allowed to warm to room temperature over 2 h. Upon completion, the reaction mixture was washed with saturated ammonia chloride (30 mL) and brine (30 mL), dried over sodium sulfate and concentrated which gave the title compound **27f** as a yellow oil (2.1 g, 87%).

**Preparation of compound 27g: (3S,4R)-3-Azido-4-fluoro-piperidine-1-carboxylic acid benzyl ester**

A mixture of **27f** (2.1 g, 0.0063 mol) and sodium azide (1.5 g, 0.023 mol) in DMF (20 mL) was heated to 90 °C and stirred for 5 h. Upon completion, the reaction mixture was washed with 1 N aq. NaOH (300 mL × 2) and brine (200 mL), dried over sodium sulfate and concentrated *in vacuo*. The residue was purified by column chromatography (EtOAc: petroleum ether = 1:50) which gave the title compound **27g** as a colorless oil (2.5 g, >100 %).

**Preparation of compound 27h: (3S,4R)-3-Amino-4-fluoro-piperidine-1-carboxylic acid benzyl ester**

To a stirred solution of **27g** (2.5 g, 8.99 mmol) in anhydrous THF (20 mL) was added triphenyl phosphane (3.5 g, 13.5 mmol) in portions over 30 min at 0 °C. After the addition, the reaction mixture was stirred at room temperature overnight. 200 mL of concentrated ammonia was added. Then the reaction mixture was heated to reflux. Upon completion, the reaction mixture was cooled to room temperature, concentrated *in vacuo*, adjusted to pH = 1-2 with 2 N HCl and washed with EtOAc (50 mL in 6 portions). The aqueous phase was made alkaline to pH = 12-13 and extracted with CH<sub>2</sub>Cl<sub>2</sub> (50 mL × 2). The combined organic layers were washed with brine (20 mL), dried over sodium sulfate and concentrated. The residue was purified by column chromatography (CH<sub>2</sub>Cl<sub>2</sub>:MeOH = 100:1) which gave the title compound **27h** as a yellow oil (1.2 g, 35%).

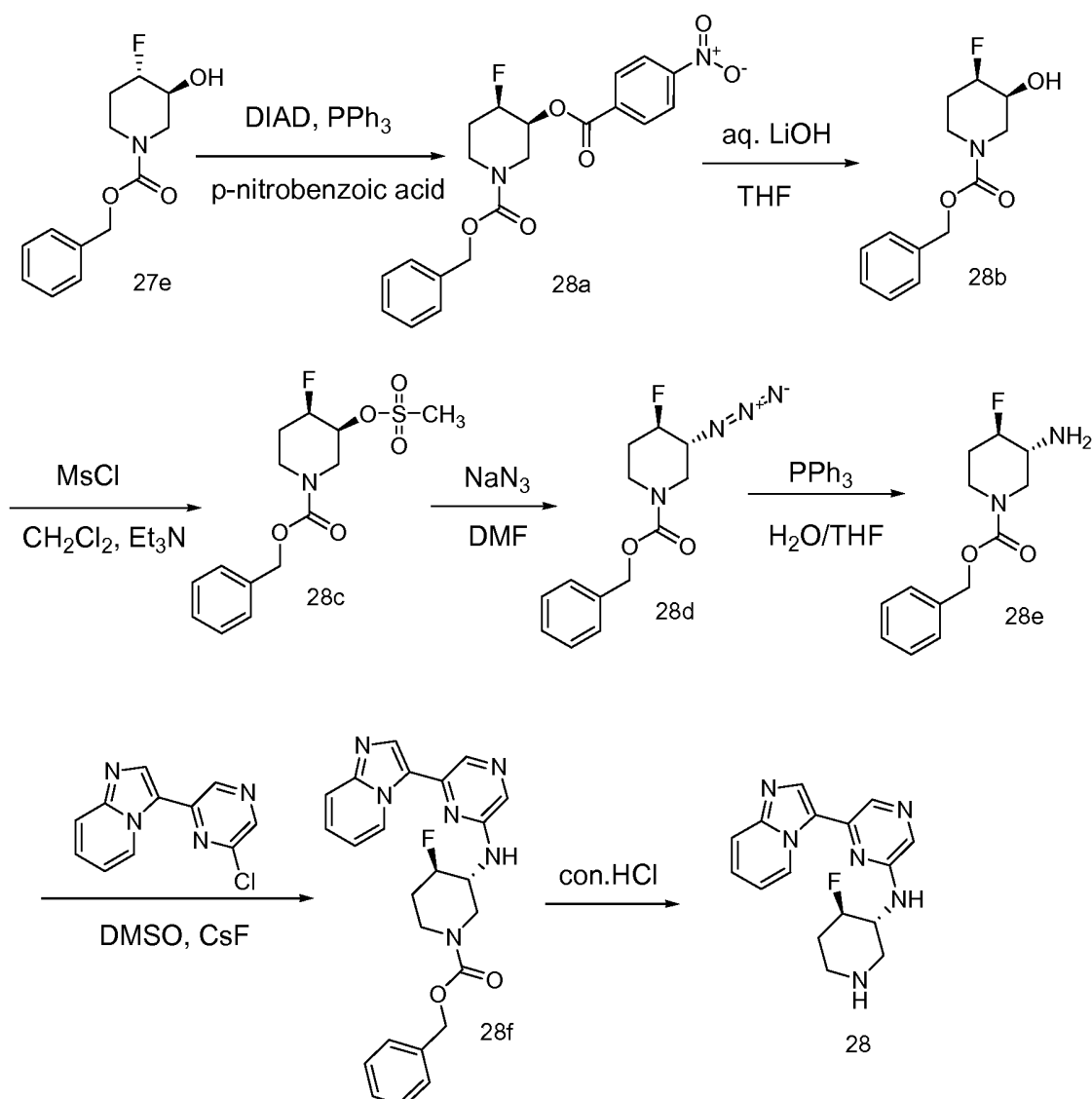
**Preparation of compound 27i: benzyl (3S,4R)-4-fluoro-3-{[6-(imidazo[1,2-a]pyridin-3-yl)pyrazin-2-yl]amino}piperidine-1-carboxylate**

A mixture of 3-(6-chloropyrazin-2-yl)imidazo[1,2-a]pyridine (115 mg, 0.49 mmol), **27h** (50 mg, 0.2117 mmol) and CsF (80 mg, 0.651 mmol) in DMSO (0.5 mL) was heated to 80 °C overnight. The reaction mixture was cooled to room temperature and then partitioned with EtOAc (50 mL) and H<sub>2</sub>O (50 mL). The combined organic layers were washed with brine (20 mL), dried over sodium sulfate and concentrated. The residue was purified by prep-HPLC which gave the title compound **27i** as a yellow solid (40 mg, 25%).

A mixture of **27i** (60 mg, 0.144 mmol) and conc. HCl (10 mL) was stirred at room temperature for 6 h. The mixture was evaporated *in vacuo*. The residue was purified via prep-HPLC which gave the title compound **27** as a brown solid (10 mg, 23%). <sup>1</sup>H NMR: MeOD δ ppm 1.503-1.462 (m, 1H), 1.936-1.859 (m, 1H), 2.326-2.295 (m, 1H), 2.984-2.894 (m, 2H), 4.260-4.136 (m, 1H), 4.480-4.387 (m, 1H), 4.596-4.486 (m, 1H), 6.973-6.956 (t, 1H), 6.993-6.976 (t, 1H), 7.383-7.341 (t, 1H), 7.584-7.562 (d, 1H), 7.708 (s, 1H), 8.131 (s, 1H), 8.156 (s, 1H), 9.726-9.709 (d, 1H).

**Example 28 (Method A): N-[(3S,4S)-4-fluoropiperidin-3-yl]-6-imidazo[1,2-a]pyridin-3-ylpyrazin-2-amine**

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**Preparation of compound 28a: (3S,4R)-4-Fluoro-3-(4-nitro-benzoyloxy)-piperidine-1-carboxylic acid benzyl ester**

To a stirred solution of triphenylphosphine (23.2 g, 0.089 mol) in THF (300 mL) was added DIAD (17.9 g, 0.089 mol) with stirring under nitrogen at 0 °C. The resulting pale yellow suspension was stirred for 40 min, then a solution of **27e** (15 g, 0.059 mol) and 4-nitrobenzoic acid (16.2 g, 0.089 mol) in THF (200 mL) was added slowly over 1.5 h. The resulting orange solution was warmed to room temperature and stirred for 48 h. The mixture was concentrated under reduced pressure, and the residual oil was purified by column chromatography (EtOAc: petroleum ether = 1:40 to 1:10) which gave the title compound **28a** as a yellow oil (30 g, 30%).

**Preparation of compound 28b: (3S,4R)-4-Fluoro-3-hydroxy-piperidine-1-carboxylic acid benzyl ester**

To a stirred solution of **28a** (30 g, 74.6 mmol) in THF (300 mL) and H<sub>2</sub>O (300 mL) was added the LiOH (12.5 g, 0.30 mol) at 0 °C. The resulting orange mixture was stirred for 1.5 h. The mixture was extracted with EtOAc (100 mL x 3). The combined organic phases were washed with brine (30 mL), dried over anhydrous Na<sub>2</sub>SO<sub>4</sub> and concentrated. The residue was purified by column chromatography (EtOAc: petroleum ether = 1:20) which gave the title compound **28b** as a yellow oil (3.2 g, 76% purity by HPLC).

**Preparation of compound 28c: (3S,4R)-4-Fluoro-3-methanesulfonyloxy-piperidine-1-carboxylic acid benzyl ester**

To a stirred solution of **28b** (4.6 g, 0.0182 mol) and triethylamine (3.7 g, 0.0364 mol) in anhydrous CH<sub>2</sub>Cl<sub>2</sub> (50 mL) was added methanesulfonyl chloride (3.11 g, 0.0281 mol) dropwise at 0 °C. After addition, the reaction mixture was allowed to warm to room temperature for 2 h. The reaction mixture was washed with saturated ammonia chloride (30 mL) and brine (30 mL), dried over sodium sulfate and concentrated which gave the title compound **28c** as a yellow oil (5.5 g, >100%).

**Preparation of compound 28d: (3R,4R)-3-Azido-4-fluoro-piperidine-1-carboxylic acid benzyl ester**

A mixture of **28c** (5.6 g, 0.166 mol) and sodium azide (2.16 g, 0.332 mol) in DMF (20 mL) was heated to 90 °C and stirred for 48 h. The reaction mixture was washed with 1 N NaOH (300 mL x 2) and brine (200 mL), dried over sodium sulfate and concentrated *in vacuo*. The residue was purified by column chromatography (EtOAc: petroleum ether = 1:50) which gave the title compound **28d** as colorless oil (2.7g, 50%).

**Preparation of compound 28e: (3R,4R)-3-Amino-4-fluoro-piperidine-1-carboxylic acid benzyl ester**

To a stirred solution of **28d** (2.7 g, 9.7 mmol) in anhydrous THF (20 mL) was added triphenyl phosphine (3.8 g, 14.57 mmol) in portions over 30 min at 0 °C. After addition, the reaction mixture was stirred at room temperature overnight. 200 mL of concentrated ammonia was added. Then the reaction mixture was heated to reflux for 7 h. The reaction mixture was cooled to room temperature and concentrated *in vacuo*, the residue was adjusted to pH = 1-2 with 2 N aq. HCl and washed with EtOAc (50 mL x 2). The aqueous phase was made alkaline to pH = 12-13 and extracted with CH<sub>2</sub>Cl<sub>2</sub> (50 mL x 2). The combined organic layers were washed with



brine (20 mL), dried over sodium sulfate and concentrated. The residue was purified by column chromatography (CH<sub>2</sub>Cl<sub>2</sub>: MeOH = 100:1) which gave the title compound **28e** as a yellow oil (1.2 g, 48%).

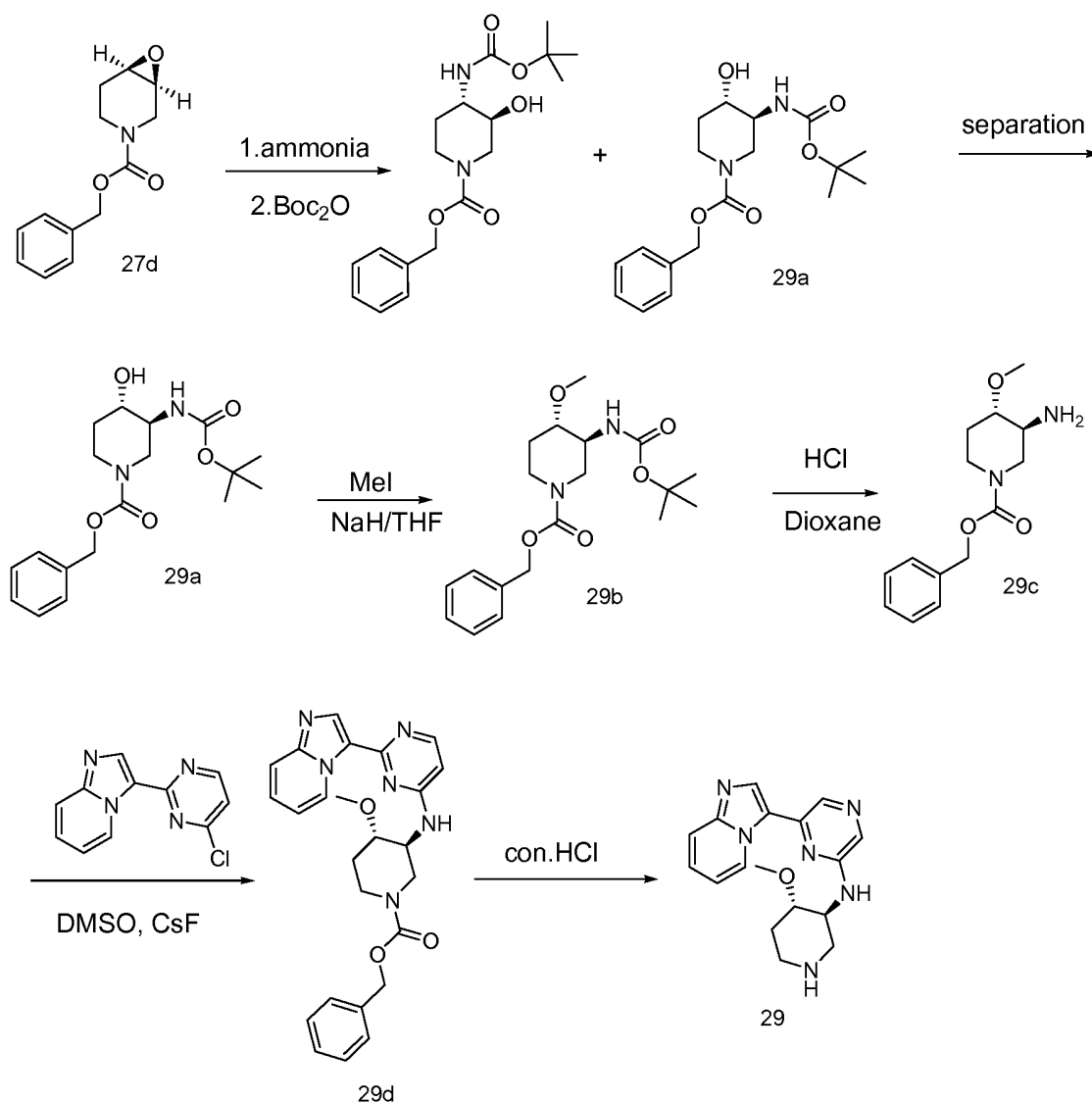
**Preparation of compound 28f: benzyl (3R,4R)-4-fluoro-3-{[6-(imidazo[1,2-a]pyridin-3-yl)pyrazin-2-yl]amino}piperidine-1-carboxylate**

A mixture of 3-(6-chloropyrazin-2-yl)imidazo[1,2-a]pyridine (20 mg, 0.0869 mmol), **28e** (44 mg, 0.175 mmol) and CsF (40 mg, 0.262 mmol) in DMSO (0.5 mL) was heated to 80 °C overnight. The reaction mixture was cooled to room temperature and then partitioned with EtOAc (50 mL) and H<sub>2</sub>O (50 mL). The organic layers were washed with brine (20 mL), dried over sodium sulfate and concentrated. The residue was purified by prep-HPLC which gave the title compound **28f** as a yellow solid (15 mg, 25%).

A mixture of **28f** (60 mg, 0.144 mmol) and conc. HCl (10 mL) was stirred at room temperature for 6 h. The mixture was evaporated *in vacuo*. The residue was purified via prep-HPLC which gave the title compound **28** as a yellow oil (18 mg, 40%). <sup>1</sup>H NMR: MeOD δ ppm 1.936-1.859 (m, 1H), 2.326-2.295 (m, 1H), 2.984-2.894 (m, 2H), 3.261-3.215 (m, 1H), 3.470-3.438 (m, 1H), 4.360-4.308 (m, 1H), 4.660-4.610 (m, 1H), 7.017-6.983 (t, 1H), 7.368-7.351 (t, 1H), 7.596-7.564 (d, 1H), 7.744 (s, 1H), 8.098 (s, 1H), 8.184 (s, 1H), 9.549-9.532 (d, 1H).

**Example 29 (Method A): 6-imidazo[1,2-a]pyridin-3-yl-N-[(3S,4S)-4-methoxypiperidin-3-yl]pyrazin-2-amine**

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**Preparation of compound 29a: benzyl (3S,4S)-3-[(tert-butoxycarbonyl)amino]-4-hydroxypiperidine-1-carboxylate**

To a stirred solution of **27d** (3 g, 12.9 mmol) in EtOH (30 mL) was added 30% ammonia (50 mL) at room temperature. After addition, the resulting mixture was stirred at room temperature for 48 h. The reaction mixture was evaporated to dryness, and the residue was diluted with  $\text{CH}_2\text{Cl}_2$  (20 mL).  $\text{(Boc)}_2\text{O}$  (1.8 g, 6 mmol) was added and the mixture was stirred at room temperature overnight. The mixture was evaporated and the residue was purified by column chromatography (petroleum ether/ EtOAc = 40:1 to 10:1) which gave (3S,4S)-4-tert-Butoxycarbonylamino-3-hydroxy-piperidine-1-carboxylic acid benzyl ester (0.2 g, 14%) and the title compound **29a** as a colorless oil (0.2 g, 14%).

**Preparation of compound 29b: (3S,4S)-3-tert-Butoxycarbonylamino-4-methoxy-piperidine-1-carboxylic acid benzyl ester**

To a 0 °C solution of **29a** (1.5 g, 4.3 mmol) in THF (50 mL) was added NaH (225 mg, 8.6 mmol) in portions. After addition, the resulting mixture was stirred at 0 °C for 0.5 h. Then CH<sub>3</sub>I (0.6 g, 8.6 mmol) was added dropwise at 0 °C. After addition, the resulting mixture was allowed to warm to room temperature and stirred for 0.5 h. The mixture was concentrated and the residue was purified by column chromatography (petroleum ether/EtOAc = 40:1 to 10:1) which gave the title compound **29b** as a brown oil (1.3 g, 83.3%).

**Preparation of compound 29c: (3S,4S)-3-Amino-4-methoxy-piperidine-1-carboxylic acid benzyl ester**

To a 0 °C solution of **29b** (100 mg, 0.275 mmol) in anhydrous CH<sub>2</sub>Cl<sub>2</sub> (10 mL) was added TFA (93.95 mg, 0.824 mmol). Then the resulting mixture was allowed to warm to room temperature and stirred overnight. The mixture was concentrated and the residue was adjusted to pH = 9 with saturated NaHCO<sub>3</sub> (aq), then extracted with EtOAc (20 mL x 3). The combined organic layers were washed with brine (50 mL), dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated which gave the title compound **29c** which was used directly to next step without further purification (60 mg, 82 %).

**Preparation of compound 29d: benzyl (3S,4S)-3-[[2-(imidazo[1,2-a]pyridin-3-yl)pyrimidin-4-yl]amino}-4-methoxypiperidine-1-carboxylate**

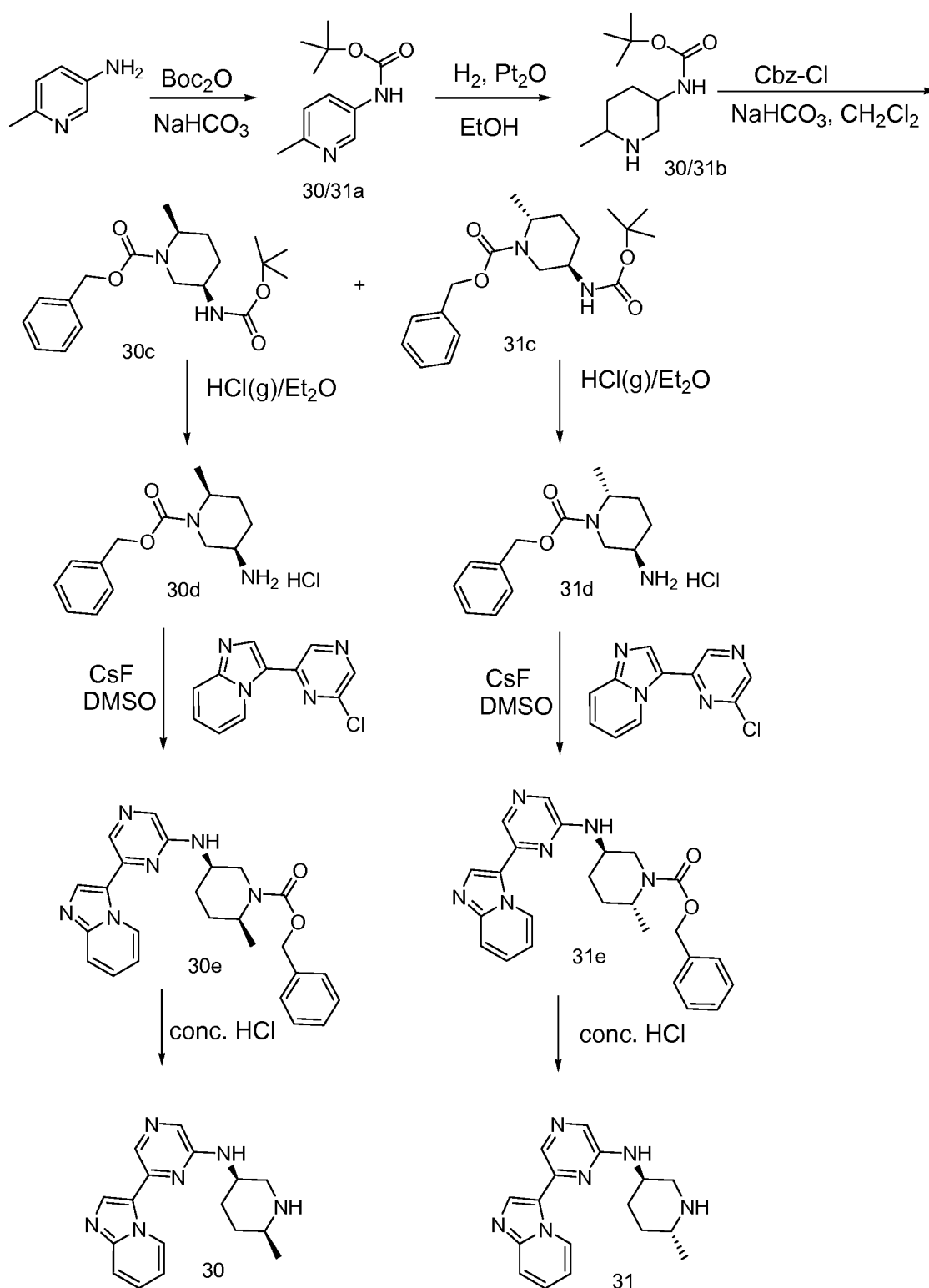
A mixture of 3-(4-chloropyrimidin-2-yl)imidazo[1,2-a]pyridine (50 mg, 0.217 mmol), **29c** (115 mg, 0.436 mmol) and CsF (99 mg, 0.651 mmol) in DMSO (0.5 mL) was heated to 80 °C overnight. The reaction mixture was cooled to room temperature and diluted with H<sub>2</sub>O (50 mL), then extracted with EtOAc (50 mL x 2). The combined organic layers were washed with brine (20 mL), dried over sodium sulfate and concentrated. The residue was purified by prep-HPLC which gave the title compound **29d** as a yellow solid (60 mg, 59 %).

A mixture of **29d** (80 mg, 0.187 mmol) in conc. HCl (10 mL) was stirred at room temperature for 6 h. The mixture was evaporated *in vacuo*. The residue was purified via prep-HPLC which gave the title compound **29** as a yellow solid (50 mg, 83 %). <sup>1</sup>H NMR: MeOD δ ppm 1.929-1.873 (m, 1H), 2.421-2.394 (m, 1H), 3.261-3.215(m, 2H), 3.470-3.438 (m, 1H), 3.481 ?s, 3H), 3.624-3.537 (m, 2H), 4.395-4.349 (m, 1H), 7.130-

7.096 (t, 1H), 7.497-7.459 (t, 1H), 7.696-7.673 (d, 1H), 7.885 (s, 1H) 8.222 (s, 1H), 8.319 (s, 1H), 9.676-9.659 (d, 1H).

**Example 30/ 31 (Method A): 6-imidazo[1,2-a]pyridin-3-yl-N-[(3R,6S)-6-methylpiperidin-3-yl]pyrazin-2-amine/ 6-imidazo[1,2-a]pyridin-3-yl-N-[(3R,6R)-6-methylpiperidin-3-yl]pyrazin-2-amine**

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**Preparation of compound 30/31a: (6-Methyl-pyridin-3-yl)-carbamic acid tert-butyl ester**

To a solution of 6-Methyl-pyridin-3-ylamine (50 g, 0.46 mol) and Et<sub>3</sub>N (80 g, 0.79 mol) in CH<sub>2</sub>Cl<sub>2</sub> (800 mL) was added Boc<sub>2</sub>O (119 g, 0.55 mol). The reaction mixture was stirred at rt overnight. The reaction mixture was extracted with CH<sub>2</sub>Cl<sub>2</sub> (250 mL × 3). The combined organic layers were washed with water (200 mL) and brine (200 mL), dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated *in vacuo*. The residue was purified by recrystallization from CH<sub>2</sub>Cl<sub>2</sub>/petroleum ether (20 mL/100 mL) which gave the title compound **30/31a** as a blue solid (40 g, 40%).

**Preparation of compound 30/31b: (6-Methyl-piperidin-3-yl)-carbamic acid tert-butyl ester**

To a mixture of **30/31a** (25 g, 0.12 mol), EtOH (200 mL) and AcOH (25 mL) was added PtO<sub>2</sub> (2.6 g, 11.5 mmol). The suspension was degassed under vacuum and purged with H<sub>2</sub> × 3. The mixture was stirred under H<sub>2</sub> (55 psi) at 50 °C for 72 h. The mixture was filtered and the filtrate was neutralized with aqueous NaHCO<sub>3</sub>. The solvent was removed and the residue was extracted with EtOAc (100 mL × 5). The combined organic layers were washed with brine (200 mL), dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated *in vacuo* which gave the title compound **30/31b** as a red oil (24 g, 95%).

**Preparation of compound 30c: benzyl (2S,5R)-5-[(tert-butoxycarbonyl)amino]-2-methylpiperidine-1-carboxylate and 31c: (2R,5R)-5-tert-Butoxycarbonylamino-2-methylpiperidine-1-carboxylic acid benzyl ester**

To a stirred solution of **30/31b** (24 g, 0.092 mol) and NaHCO<sub>3</sub> (48 g, 0.57 mol) in THF (300 mL) and H<sub>2</sub>O (1500 mL) was added Cbz-Cl (24.5 g, 0.14 mol) dropwise. The mixture was stirred at room temperature for 2 h. The solvent was removed and the residue was extracted with EtOAc (200 mL × 3). The combined organic layers were washed with brine (200 mL × 2) and concentrated *in vacuo*. The residue was purified by chiral SFC which gave the title compound **30c** as a colorless oil (10 g, 25%) and **31c** as a colorless oil (5 g, 13%).

**Preparation of compound 30d: (2S,5R)-5-Amino-2-methyl-piperidine-1-carboxylic acid benzyl ester HCl salt**

A solution of **30c** (20 g, 0.057 mol) in HCl (g)/Et<sub>2</sub>O (4 N, 100 mL) was stirred at room temperature for 2 h. The mixture was filtered which gave the title compound **30d** as a

white solid (16 g, 73%). <sup>1</sup>H NMR (400 MHz, DMSO): δ ppm 1.097-1.080 (d, 3H), 1.627-1.573 (m, 2H), 1.849-1.749 (m, 2H), 2.991-2.978 (m, 2H), 4.158-4.139 (d, 1H), 4.317-4.292 (m, 1H), 5.072 (s, 2H), 7.386-7.305 (m, 5H), 8.392 (s, 3H).

**Preparation of compound 31d: (2R,5R)-5-Amino-2-methyl-piperidine-1-carboxylic acid benzyl ester HCl salt**

A solution of **31c** (10 g, 0.029 mol) in HCl (g)/Et<sub>2</sub>O (4 N, 100 mL) was stirred at room temperature for 2 h. The mixture was filtered which gave the title compound **31d** as a white solid (7 g, 64%). <sup>1</sup>H NMR (400 MHz, DMSO): δ ppm 1.095-1.077 (d, 3H), 1.395-1.321 (m, 1H), 1.722-1.718 (m, 1H), 1.919-1.896 (m, 2H), 3.226-3.184 (d, 1H), 3.379 (s, 1H), 3.994-3.957 (d, 1H), 4.315 (s, 1H), 5.072 (s, 2H), 7.381-7.309 (m, 5H), 8.208 (s, 3H).

**Preparation of compound 30e: benzyl (2S,5R)-5-[[6-(imidazo[1,2-a]pyridin-3-yl)pyrazin-2-yl]amino}-2-methylpiperidine-1-carboxylate**

A mixture of 3-(6-chloropyrazin-2-yl)imidazo[1,2-a]pyridine (0.1 g, 0.43 mmol), **30d** (0.108 g, 0.43 mmol) and CsF (0.13 g, 0.86 mmol) in anhydrous DMSO (2 mL) was heated at 80 °C under N<sub>2</sub> and stirred overnight. The mixture was cooled to room temperature and water (10 mL) was added. The mixture was extracted with EtOAc (20 mL x 3). The combined organic extracts were dried over Na<sub>2</sub>SO<sub>4</sub>, filtered and concentrated which gave the title compound **30e** as a yellow solid (0.14 g, 73%).

A mixture of **30e** (0.2 g, 0.45 mmol) in concentrated HCl (20 mL) was stirred at room temperature for 4 h. The reaction mixture was diluted with water (60 mL), extracted with EtOAc (30 mL x 2). The separated aqueous layer was neutralized with saturated Na<sub>2</sub>CO<sub>3</sub> to pH~7 and concentrated to give a residue. The residue was suspended in THF (80 mL) and refluxed for 30 min, then filtered. This process was repeated x3.

The filtrates were combined and concentrated to give a residue, which was purified by preparative HPLC which gave the title compound **30** as a yellow solid (formate salt, 47 mg, 33%). <sup>1</sup>H NMR (400 MHz, DMSO): δ ppm 1.175-1.154 (d, 3H), 1.655-1.636 (m, 1H), 1.966-1.839 (m, 2H), 2.984-2.912 (m, 2H), 3.455-3.173 (m, 1H), 4.448-4.148 (d, 1H), 7.114-7.070 (t, 1H), 7.493-7.397 (m, 2H), 7.736-7.706 (d, 1H), 7.926 (s, 1H), 8.311 (s, 1H), 8.378-8.363 (d, 1H), 9.695-9.651 (d, 1H).

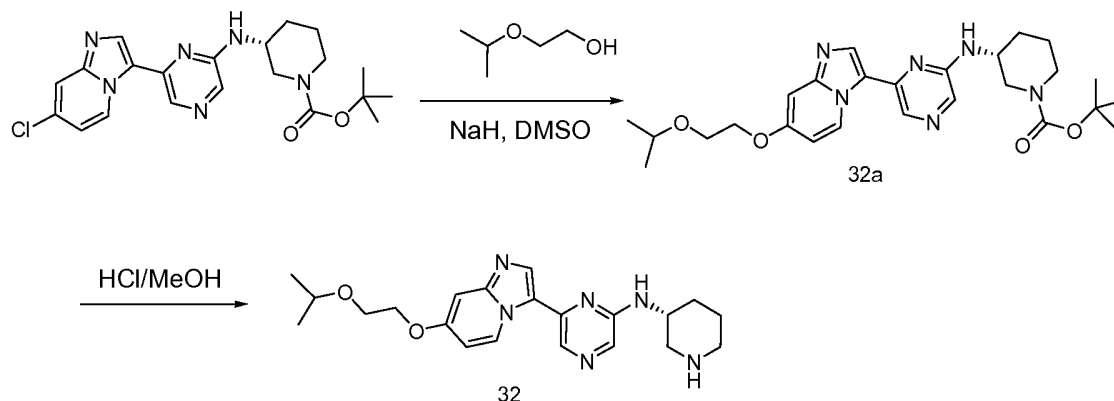
**Preparation of compound 31e: benzyl (2R,5R)-5-[[6-(imidazo[1,2-a]pyridin-3-yl)pyrazin-2-yl]amino}-2-methylpiperidine-1-carboxylate**

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A mixture of 3-(6-chloropyrazin-2-yl)imidazo[1,2-*a*]pyridine (0.1 g, 0.43 mmol), **31d** (0.108 g, 0.43 mmol) and CsF (0.13 g, 0.86 mmol) in anhydrous DMSO (2 mL) was heated at 80 °C under N<sub>2</sub> and stirred overnight. The mixture was cooled to room temperature and water (10 mL) was added. The mixture was extracted with EtOAc (20 mL x 3). The combined organic extracts were dried over Na<sub>2</sub>SO<sub>4</sub>, filtered and concentrated which gave the title compound **31e** as light yellow oil (0.17g, 89%).

A mixture of **31e** (0.2 g, 0.45 mmol) in concentrated HCl (20 mL) was stirred at room temperature for 4 h. The reaction mixture was diluted with water (60 mL), extracted with EtOAc (30 mL x 2). The separated aqueous layer was neutralized with saturated Na<sub>2</sub>CO<sub>3</sub> to pH~7 and concentrated to give a residue. The residue was suspended in THF (80 mL) and refluxed for 30 min, then filtered. This process was repeated x3. The filtrates were combined and concentrated to give a residue, which was purified by preparative HPLC which gave the title compound **31** as a yellow solid (formate salt, 58 mg, 41%). <sup>1</sup>H NMR (400 MHz, DMSO): δ ppm 1.162-1.141 (d, 3H), 1.537-1.393 (m, 2H), 1.834-1.804 (m, 1H), 2.277-2.116 (m, 1H), 2.584-2.512 (d, 1H), 2.738-2.623 (m, 2H), 3.925-3.887 (d, 1H), 7.138-7.005 (t, 1H), 7.237-7.215 (d, 1H), 7.445-7.391 (t, 1H), 7.743-7.713 (d, 1H), 7.797 (s, 1H), 8.260 (s, 1H), 8.380-8.353 (d, 1H), 9.721-9.699 (d, 1H).

**Example 32 (Method A): 6-(7-(2-isopropoxyethoxy)H-imidazo[1,2-*a*]pyridin-3-yl)-N-((R)-piperidin-3-yl)pyrazin-2-amine**



**Preparation of compound 32a: (3R)-tert-butyl 3-(6-(7-(2-isopropoxyethoxy)H-imidazo[1,2-*a*]pyridin-3-yl)pyrazin-2-ylamino)piperidine-1-carboxylate**

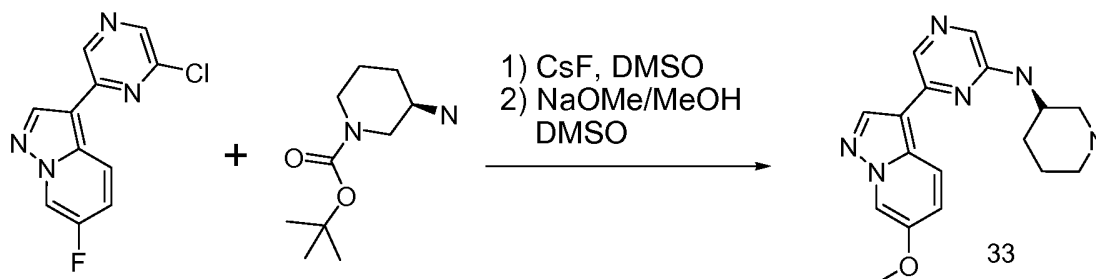
To a solution of 2-isopropoxyethanol (195 mg, 1.87 mmol) in DMSO (50 ml) was added NaH (75 mg, 1.87 mmol) at room temperature. The resulting mixture was stirred at room temperature for 1 h. Then (3R)-tert-butyl 3-(6-(7-chloroH-imidazo[1,2-*a*]pyridin-3-yl)pyrazin-2-ylamino)piperidine-1-carboxylate (400 mg, 0.935 mmol) was

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added. The resulting mixture was heated to 80 °C for 24 h. The mixture was then cooled and 50 mL of H<sub>2</sub>O was added. The resulting mixture was extracted with EtOAc (50 mL x 4). The combined organic layers were washed with water (50 mL), followed by brine (50 ml), dried over Na<sub>2</sub>SO<sub>4</sub> and filtered. The filtrate was concentrated which gave the title compound **32a** which was used directly for the next stage without further purification (400 mg).

To a solution of **32a** (420 mg, 0.84 mmol) in MeOH (50 mL) was added 4N HCl in MeOH (10 mL). The resulting mixture was stirred at room temperature overnight. The mixture was concentrated and the residue was purified via prep. HPLC which gave the title compound **32** as a white solid (39.5 mg, 10.7% for two steps). <sup>1</sup>H NMR (400 MHz, DMSO): δ ppm 1.107-1.122 (d, 6H), 1.428-1.509 (m, 2H), 1.663-1.684 (m, 1H), 1.987-2.010 (m, 1H), 2.404-2.492 (m, 1H), 2.813-2.844 (d, 1H), 3.130-3.160 (d, 2H), 3.610-3.671 (m, 1H), 3.721-3.743 (t, 3H), 4.173-4.195 (t, 2H), 6.799-6.825 (d, 1H), 7.061-7.095 (m, 2H), 7.738 (s, 1H), 8.200-8.242 (d, 2H), 9.597-9.617 (d, 1H).

**Example 33 (Method A): 6-(6-methoxypyrazolo[1,5-a]pyridin-3-yl)-N-[(3R)-piperidin-3-yl]pyrazin-2-amine**



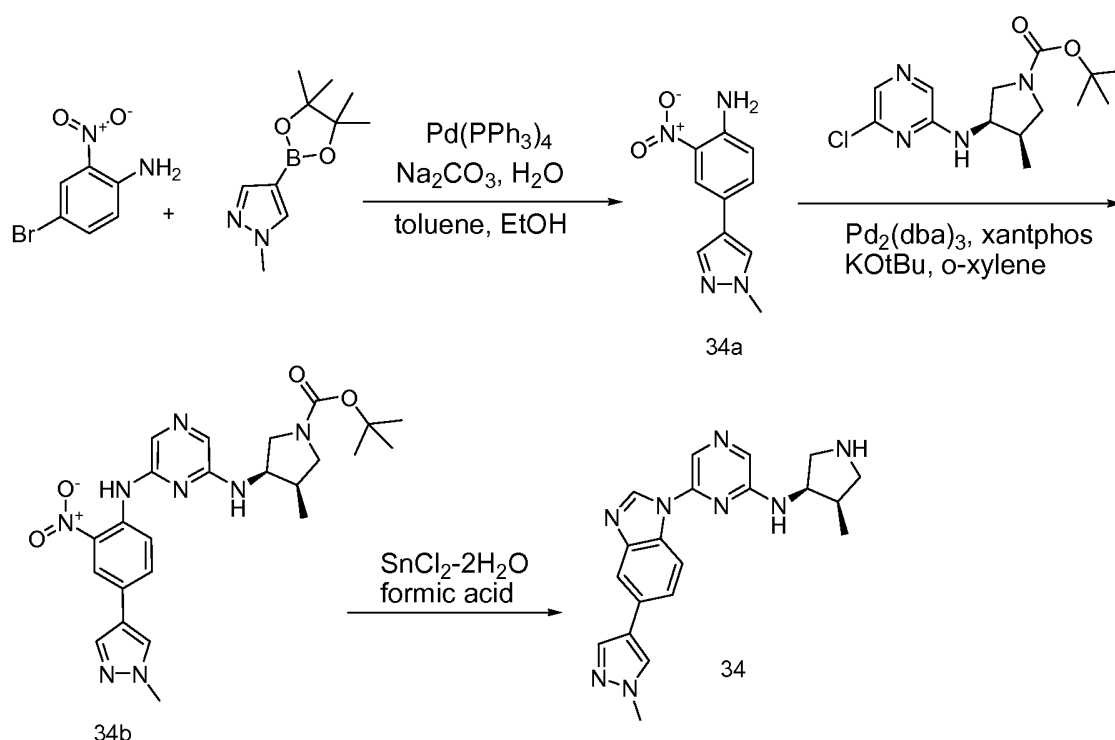
A mixture of 3-(6-Chloro-pyrazin-2-yl)-6-fluoro-pyrazolo[1,5-a]pyridine (124 mg, 0.5 mmol), (R)-3-Amino-piperidine-1-carboxylic acid tert-butyl ester (120 mg, 0.6 mmol) and cesium fluoride (152 mg, 0.8 mmol) in DMSO (1 mL) was heated to 120 °C. When the reaction was determined to be completed by LCMS, the reaction mixture was cooled to 23 °C then diluted with ethyl acetate and water. The ethyl acetate phase was washed with brine then dried with sodium sulfate and concentrated *in vacuo*. The crude residue was purified by silica gel chromatography (0-30% methanol in ethylacetate). The purified material was dissolved in dimethylsulfoxide (3 ml), then a solution of sodium methoxide in methanol (1 ml) was added. The resulting mixture was heated to 120 °C for 12 h. The reaction mixture was cooled to 23 °C then diluted with ethylacetate and water. The organic phase was concentrated to an oil then purified by reverse phase prep HPLC which gave the title compound **33**. <sup>1</sup>H NMR



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(400 MHz, MeOD)  $\delta$  ppm 1.76 (q,  $J=9.60$  Hz, 1 H) 1.93 (dt,  $J=13.71$ , 10.20 z, 1 H) 2.13 (d,  $J=14.40$  Hz, 1 H) 2.23 (d,  $J=11.12$  Hz, 1 H) 3.00 - 3.18 (m, 2 H) 3.34 - 3.40 (m, 1 H) 3.61 (d,  $J=10.61$  Hz, 1 H) 3.89 (s, 3 H) 4.22 - 4.43 (m, 1 H) 7.21 (d,  $J=9.60$  Hz, 1 H) 7.71 (s, 1 H) 8.19 (s, 1 H) 8.24 (br. s., 1 H) 8.27 (d,  $J=9.60$  Hz, 1 H) 8.43 (s, 1 H); LCMS:  $M + 1$  325.

**Example 34 (Method G): 6-[5-(1-methyl-1H-pyrazol-4-yl)-1H-benzimidazol-1-yl]-N-[(3R,4R)-4-methylpyrrolidin-3-yl]pyrazin-2-amine**



**Preparation of compound 34a: 4-(1-methyl-1H-pyrazol-4-yl)-2-nitroaniline**

To a round bottom flask was added sequentially 4-bromo-2-nitroaniline (500 mg, 2.30 mmol), 1-methyl-4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-1H-pyrazole (575 mg, 2.76 mmol), toluene (15 mL), EtOH (8 mL),  $\text{Na}_2\text{CO}_3$  (aq) (1250 mg, 11.5 mmol) and palladium tetrakis (106 mg, 0.0920 mmol). The red slurry was heat to reflux for 1.5 h. The solution was cooled and concentrated *in vacuo*. The residue was worked-up with EtOAc,  $\text{NaHCO}_3$ , brine and dried over  $\text{MgSO}_4$ . The residue was purified by column chromatography (10-30% EtOAc-DCM). The solids were triturated with MTBE which gave the title compound **34a** as a red solid (341 mg, 68%).

**Preparation of compound 34b: tert-butyl (3R,4R)-3-methyl-4-[(6-{[4-(1-methyl-1H-pyrazol-4-yl)-2-nitrophenyl]amino}pyrazin-2-yl)amino]pyrrolidine-1-carboxylate**

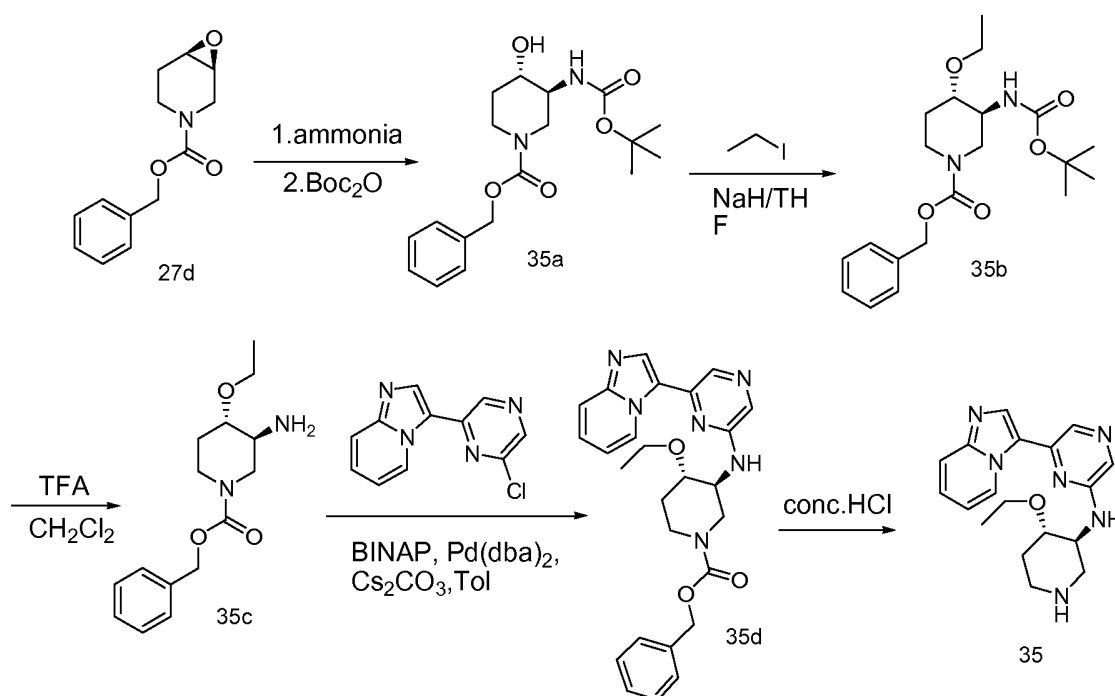
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To a 250 mL rb flask was added **34a** (200 mg, 0.917 mmol) and *tert*-butyl (3*R*,4*R*)-3-[(6-chloropyrazin-2-yl)amino]-4-methylpyrrolidine-1-carboxylate (287 mg, 0.917 mmol), which were dissolved in *o*-Xylenes (5 mL) with stirring. The mixture was degassed with N<sub>2</sub> for 10 min. Pd<sub>2</sub>(dba)<sub>3</sub> (53.1 mg, 0.0180 mmol), xantphos (10.6 mg, 0.0180 mmol) and KO<sup>t</sup>Bu (162 mg, 1.40 mmol) were added to the flask. The reaction mixture was heated at 130 °C for 2 h under N<sub>2</sub>. The reaction mixture was filtered through a pad of Celite and washed with several volumes of toluene. Solvent was removed *in vacuo*. The residue was taken up in EtOAc (50 mL). The organics were then washed with H<sub>2</sub>O (2 x 50 mL), filtered through a phase separator syringe, concentrated *in vacuo* to afford reddish residue. The residue was purified by column chromatography (Heptane/EtOAc, 0-100%) which gave the title compound **34b** as a reddish oil (123 mg, 27%).

To a 2 mL microwave vial was added **34b** (60 mg, 0.12 mmol) and formic Acid (2 mL). Stannous chloride-2H<sub>2</sub>O (85 mg, 0.38 mmol) was added. The reaction vessel was sealed and heated via microwave at 130 °C for 20 min. The reaction mixture was poured into a 125 mL sep. funnel and diluted with H<sub>2</sub>O. The aq. layer was neutralized with 10 N NaOH. The aq. layer was extracted with EtOAc (2 x 25 mL). The aq. layer was concentrated *in vacuo* which gave the title compound **34** as a purple gum (7.4 mg, 16%). <sup>1</sup>H NMR (400 MHz, MeOD) δ ppm 0.93 - 1.07 (m, 7 H), 3.95 (s, 5 H), 3.96 (s, 1 H), 7.64 (d, J=1.76 Hz, 1 H), 7.87 (s, 1 H), 7.90 (d, J=1.01 Hz, 1 H), 7.96 (s, 1 H), 8.01 (s, 1 H), 8.16 (s, 1 H), 8.18 (d, J=8.56 Hz, 1 H), 8.55 (s, 1 H), 8.80 (s, 1 H); LCMS: M + 1 375.2.

**Example 35 (Method X): N-[(3*S*,4*S*)-4-ethoxypiperidin-3-yl]-6-(imidazo[1,2-*a*]pyridin-3-yl)pyrazin-2-amine**

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**Preparation of compound 35a: benzyl (3S,4S)-3-[(*tert*-butoxycarbonyl)amino]-4-hydroxypiperidine-1-carboxylate**

A solution of **27d** (75 g, 0.323 mol) in  $\text{NH}_3 \cdot \text{H}_2\text{O}$  (800 mL) and EtOH (500 mL) was stirred at room temperature for 48 h. The reaction solution was evaporated to dryness, and then diluted with  $\text{CH}_2\text{Cl}_2$  (2 L). To the diluted solution was added  $(\text{Boc})_2\text{O}$  (140 g, 0.646 mol) and then stirred at room temperature for 4 h. The reaction solution was evaporated and the residue was purified by column chromatography (petroleum ether / EtOAc = 10:1 to 3:1) which gave the title compound **35a** as a white solid (30 g, 13%).

**Preparation of compound 35b: benzyl (3S,4S)-3-[(*tert*-butoxycarbonyl)amino]-4-ethoxypiperidine-1-carboxylate**

To a solution of **35a** (7.5 g, 21.4 mmol) in THF (250 mL) was added NaH (60%, 1.7 g, 42.8 mmol) at 0 °C in portions. After the addition, the resulting mixture was stirred at 0 °C for 0.5 h. Then  $\text{CH}_3\text{CH}_2\text{I}$  (6.6 g, 42.8 mmol) was added dropwise at the temperature. After the addition, the resulting solution was warmed to room temperature and stirred at room temperature overnight. The reaction mixture was separated between  $\text{H}_2\text{O}$  (200 mL) and EtOAc (200 mL). The aqueous layer was extracted with EtOAc (200 mL). The combined organic layers were washed with brine (200 mL), dried over  $\text{Na}_2\text{SO}_4$  and concentrated. The residue was purified by column

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chromatography (petroleum ether / EtOAc = 50:1 to 10:1) which gave the title compound **35b** as a yellow oil (1.7 g, 21%).

**Preparation of compound 35c: benzyl (3S,4S)-3-amino-4-ethoxypiperidine-1-carboxylate**

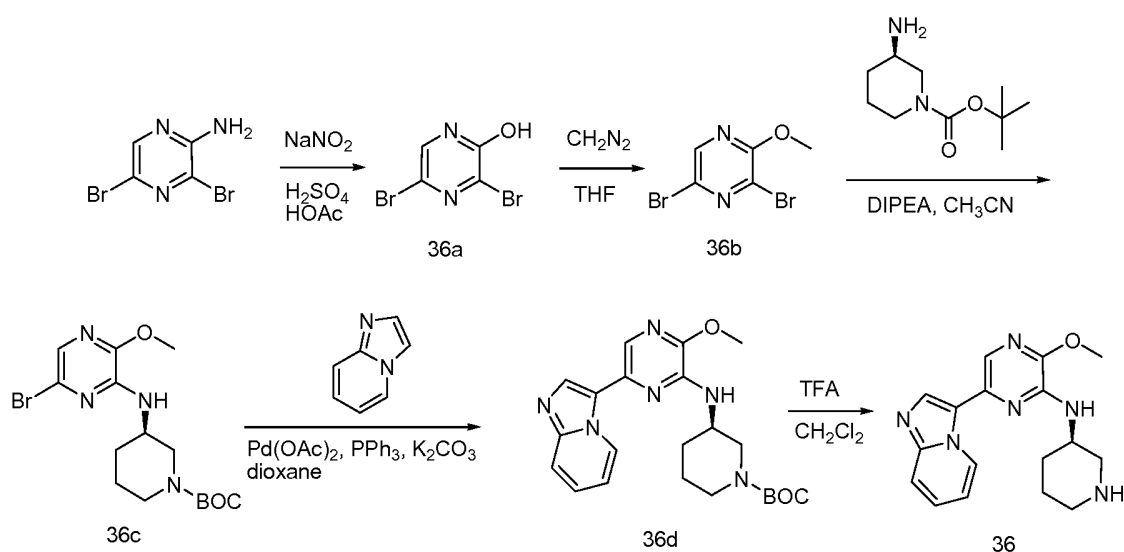
To solution of **35b** (1.7 g, 4.5 mmol) in CH<sub>2</sub>Cl<sub>2</sub> (45 mL) was added TFA (9 mL) at 0 °C. The resulting solution was allowed to warm room temperature and stirred for 2 h. The reaction solution was concentrated and the residue was adjusted to pH ~ 9 with sat. aq. NaHCO<sub>3</sub> and then extracted with EtOAc (50 mL x 2). The combined organic layers were washed with brine (50 mL x 2), dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated which gave the title compound **35c** as a yellow oil (1.2 g, 100%).

**Preparation of compound 35d: benzyl (3S,4S)-4-ethoxy-3-[[6-(imidazo[1,2-a]pyridin-3-yl)pyrazin-2-yl]amino]piperidine-1-carboxylate**

A mixture of 3-(6-chloropyrazin-2-yl)imidazo[1,2-a]pyridine (230 mg, 1.087 mmol), **35c** (302 mg, 1.087 mmol), BINAP (28 mg) and Cs<sub>2</sub>CO<sub>3</sub> (708 mg, 2.174 mmol) in dry toluene (1.5 mL) was added Pd(dba)<sub>2</sub> (26 mg) quickly under N<sub>2</sub>. The mixture was stirred at 120 °C for 1 h. The reaction mixture was cooled to room temperature and then partitioned between EtOAc (50 mL) and H<sub>2</sub>O (50 mL). The organic layer was washed with brine (20 mL), dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated which gave the title compound **35d**, which was used in the next step directly.

A mixture of **35d** (500 mg, 1.05 mmol) in con.HCl (40 mL) was stirred at room temperature for 6 h. The reaction mixture was adjusted to pH~9 with NH<sub>3</sub>.H<sub>2</sub>O. The residue was extracted with CH<sub>2</sub>Cl<sub>2</sub> (100 mL x 4). The combined organic layers were dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated. The residue was purified by prep HPLC which gave the title compound **35** as a yellow solid (67 mg, 18%). <sup>1</sup>H NMR (400 MHz, MeOD): δ ppm 1.04 (t, 3H), 1.55-1.50 (m, 1H), 2.22-2.12 (m, 1H), 2.61-2.50 (m, 2H), 3.05-3.02 (m, 1H), 3.39-3.38 (m, 1H), 3.50-3.46 (m, 2H), 3.68-3.64 (m, 2H), 4.01 (m, 1H), 7.06 (t, 1H), 7.41 (t, 1H), 7.61 (d, 1H), 7.73 (s, 1H), 8.15 (d, 2H), 9.81 (d, 1H); LCMS: M + 1 339.4.

**Example 36 (Method B): 6-(imidazo[1,2-a]pyridin-3-yl)-3-methoxy-N-[(3R)-piperidin-3-yl]pyrazin-2-amine**



### Preparation of compound 36a: 3,5-dibromopyrazin-2-ol

To a stirred solution of 3,5-dibromopyrazin-2-amine (30 g, 0.12 mol) in AcOH (300 mL) was added dropwise conc. H<sub>2</sub>SO<sub>4</sub> (50 mL) at 15~25 °C. To the resulting solution was then added dropwise a solution of NaNO<sub>2</sub> (16.6 g, 0.24 mol) in water (100 mL) at 10~15 °C during a period of 1.5 h. After the addition, the resulting mixture was stirred at 10~15 °C for 1 h. The reaction mixture was poured into water (3 L) and extracted with EtOAc (1 L x 3). The combined organic layers were washed with saturated NaHCO<sub>3</sub> (1 L x 3) and brine (1 L) in sequence, dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated *in vacuo* which gave the title compound **36a** as a yellow solid (24 g, 79.4%). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>): 7.44 (s, 1H).

### Preparation of compound 36b: 3,5-dibromo-2-methoxypyrazine

To a stirred solution of **36a** (8 g, 0.031 mol) in dry THF (100 mL) was added dropwise a solution of CH<sub>2</sub>N<sub>2</sub> in Et<sub>2</sub>O (0.7 N, 134 mL, 0.093 mol) at 0 °C. After the addition, the resulting mixture was stirred at r.t. for 0.3 h. The reaction mixture was concentrated *in vacuo* and the residue was purified by column chromatography (petroleum ether/EtOAc 10:1) which gave the title compound **36b** as a yellow solid (5.5 g, 32.6%). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) 3.963 (s, 3H), 8.060 (s, 1H).

### Preparation of compound 36c: *tert*-butyl (3*R*)-3-[(6-bromo-3-methoxypyrazin-2-yl)amino]piperidine-1-carboxylate

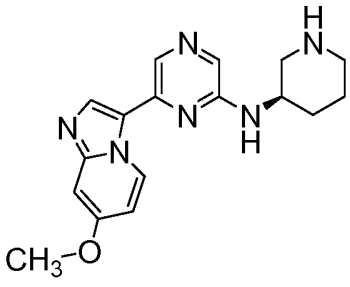
A solution of **36b** (1.26 g, 4.7 mmol), DIPEA (1.22 g, 9.4 mmol) and *tert*-butyl (3*R*)-3-aminopiperidine-1-carboxylate (1.12 g, 5.64 mmol) in CH<sub>3</sub>CN (5 mL) was stirred at reflux overnight. The reaction mixture was concentrated *in vacuo* and the residue was purified by column chromatography (petroleum ether/EtOAc 10:1 to 3:1) which gave

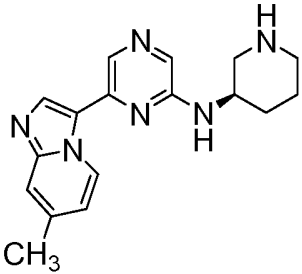
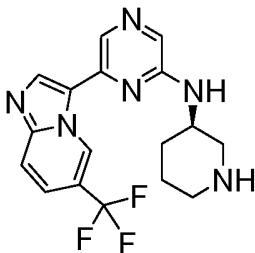
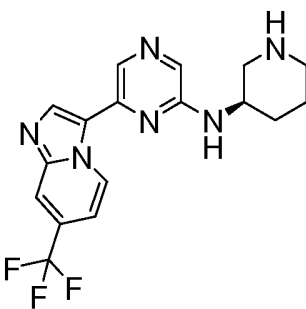
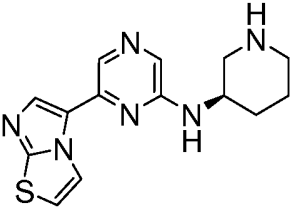
the title compound **36c** as yellow syrup (0.3 g, 16.5%). <sup>1</sup>H NMR (400 MHz, DMSO) δ ppm 1.177 (s, 9H), 1.75~1.60 (m, 2H), 1.90~1.80 (m 1H), 3.10~2.75 (m, 3H), 3.85~3.55 (m, 3H), 3.889 (s, 3H), 6.837 (s, 1H), 7.355 (s, 1H).

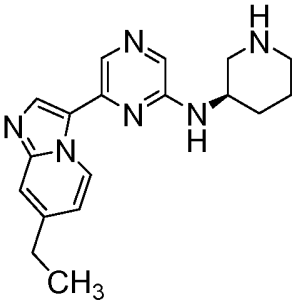
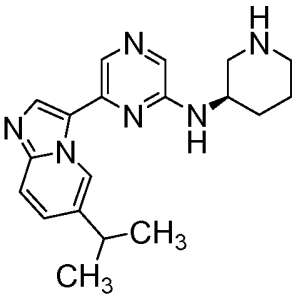
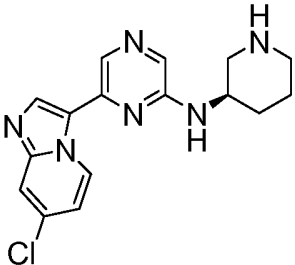
**Preparation of compound 36d: *tert*-butyl (3R)-3-[[6-(imidazo[1,2-a]pyridin-3-yl)-3-methoxypyrazin-2-yl]amino}piperidine-1-carboxylate**

A solution of **36c** (0.3 g, 0.77 mmol), imidazo[1,2-*a*]pyridine (0.16 g, 1.39 mmol), K<sub>2</sub>CO<sub>3</sub> (0.43g, 0.31 mmol), P(Ph)<sub>3</sub> (20.3 mg, 0.077 mmol) and a catalytic amount of Pd(OAc)<sub>2</sub> (25 mg) in dioxane (5 mL) was stirred at reflux under N<sub>2</sub> atmosphere overnight. The reaction mixture was cooled to r.t., diluted with EtOAc (100 mL) and the resulting mixture was washed with brine (30 mL x 2), dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated *in vacuo*. The residue was purified by column chromatography (petroleum ether/EtOAc 10:1 to 2:1) which gave the title compound **36d** as yellow syrup (0.12 g, 36.5%).

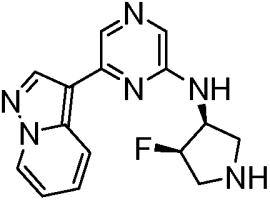
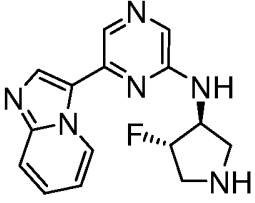
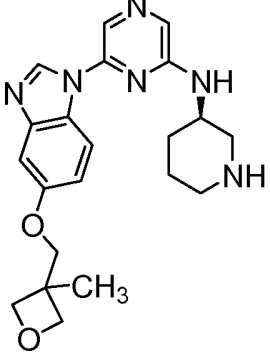
To a stirred solution of **36d** (0.12 g, 0.28 mmol) in CH<sub>2</sub>Cl<sub>2</sub> (2 mL) was added TFA (0.2 mL) at 0 °C. After the addition, the resulting solution was stirred at rt for 5 h. Water (5 mL) was added and the resulting mixture was stirred at rt for 5 min. The aq. layer was separated and purified by prep. HPLC under TFA conditions which gave the title compound **36** as a white solid (TFA salt, 30.3 mg, 33.0%). <sup>1</sup>H NMR (400 MHz, D<sub>2</sub>O) δ ppm 1.828~1.776 (m, 2H), 2.164~2.047 (m, 2H), 3.084~3.030 (m, 2H), 3.335~3.302 (m, 1H), 3.530~3.508 (m, 1H), 4.019 (s, 3H), 4.328 (m, 1H), 7.480~7.449 (t, 1H), 7.691 (s, 1H), 7.954~7.937 (m, 2H), 8.130 (s, 1H), 9.164~9.147 (d, 1H).

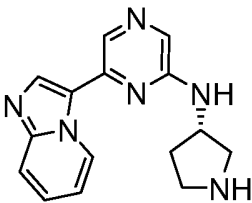
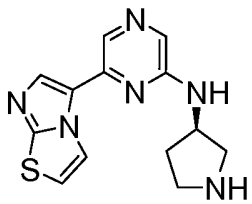
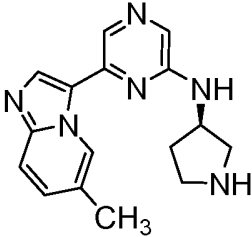
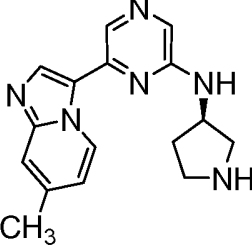
Ex.	Structure	Name, Data and Preparation Method
37		6-(7-Methoxyimidazo[1,2-a]pyridin-3-yl)-N-[(3R)-piperidin-3-yl]pyrazin-2-amine. <sup>1</sup> H NMR (400 MHz, MeOD) δ ppm 1.29 (br. s., 1 H), 1.47 - 1.63 (m, 1 H), 1.71 (d, <i>J</i> = 14.4 Hz, 1 H), 1.81 - 1.93 (m, 1 H), 2.17 (d, <i>J</i> = 8.1 Hz, 1 H), 2.52 - 2.76 (m, 2 H), 3.03 (d, <i>J</i> = 12.3 Hz, 1 H), 3.93 (s, 3 H), 3.97 - 4.12 (m, 1 H), 6.85 (dd, <i>J</i> = 7.8, 2.5 Hz, 1 H), 6.98 (d, <i>J</i> = 2.3 Hz, 1 H), 7.69 (s, 1H), 8.09 (s, 1 H), 8.19 (s, 1 H), 9.62 (d, <i>J</i> = 7.5 Hz, 1 H); LCMS: M+1 325. Method A (Example 7)

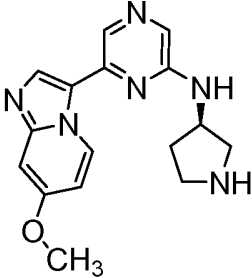
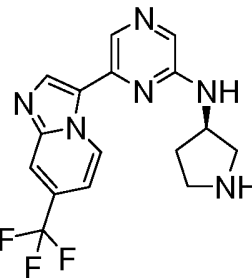
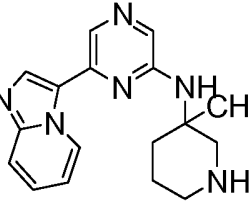
Ex.	Structure	Name, Data and Preparation Method
38		6-(7-Methylimidazo[1,2-a]pyridin-3-yl)-N-[(3R)-piperidin-3-yl]pyrazin-2-amine. <sup>1</sup> H NMR (400 MHz, MeOD) $\delta$ ppm 1.77 (br. s., 1 H), 1.99 (br. s., 1 H), 2.11 (br. s., 1 H), 2.24 (br. s., 1 H), 2.66 (s, 3 H), 3.09 (br. s., 2 H), 3.36 (br. s., 1 H), 3.58 (br. s., 1 H), 4.39 (br. s., 1 H), 7.59 (br. s., 1 H), 7.86 (s, 1 H), 8.03 (s, 1 H), 8.36 (s, 1 H), 8.63 (br. s., 1 H), 9.70 (br. s., 1 H); LCMS: M+1 309. Method B (Example 5)
39		N-[(3R)-piperidin-3-yl]-6-[6-(trifluoromethyl)imidazo[1,2-a]pyridin-3-yl]pyrazin-2-amine. <sup>1</sup> H NMR (400 MHz, MeOD) $\delta$ ppm 1.80 (br. s., 2 H), 1.98 (br. s., 2 H), 2.19 (br. s., 1 H), 3.01 (br. s., 1 H), 3.15 (br. s., 2 H), 4.21 (br. s., 1 H), 7.65 (br. s., 1 H), 7.85 (br. s., 1 H), 7.90 (s, 1 H), 8.35 (br. s., 2 H), 10.12 (s, 1 H); LCMS: M+1 363. Method B (Example 5)
40		N-[(3R)-piperidin-3-yl]-6-[7-(trifluoromethyl)imidazo[1,2-a]pyridin-3-yl]pyrazin-2-amine <sup>1</sup> H NMR (400 MHz, DMSO-d <sub>6</sub> ) $\delta$ ppm 1.48 (s, 2 H), 1.67 (br. s., 1 H), 1.88 (s, 2 H), 2.02 (br. s., 1 H), 2.43 (br. s., 1 H), 2.83 (br. s., 1 H), 3.17 (br. s., 1 H), 3.80 (br. s., 1 H), 7.25 (s, 1 H), 7.40 (dd, <i>J</i> = 7.4, 1.9 Hz, 1 H), 7.87 (s, 1 H), 8.22 (s, 1 H), 8.38 (s, 1 H), 8.59 (s, 1 H), 9.93 (d, <i>J</i> = 7.3 Hz, 1 H); LCMS: M+1 363, Method A (Example 7)
41		6-Imidazo[2,1-b][1,3]thiazol-5-yl-N-[(3R)-piperidin-3-yl]pyrazin-2-amine. <sup>1</sup> H NMR (400 MHz, MeOD) $\delta$ ppm 1.56 (br. s., 1 H), 1.73 (br. s., 1 H), 1.91 (br. s., 1 H), 2.15 (br. s., 1 H), 2.66 (br. s., 2 H), 3.03 (br. s., 1 H), 3.36 (br. s., 1 H), 4.02 (br. s., 1 H), 7.30 (s, 1 H), 7.71 (br. s., 1 H),

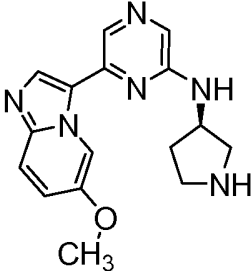
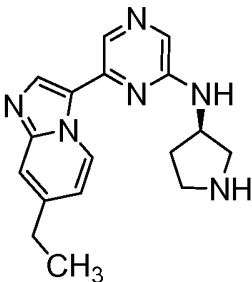
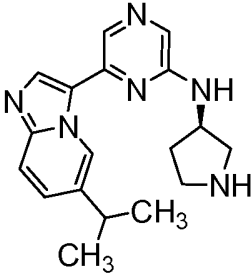
Ex.	Structure	Name, Data and Preparation Method
		7.93 (s, 1 H), 8.17 (br. s., 1 H), 8.58 (br. s., 1 H); LCMS: M+1 301. Method A (Example 4)
42		6-(7-Ethylimidazo[1,2-a]pyridin-3-yl)-N-[(3R)-piperidin-3-yl]pyrazin-2-amine. <sup>1</sup> H NMR (400 MHz, DMSO-d <sub>6</sub> ) δ ppm 1.30 (t, <i>J</i> = 7.6, Hz, 3 H), 1.93 (br. s., 2 H), 2.33 (s, 1 H), 2.67 (s, 1 H), 2.90 (q, 3 H), 7.76 (br. s., 2 H), 7.85 (s, 1 H), 8.03 (s, 1 H), 8.44 (s, 1 H), 8.92 (s, 1 H), 9.79 (s, 1 H); LCMS: M+1 323. Method A (Example 7)
43		6-(6-Isopropylimidazo[1,2-a]pyridin-3-yl)-N-[(3R)-piperidin-3-yl]pyrazin-2-amine <sup>1</sup> H NMR (400 MHz, DMSO-d <sub>6</sub> ) δ ppm 1.27 - 1.35 (m, 7 H), 1.40 - 1.51 (m, 2 H), 1.63 - 1.72 (m, 1 H), 1.96 - 2.04 (m, 1 H), 2.76 - 2.84 (m, 1 H), 2.96 - 3.14 (m, 3 H), 3.83 - 3.97 (m, 1 H), 7.15 (d, <i>J</i> = 7.6 Hz, 1 H), 7.38 (dd, <i>J</i> = 9.4, 1.8 Hz, 1 H), 7.65 (d, <i>J</i> = 9.09 Hz, 1 H); LCMS: M+1 337. Method A (Example 7)
44		6-(7-Chloroimidazo[1,2-a]pyridin-3-yl)-N-[(3R)-piperidin-3-yl]pyrazin-2-amine. <sup>1</sup> H NMR (400 MHz, DMSO-d <sub>6</sub> ) δ ppm 1.49 - 1.66 (m, 1 H), 1.88 (d, <i>J</i> = 13.4 Hz, 1 H), 2.03 (d, <i>J</i> = 11.6 Hz, 2 H), 2.79 (q, <i>J</i> = 10.2 Hz, 1 H), 2.84 - 2.98 (m, 1 H), 3.20 (d, <i>J</i> = 12.1 Hz, 1 H), 3.44 (d, <i>J</i> = 10.6 Hz, 1 H), 4.41 (br. s., 1 H), 7.83 (br. s., 1 H), 8.02 (s, 2 H), 8.22 (d, <i>J</i> = 2.0 Hz, 1 H), 8.47 (s, 1 H), 8.96 (s, 1 H), 9.18 (br. s., 1 H), 9.92 (d, <i>J</i> = 7.6 Hz, 1 H), 10.18 (br. s., 1 H); LCMS: M+1 329. Method A (Example 7)

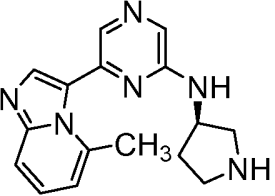
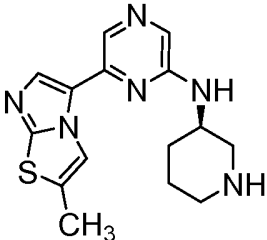
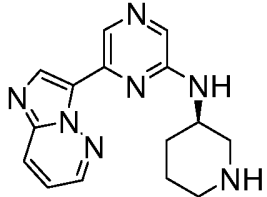


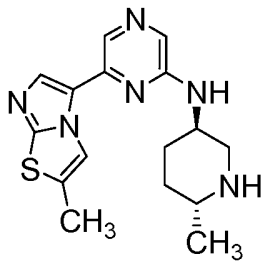
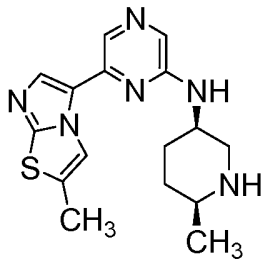
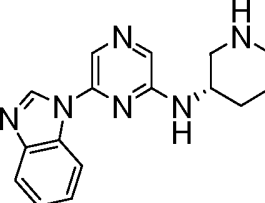
Ex.	Structure	Name, Data and Preparation Method
45		<p>Cis N-[4-fluoropyrrolidin-3-yl]-6-pyrazolo [1,5-a]pyridin-3-ylpyrazin-2-amine. <sup>1</sup>H NMR (400 MHz, MeOD) <math>\delta</math> ppm 3.25 (t, <math>J</math> = 11.2 Hz, 1 H), 3.68 - 3.91 (m, 3 H), 5.04 (ddd, <math>J</math> = 19.3, 15.8, 7.8 Hz, 1 H), 5.33 - 5.53 (m, 1 H), 7.03 (t, <math>J</math> = 6.7 Hz, 1 H), 7.43 (d, <math>J</math> = 8.3 Hz, 1 H), 7.82 (s, 1 H), 8.28 (s, 1 H), 8.37 (d, <math>J</math> = 8.8 Hz, 1 H), 8.57 (s, 1 H), 8.62 (d, <math>J</math> = 7.1 Hz, 1 H); LCMS: M+1 299. Method E (Example 6)</p>
46		<p>Trans N-[4-fluoropyrrolidin-3-yl]-6-imidazo[1,2-a]pyridin-3-ylpyrazin-2-amine. <sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) <math>\delta</math> ppm 3.41 - 3.59 (m, 3 H), 3.66 (d, <math>J</math> = 5.6 Hz, 1 H), 4.22 - 4.51 (m, 1 H), 4.91 - 5.23 (m, 1 H), 7.03 (t, <math>J</math> = 6.7 Hz, 1 H), 7.40 (d, <math>J</math> = 7.1 Hz, 1 H), 7.57 (br. s., 1H), 7.71 (d, <math>J</math> = 9.1 Hz, 1 H), 7.86 (s, 1 H), 8.40 (d, <math>J</math> = 1.8 Hz, 2 H), 9.82 (d, <math>J</math> = 6.8 Hz, 1 H); LCMS: M+1 299. Method E (Example 6)</p>
47		<p>6-{5-[(3-Methyloxetan-3-yl)methoxy]-1H-benzimidazol-1-yl}-N-[(3R)-piperidin-3-yl]pyrazin-2-amine. <sup>1</sup>H NMR (400 MHz, MeOD) 1.48 (s, 3 H) 1.70 - 1.82 (m, 1 H) 1.84 - 1.97 (m, 1 H) 2.07 - 2.18 (m, 1 H) 2.18 - 2.28 (m, 1 H) 2.97 - 3.11 (m, 2 H) 3.33 - 3.37 (m, 1 H) 3.61 (dd, <math>J</math>=12.38, 3.54 Hz, 1 H) 4.13 (s, 2 H) 4.23 - 4.33 (m, 1 H) 4.49 (d, <math>J</math>=5.81 Hz, 2 H) 4.71 (d, <math>J</math>=6.06 Hz, 2 H) 7.34 (d, <math>J</math>=2.27 Hz, 1 H) 7.15 (dd, <math>J</math>=8.97, 2.40 Hz, 1 H) 7.97 (s, 1 H) 7.99 (d, <math>J</math>=9.09 Hz, 1 H) 8.24 (s, 1 H) 8.45 (br. s., 1 H) 8.79 (s, 1 H). Method C (Example 9)</p>

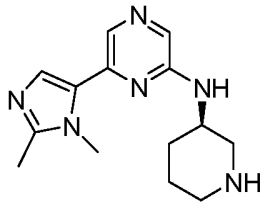
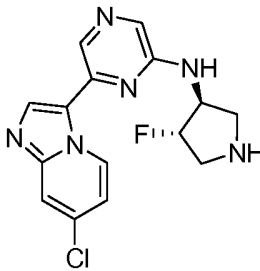
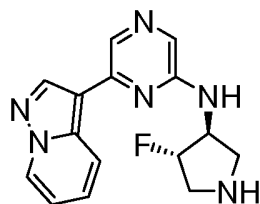
Ex.	Structure	Name, Data and Preparation Method
48		<p>6-Imidazo[1,2-a]pyridin-3-yl-N-[(3S)-pyrrolidin-3-yl]pyrazin-2-amine. <sup>1</sup>H NMR (400 MHz, DMSO-<i>d</i><sub>6</sub>) δ ppm 1.87 - 1.95 (m, 1 H), 2.19 - 2.28 (m, 1 H), 3.03 - 3.07 (m, 1 H), 3.12 - 3.24 (m, 2 H), 3.35 - 3.40 (m, 1 H), 4.43 - 4.48 (m, 1 H), 7.09 - 7.12 (m, 1 H), 7.39 - 7.45 (m, 2 H), 7.73 (d, <i>J</i> = 9.0 Hz, 1 H), 7.83 (s, 1 H), 8.39 (s, 1 H), 8.40 (s, 1 H), 9.71 (d, <i>J</i> = 7.0 Hz, 1 H); APCI LCMS <i>m/z</i> 281 (M + H). Method A (Example 3).</p>
49		<p>6-Imidazo[2,1-b][1,3]thiazol-5-yl-N-[(3R)-pyrrolidin-3-yl]pyrazin-2-amine. <sup>1</sup>H NMR (400 MHz, MeOD) δ ppm 2.13 - 2.27 (m, 1 H), 2.43 - 2.58 (m, 1 H), 3.34 - 3.41 (m, 1 H), 3.45 - 3.59 (m, 2 H), 3.65 - 3.73 (m, 1 H), 4.70 - 4.80 (m, 1 H), 7.79 (d, <i>J</i> = 3.5 Hz, 1 H), 8.03 (s, 1 H), 8.40 (s, 1 H), 8.49 (s, 1 H), 8.85 (d, <i>J</i> = 4.0 Hz, 1 H); APCI LCMS <i>m/z</i> 287 (M + H). Method A (Example 4).</p>
50		<p>6-(6-Methylimidazo[1,2-a]pyridin-3-yl)-N-[(3R)-pyrrolidin-3-yl]pyrazin-2-amine. <sup>1</sup>H NMR (400 MHz, MeOD) δ ppm 1.98 (br. s., 1 H), 2.33 (br. s., 1 H), 2.42 (s, 3 H), 3.15 (br. s., 3 H), 3.37 (br. s., 1 H), 4.52 (br. s., 1 H), 7.32 (s, 1H), 7.56 (br. s., 1 H), 7.76 (br. s., 1 H), 8.17 (s, 1 H), 8.25 (s, 1 H), 9.63 (s, 1 H). Method A (Example 4 use dichloropyrazine).</p>
51		<p>6-(7-Methylimidazo[1,2-a]pyridin-3-yl)-N-[(3R)-pyrrolidin-3-yl]pyrazin-2-amine. <sup>1</sup>H NMR (400 MHz, MeOD) δ ppm 1.86 - 1.92 (m, 1 H), 2.25 - 2.31 (m, 1 H), 2.46 (s, 3 H), 2.90 - 2.97 (m, 1 H), 3.01 - 3.09 (m, 1 H), 3.10 - 3.20 (m, 1 H), 4.44 - 4.59 (m, 1 H), 6.95 (dd, <i>J</i> = 7.3, 1.8 Hz, 1 H),</p>

Ex.	Structure	Name, Data and Preparation Method
		7.42 (s, 1 H), 7.73 (s, 1 H), 8.14 (s, 1 H), 8.22 (s, 1 H), 9.68 (d, $J = 7.3$ Hz, 1 H); APCI LCMS 295 (M + H). Method A (Exmaple 4, use dichloropyrazine).
52		6-(7-Methoxyimidazo[1,2-a]pyridin-3-yl)-N-[(3R)-pyrrolidin-3-yl]pyrazin-2-amine. $^1\text{H}$ NMR (400 MHz, MeOD) $\delta$ ppm 1.82 – 1.89 (m, 1 H), 2.17 - 2.32 (m, 1 H), 2.80 - 2.94 (m, 1 H), 2.96 - 3.06 (m, 1 H), 3.06 - 3.16 (m, 1 H), 3.22 - 3.29 (m, 1 H), 3.90 - 3.95 (m, 3 H), 4.36 - 4.52 (m, 1 H), 6.79 (dd, $J = 7.7, 2.6$ Hz, 1 H), 6.97 (d, $J = 2.5$ Hz, 1 H), 7.70 (s, 1 H), 8.08 (s, 1 H), 8.20 (s, 1 H), 9.66 (d, $J = 7.8$ Hz, 1 H). Method B (Example 10).
53		N-[(3R)-pyrrolidin-3-yl]-6-[7-(trifluoromethyl)imidazo[1,2-a]pyridin-3-yl]pyrazin-2-amine. $^1\text{H}$ NMR (400 MHz, DMSO- $d_6$ ) $\delta$ ppm 1.63 - 1.78 (m, 1 H), 2.05 - 2.18 (m, 1 H), 2.74 (dd, $J = 11.3, 4.0$ Hz, 1 H), 2.80 - 2.89 (m, 1 H), 2.91 - 2.99 (m, 1 H), 3.09 - 3.20 (m, 1 H), 4.23 - 4.37 (m, 1 H), 7.36 - 7.48 (m, 2 H), 7.86 (s, 1 H), 8.21 (s, 1 H), 8.40 (s, 1 H), 8.59 (s, 1 H), 9.96 (d, $J = 7.3$ Hz, 1 H); APCI LCMS $m/z$ 349 (M + H). Method A (Example 7)
54		6-Imidazo[1,2-a]pyridin-3-yl-N-(3-methylpiperidin-3-yl)pyrazin-2-amine. $^1\text{H}$ NMR (400 MHz, DMSO- $d_6$ ) $\delta$ ppm 1.45 (s, 3 H), 1.57 - 1.76 (m, 2 H), 1.87 - 2.07 (m, 1 H), 2.11 - 2.23 (m, 1 H), 2.79 - 2.92 (m, 1 H), 2.92 - 3.02 (m, 1 H), 3.09 - 3.24 (m, 1 H), 3.91 - 4.07 (m, 1 H), 7.50 (s, 1 H), 7.65 - 7.75 (m, 1 H), 7.97 - 8.06 (m, 1 H), 8.06 - 8.13 (m, 1 H), 8.32 (s, 1 H), 8.21 (s, 1 H), 8.61 (d,

Ex.	Structure	Name, Data and Preparation Method
		$J = 8.6$ Hz, 1 H), 8.80 (s, 1 H), 9.36 (d, $J = 6.8$ Hz, 1 H), 9.60 (d, $J = 14.4$ Hz, 1 H); LCMS $m/z$ 309. Method A (Example 4)
55		6-(6-Methoxyimidazo[1,2-a]pyridin-3-yl)-N-[(3R)-pyrrolidin-3-yl]pyrazin-2-amine. $^1\text{H}$ NMR (400 MHz, MeOD) $\delta$ ppm 1.80 - 1.86 (m, 2 H), 1.95 - 1.99 (m, 1 H), 2.02 - 2.06 (m, 1 H), 2.66 (s, 3 H), 3.31 - 3.37 (m, 1 H), 5.99 (dd, $J = 9.7, 2.4$ Hz, 1 H), 6.31 (d, $J = 9.6$ Hz, 1 H), 6.51 (s, 1 H), 6.85 (s, 1 H), 6.96 (s, 1 H), 8.10 (d, $J = 2.1$ Hz, 1 H); LCMS $m/z$ 311 (M + H). Method A, (Example 7).
56		6-(7-Ethylimidazo[1,2-a]pyridin-3-yl)-N-[(3R)-pyrrolidin-3-yl]pyrazin-2-amine $^1\text{H}$ NMR (400 MHz, DMSO- $d_6$ ) $\delta$ ppm 1.26 (t, $J = 7.6$ Hz, 3 H), 1.67 - 1.80 (m, 1 H), 2.04 - 2.19 (m, 1 H), 2.72 (q, $J = 7.5$ Hz, 2 H), 2.80 (dd, $J = 11.3, 4.0$ Hz, 1 H), 2.85 - 2.95 (m, 1 H), 2.95 - 3.05 (m, 1 H), 3.09 - 3.20 (m, 1 H), 4.24 - 4.39 (m, 1 H), 7.02 (dd, $J = 7.3, 1.8$ Hz, 1 H), 7.36 (d, $J = 6.0$ Hz, 1 H), 7.50 (s, 1 H), 7.77 (s, 1 H), 8.31 (s, 1 H), 8.32 (s, 1 H), 9.69 (d, $J = 7.3$ Hz, 1 H); LCMS $m/z$ 309 (M + H). Method A (Example 7).
57		6-(6-Isopropylimidazo[1,2-a]pyridin-3-yl)-N-[(3R)-pyrrolidin-3-yl]pyrazin-2-amine. $^1\text{H}$ NMR (400 MHz, DMSO- $d_6$ ) $\delta$ ppm 1.23 - 1.37 (m, 6 H), 2.19 - 2.35 (m, 2 H), 3.10 - 3.50 (m, 4 H), 4.57 (br. s., 1 H), 8.01 - 8.13 (m, 3 H), 8.42 (s, 1 H), 8.85 - 8.95 (m, 1 H), 9.59 (s, 1 H). Method A (Example 7)

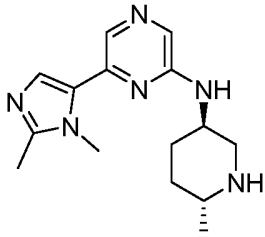
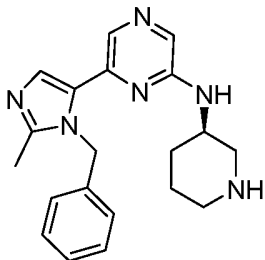
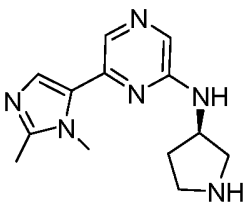
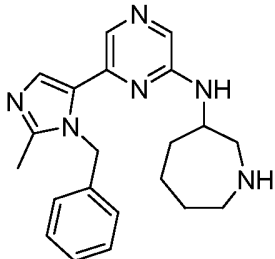
Ex.	Structure	Name, Data and Preparation Method
58		<p>6-(5-Methylimidazo[1,2-a]pyridin-3-yl)-N-[(3R)-pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, MeOD) <math>\delta</math> ppm 1.73 - 1.94 (m, 1 H) 2.22 (dd, <math>J=13.35</math>, 7.55 Hz, 1 H) 2.46 (s, 3 H) 2.88 (dd, <math>J=11.71</math>, 4.91 Hz, 1 H) 2.99 - 3.10 (m, 1 H) 3.10 - 3.22 (m, 1 H) 3.26 (dd, <math>J=11.96</math>, 6.42 Hz, 1 H) 4.42 (s, 1 H) 6.80 (d, <math>J=6.80</math> Hz, 1 H) 7.34 (dd, <math>J=8.81</math>, 6.80 Hz, 1 H) 7.54 (d, <math>J=9.06</math> Hz, 1 H) 7.67 (s, 1 H) 7.94 (s, 1 H) 7.98 (s, 1 H). Method A (Example 4, use dichloropyrazine).</p>
59		<p>6-(2-Methylimidazo[2,1-b][1,3]thiazol-5-yl)-N-[(3R)-piperidin-3-yl]pyrazin-2-amine. 1H NMR (400 MHz, MeOD) <math>\delta</math> ppm 1.63 - 1.83 (m, 1 H), 1.87 - 2.03 (m, 1 H), 2.08 - 2.20 (m, 1 H), 2.20 - 2.35 (m, 1 H), 2.67 (s, 3 H), 3.06 - 3.19 (m, 2 H), 3.55 (dd, <math>J = 12.5</math>, 3.4 Hz, 1 H), 4.23 - 4.42 (m, 1 H), 8.01 (s, 1 H), 8.22 - 8.44 (m, 2 H), 8.53 (s, 1 H); LCMS: <math>M + 1</math> 315. Method A (Example 4)</p>
60		<p>6-Imidazo[1,2-b]pyridazin-3-yl-N-[(3R)-piperidin-3-yl]pyrazin-2-amine. 1H NMR (400 MHz, DMSO-<math>d_6</math>) <math>\delta</math> ppm 1.59 - 1.72 (m, 1 H), 1.74 - 1.89 (m, 1 H), 1.92 - 2.06 (m, 2 H), 2.69 - 2.81 (m, 1 H), 2.83 - 3.01 (m, 1 H), 3.21 - 3.30 (m, 1 H), 3.53 (d, <math>J = 11.1</math> Hz, 1 H) 4.26 (br. s., 1 H), 7.51 (dd, <math>J = 9.1</math>, 4.5 Hz, 1 H), 7.99 (s, 1 H), 8.37 (dd, <math>J = 9.2</math>, 1.6 Hz, 1 H), 8.80 (s, 1 H), 8.86 (dd, <math>J = 4.5</math>, 1.5 Hz, 1 H), 8.95 (s, 1 H), 9.19 (d, <math>J = 10.8</math> Hz, 1 H). Method A (Example 4).</p>

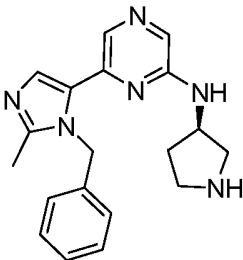
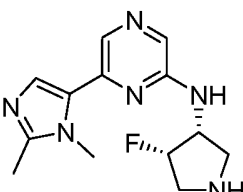
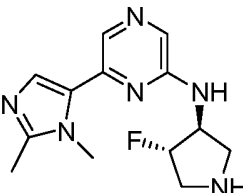
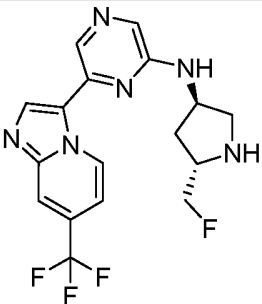
Ex.	Structure	Name, Data and Preparation Method
61		<p>Trans 6-(2-Methylimidazo[2,1-b][1,3]thiazol-5-yl)-N-(6-methylpiperidin-3-yl)pyrazin-2-amine 1H NMR (400 MHz, DMSO-d<sub>6</sub>) <math>\delta</math> ppm 1.31 (d, <math>J</math> = 6.3 Hz, 3 H), 1.40 - 1.56 (m, 1 H), 1.69 - 1.85 (m, 1 H), 1.86 - 1.97 (m, 1 H), 2.14 (d, <math>J</math> = 11.6 Hz, 1 H), 2.64 (s, 3 H), 2.82 (q, <math>J</math> = 11.2 Hz, 1 H), 3.13 - 3.29 (m, 1 H), 3.41 (d, <math>J</math> = 11.1 Hz, 1 H), 4.26 - 4.46 (m, 1 H), 7.88 (s, 1 H), 8.32 (s, 1 H), 8.36 (s, 1 H), 8.47 (s, 1 H), 9.26 (d, <math>J</math> = 10.3 Hz, 1 H), 9.90 (d, <math>J</math> = 10.6 Hz, 1 H). Method A (Example 4, CBZ was used instead of Boc as the protecting group of the ring nitrogen of the 3-amino piperidine piece)</p>
62		<p>Cis 6-(2-Methylimidazo[2,1-b][1,3]thiazol-5-yl)-N-(6-methylpiperidin-3-yl)pyrazin-2-amine 1H NMR (400 MHz, DMSO-d<sub>6</sub>) <math>\delta</math> ppm 1.31 (d, <math>J</math> = 6.3 Hz, 3 H), 1.71 - 1.85 (m, 2 H), 1.86 - 1.98 (m, <math>J</math> = 4.5 Hz, 3 H), 2.54 (s, 3 H), 3.20 - 3.32 (m, 2 H), 3.34 - 3.45 (m, 1 H), 4.30 (br. s., 1 H), 7.92 (s, 2 H), 8.15 (br. s., 1 H), 8.33 (s, 1 H), 8.35 - 8.43 (m, 1 H), 9.04 - 9.41 (m, 1 H). Method A (Example 4, CBZ was used instead of Boc as the protecting group of the ring nitrogen of the 3-amino piperidine piece)</p>
63		<p>6-(1H-benzimidazol-1-yl)-N-[(3S)-piperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, MeOD) <math>\delta</math> ppm 1.46 - 1.60 (m, 1 H), 1.59 - 1.74 (m, 1 H), 1.82 (ddd, <math>J</math> = 13.4, 3.8, 3.7 Hz, 1 H), 1.89 (d, <math>J</math> = 3.5 Hz, 1 H), 2.10 - 2.21 (m, 1 H), 2.53 (dd, <math>J</math> = 11.9, 9.8 Hz, 1 H), 2.57 - 2.64 (m, 1 H), 2.96 (d, <math>J</math> = 12.6 Hz, 1 H), 3.95 - 4.07 (m, 1 H), 7.39 (d, <math>J</math> = 7.3 Hz, 1 H), 7.45 (t, <math>J</math> = 7.3 Hz, 1 H), 7.76 (d, <math>J</math> =</p>

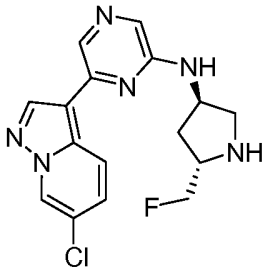
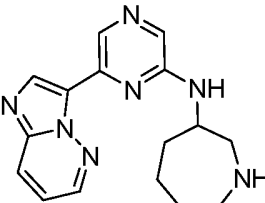
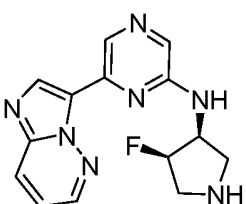
Ex.	Structure	Name, Data and Preparation Method
		8.1 Hz, 1 H), 7.88 (s, 1 H), 8.14 (s, 1 H), 8.17 (d, $J = 8.2$ Hz, 1 H), 8.82 (s, 1 H); LCMS: $M+1$ 295. Method B (Example 1).
64		6-(1,2-dimethyl-1H-imidazol-5-yl)-N-[(3R)-piperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO- $d_6$ ) $\delta$ ppm 1.48 - 1.64 (m, 1 H) 2.67 (s, 3 H) 2.74 - 2.84 (m, 1 H) 2.85 - 2.96 (m, 1 H) 3.07 - 3.25 (m, 2 H) 3.27 - 3.37 (m, 1 H) 3.42 (d, $J=7.55$ Hz, 1 H) 3.98 (s, 3 H) 4.10 - 4.29 (m, 1 H) 7.76 (d, $J=6.29$ Hz, 1 H) 8.03 (s, 1 H) 8.15 (d, $J=3.78$ Hz, 2 H) 8.49 (br. s., 1 H) 9.39 (br. s., 1 H). Method A (Example 4).
65		6-(7-chloroimidazo[1,2-a]pyridin-3-yl)-N-[(3S,4S)-4-fluoropyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, D $_2$ O) $\delta$ ppm 3.58 (dd, $J=13.26$ , 2.91 Hz, 1 H), 3.67 - 3.85 (m, 2 H), 3.98 (dd, $J=13.14$ , 6.82 Hz, 1 H), 4.85 (dd, $J=14.02$ , 3.92 Hz, 1 H), 5.39 - 5.56 (m, 1 H), 7.55 (dd, $J=7.45$ , 1.89 Hz, 1 H), 8.03 (s, 1 H), 8.08 (d, $J=1.26$ Hz, 1 H), 8.43 (s, 1 H), 8.31 (s, 1 H), 9.67 (d, $J=7.33$ Hz, 1 H). Method A (Example 4).
66		N-[(3S,4S)-4-fluoropyrrolidin-3-yl]-6-(pyrazolo[1,5-a]pyridin-3-yl)pyrazin-2-amine 1H NMR (400 MHz, MeOD) $\delta$ ppm 3.44 - 3.74 (m, 3 H), 3.88 (dd, $J = 12.4$ , 5.8 Hz, 1 H), 4.77 - 4.88 (m, 1 H), 5.44 (d, $J = 52.0$ Hz, 1 H), 7.01 (t, $J = 6.6$ Hz, 1 H), 7.36 (d, $J = 8.1$ Hz, 1 H), 7.75 (br. s., 1 H), 8.30 (s, 1 H), 8.43 - 8.69 (m, 3 H); LCMS $m/z$ 299 ( $M+H$ ). Method E (Example 6).

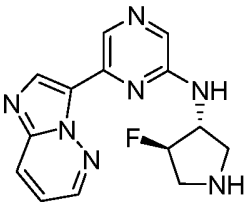
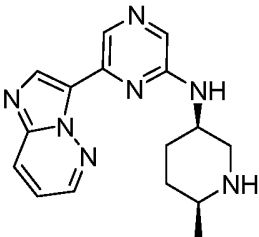
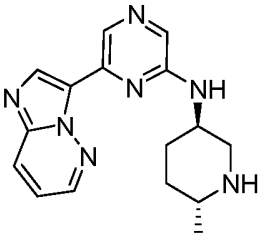
Ex.	Structure	Name, Data and Preparation Method
67		N-[(3R,5S)-5-(fluoromethyl)pyrrolidin-3-yl]-6-imidazo[1,2-a]pyridin-3-ylpyrazin-2-amine 1H NMR (400 MHz, MeOD): $\delta$ ppm 2.19-2.11 (m, 2H), 3.20-3.16 (m, 1H), 3.50-3.47 (m, 1H), 3.95-3.80 (m, 1H), 4.70-4.39 (m, 3H), 7.09-7.06 (t, 1H), 7.45-7.43 (t, 1H), 7.65-7.63 (d, 1H), 7.77 (s, 1H), 8.21 (s, 1H), 8.28, (s, 1H), 9.76-9.74 (d, 1H). Method A (Example 26).
68		6-(1-benzyl-2-methyl-1H-imidazol-5-yl)-N-[(3R,6R)-6-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, MeOD) $\delta$ ppm 0.98 - 1.11 (m, 1 H) 1.13 (d, J=6.55 Hz, 3 H) 1.31 - 1.47 (m, 1 H) 1.70 - 1.80 (m, 1 H) 1.91 (s, 3 H) 2.29 (s, 3 H) 2.39 - 2.49 (m, 1 H) 2.67 - 2.83 (m, 1 H) 3.08 - 3.21 (m, 1 H) 3.59 - 3.79 (m, 1 H) 5.78 (dd, 2 H) 7.08 (d, J=7.05 Hz, 2 H) 7.20 - 7.38 (m, 3 H) 7.42 (s, 1 H) 7.68 (s, 1 H) 7.96 (s, 1 H). Method A (Example 4).
69		N-[6-(1,2-dimethyl-1H-imidazol-5-yl)pyrazin-2-yl]azepan-3-amine 1H NMR (400 MHz, MeOD) $\delta$ ppm 1.58 - 1.79 (m, 2 H) 1.78 - 1.95 (m, 5 H) 2.04 - 2.17 (m, 1 H) 2.42 (s, 3 H) 2.96 - 3.14 (m, 3 H) 3.88 (s, 3 H) 4.10 - 4.31 (m, 1 H) 7.28 (s, 1 H) 7.75 (s, 1 H) 7.95 (s, 1 H). Method A (Example 4).
70		6-(1,2-dimethyl-1H-imidazol-5-yl)-N-[(3R,6S)-6-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, MeOD) $\delta$ ppm 1.27 (d, J=6.55 Hz, 3 H) 1.89 (s, 3 H) 1.92 - 2.07 (m, 2 H) 2.41 (s, 3 H) 2.99 - 3.17 (m, 2 H) 3.43 - 3.55 (m, 2 H) 3.86 (s, 3 H) 4.08 - 4.18 (m, 1 H) 7.27 (s, 1 H) 7.83 (s, 1 H) 8.01 (s, 1 H) Method A (Example 4).

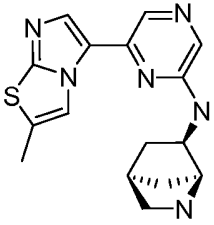
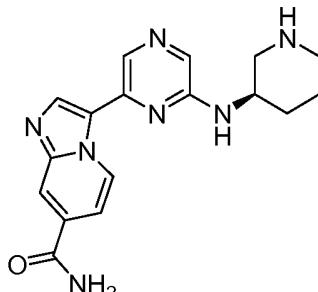
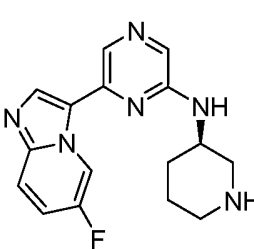


Ex.	Structure	Name, Data and Preparation Method
71		6-(1,2-dimethyl-1H-imidazol-5-yl)-N-[(3R,6R)-6-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, MeOD) $\delta$ ppm 1.29 (d, J=6.29 Hz, 3 H) 1.47 - 1.65 (m, 2 H) 1.96 - 2.05 (m, 1 H) 2.10 - 2.21 (m, 1 H) 2.41 (s, 3 H) 3.03 - 3.17 (m, 1 H) 3.53 - 3.60 (m, 1 H) 3.85 (s, 3 H) 4.05 - 4.18 (m, 1 H) 7.25 (s, 1 H) 7.71 (s, 1 H) 7.94 (s, 1 H). Method A (Example 4).
72		6-(1-benzyl-2-methyl-1H-imidazol-5-yl)-N-[(3R)-piperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d6) $\delta$ ppm 1.06 - 1.32 (m, 2 H) 1.52 (d, J=14.60 Hz, 1 H) 1.61 - 1.72 (m, 1 H) 2.20 - 2.23 (m, 3 H) 2.63 - 2.73 (m, 1 H) 2.81 (d, J=12.09 Hz, 1 H) 3.28 - 3.55 (m, 1 H) 5.62 - 5.91 (m, 2 H) 6.98 (t, J=6.29 Hz, 3 H) 7.27 - 7.33 (m, 2 H) 7.46 (s, 1 H) 7.71 (s, 1 H) 7.99 (s, 1 H) Method A (Example 4).
73		6-(1,2-dimethyl-1H-imidazol-5-yl)-N-[(3R)-pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d6) $\delta$ ppm 1.90 - 2.05 (m, 1 H) 2.17 - 2.30 (m, 1 H) 2.30 - 2.36 (m, 1 H) 2.66 (s, 3 H) 3.04 - 3.19 (m, 1 H) 3.20 - 3.31 (m, 2 H) 3.95 (s, 3 H) 4.38 - 4.53 (m, 1 H) 8.04 (s, 1 H) 8.13 (s, 1 H) 8.17 (s, 1 H) 9.36 (br. s., 1 H) 9.48 (br. s., 1 H). Method A (Example 4).
74		N-[6-(1-benzyl-2-methyl-1H-imidazol-5-yl)pyrazin-2-yl]azepan-3-amine 1H NMR (400 MHz, DMSO-d6) $\delta$ ppm 1.16 - 1.31 (m, 1 H) 1.35 - 1.44 (m, 1 H) 1.45 - 1.58 (m, J=7.30 Hz, 3 H) 1.58 - 1.67 (m, 1 H) 1.87 (s, 3 H) 2.56 - 2.64 (m, 1 H) 2.64 - 2.77 (m, 2 H) 3.56 - 3.66 (m, J=8.56 Hz, 1 H) 5.68 - 5.86 (m, 2 H) 6.95 (t, J=8.31 Hz,

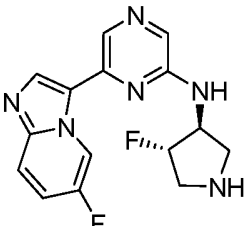
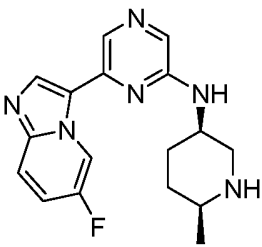
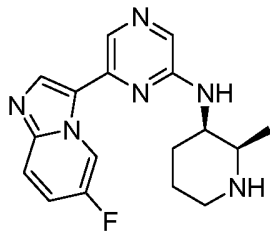
Ex.	Structure	Name, Data and Preparation Method
		3 H) 7.26 - 7.32 (m, 2 H) 7.44 (s, 1 H) 7.72 (s, 1 H) 7.96 (s, 1 H). Method A (Example 4).
75		6-(1-benzyl-2-methyl-1H-imidazol-5-yl)-N-[(3R)-pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) $\delta$ ppm 1.41 - 1.54 (m, 1 H) 1.67 - 1.78 (m, 1 H) 2.21 - 2.25 (m, 3 H) 2.52 - 2.59 (m, 1 H) 2.65 - 2.76 (m, 2 H) 2.82 - 2.94 (m, 1 H) 3.82 - 4.01 (m, J=6.55 Hz, 1 H) 5.76 (s, 2 H) 6.96 (d, J=7.05 Hz, 2 H) 7.21 - 7.38 (m, 3 H) 7.46 (s, 1 H) 7.69 (s, 1 H) 8.02 (s, 1 H). Method A (Example 4).
76		6-(1,2-dimethyl-1H-imidazol-5-yl)-N-[(3R,4S)-4-fluoropyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) $\delta$ ppm 1.90 (s, 1 H) 2.33 (s, 3 H) 3.01 (d, J=15.61 Hz, 1 H) 3.17 - 3.27 (m, 1 H) 3.42 - 3.55 (m, 1 H) 3.84 (s, 3 H) 4.39 (d, J=17.88 Hz, 1 H) 5.13 (d, J=52.12 Hz, 1 H) 7.37 (s, 1 H) 7.79 (s, 1 H) 8.11 (s, 1 H). Method A (Example 4).
77		6-(1,2-dimethyl-1H-imidazol-5-yl)-N-[(3S,4S)-4-fluoropyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) $\delta$ ppm 2.89 (s, 3 H) 3.18 - 3.32 (m, 2 H) 3.74 - 3.83 (m, 2 H) 4.35 (s, 3 H) 5.35 - 5.83 (m, 1 H) 7.32 (d, J=9.06 Hz, 1 H) 7.79 (s, 1 H) 8.43 (s, 1 H) 8.54 (s, 1 H). Method A (Example 4).
78		N-[(3R,5S)-5-(fluoromethyl)pyrrolidin-3-yl]-6-[7-(trifluoromethyl)imidazo[1,2-a]pyridin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, MeOD): $\delta$ ppm 2.47-2.24 (m, 2H), 3.48-3.30 (m, 1H), 3.70-3.62 (m, 1H), 4.22-4.09 (m, 1H), 4.79-4.56 (m, 3H), 7.34-7.32 (d, 1H), 7.90 (s, 1H), 8.03 (s, 1H),

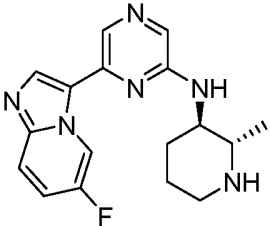
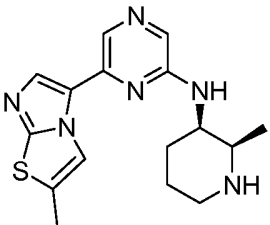
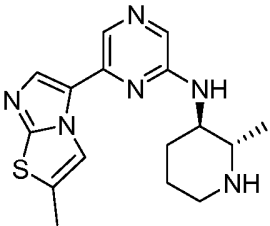
Ex.	Structure	Name, Data and Preparation Method
		8.42-8.39 (d, 2H), 9.88-9.86 (d, 1H). Method A (Example 26).
79		6-(6-chloropyrazolo[1,5-a]pyridin-3-yl)-N-[(3R,5S)-5-(fluoromethyl)pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, MeOD): $\delta$ ppm 2.12-2.04 (m, 2H), 3.03-3.09 (m, 1H), 3.44-3.40 (m, 1H), 3.81-3.70 (m, 1H), 4.62-4.40 (m, 3H), 7.41-7.38 (d, 1H), 7.70 (s, 1H), 8.19 (s, 1H), 8.55-8.52 (m, 2H), 8.76 (s, 1H). Method A (Example 26).
80		N-(6-imidazo[1,2-b]pyridazin-3-yl)pyrazin-2-ylazepan-3-amine, acetate salt 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) $\delta$ ppm 1.43 - 1.75 (m, 4 H) 1.88 (s, 3 H) 1.90 - 2.02 (m, 1 H) 2.63 - 2.73 (m, 1 H) 2.79 (t, J=5.79 Hz, 2 H) 3.05 (dd, J=13.47, 4.41 Hz, 1 H) 3.93 - 4.14 (m, J=7.05 Hz, 1 H) 7.09 (d, J=7.05 Hz, 1 H) 7.36 (dd, J=9.19, 4.41 Hz, 1 H) 7.93 (s, 1 H) 8.28 (dd, J=9.32, 1.76 Hz, 1 H) 8.39 (s, 1 H) 8.74 (dd, J=4.53, 1.51 Hz, 1 H) 8.83 (s, 1 H). Method A (Example 4).
81		N-[(3S,4R)-4-fluoropyrrolidin-3-yl]-6-imidazo[1,2-b]pyridazin-3-ylpyrazin-2-amine, acetate salt 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) $\delta$ ppm 1.83 (s, 3 H) 2.52 - 2.67 (m, 1 H) 2.94 (dd, J=29.84, 13.47 Hz, 1 H) 4.13 - 4.38 (m, 1 H) 4.97 - 5.40 (m, 1 H) 7.24 - 7.39 (m, 2 H) 7.99 (s, 1 H) 8.23 (dd, J=9.19, 1.64 Hz, 1 H) 8.44 (s, 1 H) 8.70 (dd, J=4.53, 1.51 Hz, 1 H) 8.86 (s, 1 H). Method A (Example 4).

Ex.	Structure	Name, Data and Preparation Method
82		<p>N-[(3R,4R)-4-fluoropyrrolidin-3-yl]-6-imidazo[1,2-b]pyridazin-3-ylpyrazin-2-amine 1H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 1.80 - 1.87 (m, 3 H) 2.64 - 2.75 (m, 1 H) 2.92 - 3.11 (m, 2 H) 4.22 - 4.46 (m, 1 H) 5.05 (d, J=54.39 Hz, 1 H) 7.38 (dd, J=9.06, 4.53 Hz, 2 H) 7.94 (s, 1 H) 8.21 - 8.32 (m, 1 H) 8.43 (s, 1 H) 8.75 (dd, J=4.66, 1.64 Hz, 1 H) 8.94 (s, 1 H). Method A (Example 4).</p>
83		<p>6-imidazo[1,2-b]pyridazin-3-yl-N-[(3R,6S)-6-methylpiperidin-3-yl]pyrazin-2-amine, acetate salt 1H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 0.96 - 1.03 (m, 1 H) 1.04 (d, J=6.29 Hz, 3 H) 1.27 - 1.50 (m, 2 H) 1.57 - 1.72 (m, 1 H) 1.89 (s, 3 H) 1.91 - 1.96 (m, 1 H) 2.59 - 2.69 (m, 1 H) 2.84 (dd, J=12.59, 2.77 Hz, 1 H) 2.99 (d, J=12.59 Hz, 1 H) 3.95 - 4.08 (m, 1 H) 7.14 (d, J=7.05 Hz, 1 H) 7.36 (dd, J=9.19, 4.41 Hz, 1 H) 8.05 (s, 1 H) 8.27 (dd, J=9.32, 1.76 Hz, 1 H) 8.36 (s, 1 H) 8.73 (dd, J=4.41, 1.64 Hz, 1 H) 8.83 (s, 1 H). Method A (Example 4).</p>
84		<p>6-imidazo[1,2-b]pyridazin-3-yl-N-[(3R,6R)-6-methylpiperidin-3-yl]pyrazin-2-amine, acetate salt 1H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 1.02 (d, J=6.29 Hz, 3 H) 1.16 - 1.28 (m, 1 H) 1.28 - 1.44 (m, 1 H) 1.62 - 1.75 (m, 1 H) 1.86 (s, 3 H) 2.03 (d, J=11.83 Hz, 1 H) 2.22 - 2.34 (m, 1 H) 3.19 - 3.35 (m, 1 H) 3.67 - 3.90 (m, 1 H) 7.05 (d, J=7.30 Hz, 1 H) 7.36 (dd, J=9.19, 4.41 Hz, 1 H) 7.87 (s, 1 H) 8.28 (dd, J=9.19, 1.64 Hz, 1 H) 8.41 (s, 1 H) 8.74 (dd, J=4.53, 1.51 Hz, 1 H) 8.83 (s, 1 H). Method A (Example 4).</p>

Ex.	Structure	Name, Data and Preparation Method
85		<p>(1S,4R,6R)-2-Aza-bicyclo[2.2.1]hept-6-yl-[6-(2-methyl-imidazo[2,1-b]thiazol-5-yl)-pyrazin-2-yl]-amine 1H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 1.39 - 1.51 (m, 1 H), 1.73 - 1.84 (m, 1 H), 1.96 - 2.05 (m, 1 H), 2.20 - 2.34 (m, 1 H), 2.56 (s, 3 H), 2.65 - 2.73 (m, 1 H), 3.13 (br. s., 2 H), 4.17 (br. s., 1 H), 4.35 - 4.53 (m, 1 H), 7.91 - 8.06 (m, 2 H), 8.29 - 8.45 (m, 3 H), 8.53 (br. s., 1 H), 9.80 (br. s., 1 H). Method A (Example 7).</p>
86		<p>3-{6-[(3R)-piperidin-3-ylamino]pyrazin-2-yl}imidazo[1,2-a]pyridine-7-carboxamide 1H NMR (400 MHz, MeOD): δ ppm 1.801-1.727 (m, 1H), 1.975-1.860 (m, 1H), 2.162-2.2.113 (m, 1H), 2.277-2.245 (m, 1H), 3.105-3.040 (m, 2H), 3.350-3.326 (m, 1H), 3.606-3.576 (d, 3H), 4.327-4.281 (m, 1H), 7.601-7.579 (m, 1H), 7.882 (s, 1H), 8.224 (s, 1H), 8.365-8.355 (d, 2H), 8.508 (s, 1H), 9.67 (d, 1H). Method F (Example 24)</p>
87		<p>6-(6-fluoroimidazo[1,2-a]pyridin-3-yl)-N-[(3R)-piperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 1.63 (d, J=9.82 Hz, 1 H) 1.80 (dd, J=10.07, 3.78 Hz, 1 H) 1.92 - 2.03 (m, 1 H) 2.03 - 2.15 (m, 1 H) 2.97 (d, J=3.78 Hz, 2 H) 3.18 (d, J=18.38 Hz, 1 H) 3.28 - 3.43 (m, 1 H) 4.23 (s, 1 H) 7.94 - 8.00 (m, 1 H) 8.03 - 8.07 (m, 2 H) 8.08 - 8.15 (m, 1 H) 8.46 (s, 1 H) 8.96 (s, 1 H) 9.36 (d, J=3.27 Hz, 1 H) 9.88 (br. s., 1 H). Method A (Example 7).</p>

Ex.	Structure	Name, Data and Preparation Method
88		6-(6-fluoroimidazo[1,2-a]pyridin-3-yl)-N-[(3R,6R)-6-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, MeOD) $\delta$ ppm 1.37 (d, 3 H) 1.62 - 1.76 (m, 2 H) 2.07 - 2.18 (m, 1 H) 2.25 - 2.39 (m, 1 H) 2.68 (s, 1 H) 2.93 (t, J=11.96 Hz, 1 H) 3.56 - 3.69 (m, 1 H) 4.12 - 4.34 (m, 1 H) 8.04 (s, 1 H) 8.11 (dd, J=6.04, 1.51 Hz, 2 H) 8.34 (s, 1 H) 8.76 (s, 1 H) 9.85 (d, J=4.28 Hz, 1 H). Method A (Example 7).
89		N-[(3R,5S)-5-(difluoromethyl)pyrrolidin-3-yl]-6-[7-(trifluoromethyl)imidazo[1,2-a]pyridin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, MeOD): $\delta$ ppm 2.19-2.10 (m, 1H), 2.38-2.33 (m, 1H), 3.21-3.15 (m, 1H), 3.41-3.37 (m, 1H), 3.91-3.80 (m, 1H), 4.64-4.60 (m, 1H), 6.10-5.81 (m, 1H), 7.35-7.33 (d, 1H), 7.87 (s, 1H), 8.05 (s, 1H), 8.38 (s, 1H), 8.45 (s, 1H), 9.99-9.97 (d, 1H). Method A (Example 7).
90		6-(6-fluoroimidazo[1,2-a]pyridin-3-yl)-N-[(3S,4R)-4-fluoropyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, MeOD) $\delta$ ppm 3.12 (t, J=10.83 Hz, 1 H) 3.45 - 3.49 (m, 1 H) 3.52 - 3.59 (m, 1 H) 3.58 - 3.66 (m, 1 H) 4.63 - 4.82 (m, 1 H) 5.20 - 5.49 (m, 1 H) 7.36 - 7.48 (m, 1 H) 7.68 (dd, J=9.69, 4.91 Hz, 1 H) 7.90 (s, 1 H) 8.26 (s, 1 H) 8.31 (s, 1 H) 9.63 (dd, J=5.16, 1.89 Hz, 1 H). Method A (Example 7).
91		6-(6-fluoroimidazo[1,2-a]pyridin-3-yl)-N-[(3R)-pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) $\delta$ ppm 1.72 - 1.85 (m, 1 H) 2.04 - 2.21 (m, 1 H) 2.88 - 2.99 (m, 2 H) 3.00 - 3.09 (m, 1 H) 3.19 (dd, J=11.46, 6.17 Hz, 1 H) 4.26 -

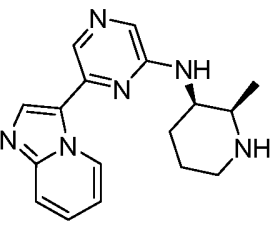
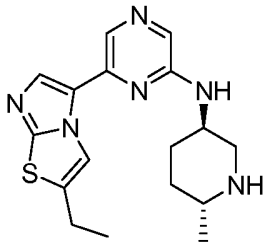
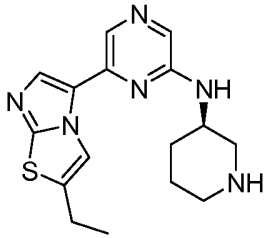
Ex.	Structure	Name, Data and Preparation Method
		4.38 (m, 1 H) 7.44 - 7.56 (m, 1 H) 7.67 (d, J=6.04 Hz, 1 H) 7.76 - 7.81 (m, 1 H) 7.82 (s, 1 H) 8.38 (s, 1 H) 8.46 (s, 1 H) 9.88 (dd, J=5.54, 2.27 Hz, 1 H). Method A (Example 7).
92		6-(6-fluoroimidazo[1,2-a]pyridin-3-yl)-N-[(3S,4S)-4-fluoropyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) δ ppm 2.77 (dd, J=11.83, 4.28 Hz, 1 H) 2.87 - 3.09 (m, 2 H) 3.41 (dd, J=11.83, 6.80 Hz, 1 H) 4.15 - 4.39 (m, 1 H) 5.06 (d, J=52.88 Hz, 1 H) 7.39 (d, J=4.78 Hz, 1 H) 7.44 - 7.54 (m, 1 H) 7.73 - 7.81 (m, 1 H) 7.84 (s, 1 H) 8.46 (s, 1 H) 8.50 (s, 1 H) 9.93 (dd, J=5.54, 2.01 Hz, 1 H). Method A (Example 7).
93		6-(6-fluoroimidazo[1,2-a]pyridin-3-yl)-N-[(3R,6S)-6-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) δ ppm 1.15 (d, J=6.29 Hz, 3 H) 1.48 - 1.65 (m, 2 H) 1.71 - 1.86 (m, 1 H) 1.90 (none, 1 H) 1.97 (d, J=13.09 Hz, 1 H) 2.91 (br. s., 1 H) 3.05 (dd, J=12.72, 2.64 Hz, 1 H) 3.22 (d, J=12.59 Hz, 1 H) 3.93 - 4.22 (m, 1 H) 7.44 - 7.51 (m, 1 H) 7.52 - 7.57 (m, 1 H) 7.80 (dd, J=9.82, 5.54 Hz, 1 H) 7.94 (s, 1 H) 8.37 (s, 1 H) 8.46 (s, 1 H) 9.75 (dd, J=5.54, 2.27 Hz, 1 H). Method A (Example 7).
94		6-(6-fluoroimidazo[1,2-a]pyridin-3-yl)-N-[(2R,3R)-2-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) δ ppm 1.05 (d, J=6.55 Hz, 3 H) 1.29 - 1.48 (m, 1 H) 1.55 - 1.71 (m, 2 H) 2.01 (d, J=7.81 Hz, 1 H) 2.58 - 2.73 (m, 1 H) 2.87 - 3.09 (m, 2 H) 4.00 (d, J=5.79 Hz, 1 H) 7.28 (d, J=8.31 Hz, 1 H) 7.42 - 7.54 (m, 1 H) 7.74 - 7.84 (m, 1 H) 8.04 (s, 1 H) 8.31 (s, 1 H) 8.43 (s, 1 H)

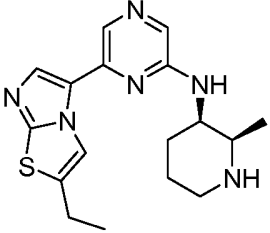
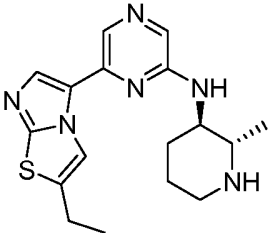
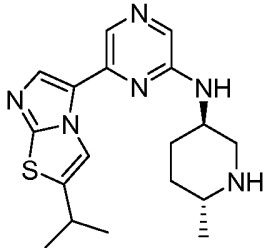
Ex.	Structure	Name, Data and Preparation Method
		9.78 (dd, J=5.41, 2.14 Hz, 1 H). Method A (Example 7).
95		6-(6-fluoroimidazo[1,2-a]pyridin-3-yl)-N-[(2S,3R)-2-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d6) $\delta$ ppm 1.09 (d, J=6.04 Hz, 3 H) 1.19 - 1.37 (m, 1 H) 1.46 - 1.61 (m, 1 H) 1.63 - 1.73 (m, 1 H) 2.17 (d, J=9.57 Hz, 1 H) 2.58 - 2.67 (m, 1 H) 2.94 (d, J=12.09 Hz, 1 H) 3.48 (d, J=8.06 Hz, 1 H) 7.25 (d, J=8.56 Hz, 1 H) 7.45 - 7.55 (m, 1 H) 7.76 - 7.85 (m, 2 H) 8.33 (s, 1 H) 8.46 (s, 1 H) 9.86 (dd, J=5.41, 2.14 Hz, 1 H). Method A (Example 7).
96		6-(2-methylimidazo[2,1-b][1,3]thiazol-5-yl)-N-[(2R,3R)-2-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d6) $\delta$ ppm 1.03 (d, J=6.55 Hz, 3 H) 1.31 - 1.44 (m, 1 H) 1.63 (d, J=9.06 Hz, 2 H) 1.89 (s, 3 H) 1.90 - 1.98 (m, J=5.04 Hz, 1 H) 2.59 - 2.68 (m, 1 H) 2.90 - 3.07 (m, 2 H) 3.98 (d, J=5.79 Hz, 1 H) 7.09 (d, J=7.81 Hz, 1 H) 7.92 (s, 1 H) 7.95 (s, 1 H) 8.15 (s, 1 H) 8.23 (br. s., 1 H). Method A (Example 7).
97		6-(2-methylimidazo[2,1-b][1,3]thiazol-5-yl)-N-[(2S,3R)-2-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d6) $\delta$ ppm 1.07 (d, J=6.04 Hz, 3 H) 1.16 - 1.32 (m, 1 H) 1.45 - 1.61 (m, 1 H) 1.65 - 1.75 (m, 1 H) 1.89 (s, 3 H) 2.07 - 2.21 (m, 1 H) 2.56 - 2.63 (m, 1 H) 2.95 (d, J=12.09 Hz, 1 H) 3.28 - 3.55 (m, 1 H) 7.11 (d, J=8.06 Hz, 1 H) 7.74 (s, 1 H) 7.95 (s, 1 H) 8.17 (s, 1 H) 8.30 (br. s., 1 H). Method A (Example 7).



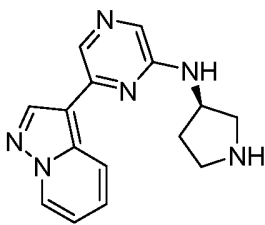
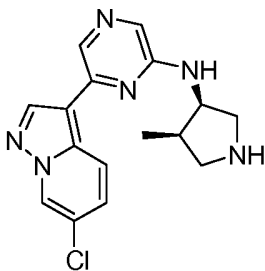
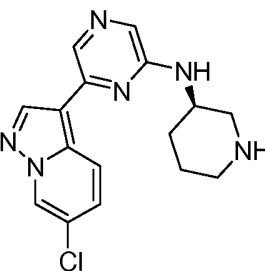
Ex.	Structure	Name, Data and Preparation Method
98		N-(3-methylpyrrolidin-3-yl)-6-(5,6,7,8-tetrahydroimidazo[1,2-a]pyridin-3-yl)pyrazin-2-amine <sup>1</sup> H NMR (400 MHz, MeOD) δ ppm 1.65 (s, 1 H) 1.90 (s, 3 H) 1.92 - 2.13 (m, 4 H) 2.40 - 2.52 (m, 3 H) 2.92 (t, J=6.3 Hz, 2 H) 3.14 (d, J=11.8 Hz, 1 H) 3.36 - 3.46 (m, 2 H) 4.02 (d, J=11.8 Hz, 1 H) 4.25 - 4.43 (m, 2 H) 7.37 (s, 1 H) 7.78 (s, 1 H) 8.02 (s, 1 H). Method A (Example 7).
99		6-imidazo[1,2-a]pyridin-3-yl-N-(3-methylpyrrolidin-3-yl)pyrazin-2-amine <sup>1</sup> H NMR (400 MHz, MeOD) δ ppm 1.74 (s, 2 H) 1.90 (s, 3 H) 2.06 - 2.22 (m, 2 H) 3.15 - 3.25 (m, 1 H) 3.36 - 3.45 (m, 2 H) 3.95 - 4.08 (m, 1 H) 7.06 - 7.19 (m, 1 H) 7.43 - 7.52 (m, 1 H) 7.65 - 7.73 (m, 1 H) 7.83 - 7.88 (m, 1 H) 8.19 - 8.23 (m, 1 H) 8.29 - 8.34 (m, 1 H) 9.40 - 9.60 (m, 1 H). Method A (Example 7).
100		6-(6-chloropyrazolo[1,5-a]pyridin-3-yl)-N-[(3R,5S)-5-(difluoromethyl)pyrrolidin-3-yl]pyrazin-2-amine <sup>1</sup> H NMR (400 MHz, MeOD): δ ppm 2.00-1.95 (m, 1H), 2.24-2.17 (m, 1H), 3.03-2.98 (m, 1H), 3.23-3.18 (m, 1H), 3.72-3.65 (m, 1H), 4.49-4.47 (m, 1H), 5.91-5.63 (m, 1H), 7.30-7.28 (d, 1H), 7.61 (s, 1H), 8.10 (s, 1H), 8.44-8.39 (m, 2H), 8.64 (s, 1H). Method A (Example 7).
101		6-imidazo[1,2-a]pyridin-3-yl-N-[(2S,3R)-2-methylpiperidin-3-yl]pyrazin-2-amine <sup>1</sup> H NMR (400 MHz, DEUTERIUM OXIDE) δ ppm 1.29 (d, J=6.57 Hz, 3 H) 1.45 - 1.63 (m, 1 H) 1.67 - 1.86(m, 1 H) 1.97 (dd, J=11.75, 2.91 Hz, 1 H) 2.07 - 2.22 (m, 1 H) 2.94 (td, J=12.76, 3.03 Hz, 1 H) 3.12 - 3.28 (m, 1 H) 3.34 (d, J=12.63 Hz, 1 H)

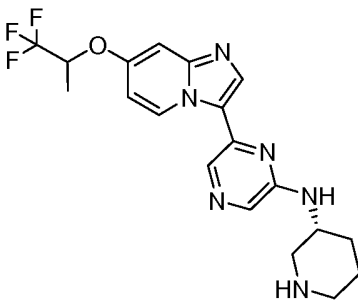
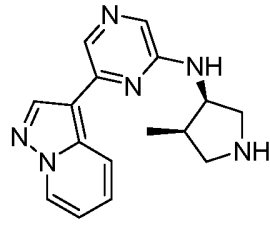
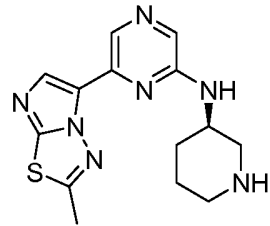
Ex.	Structure	Name, Data and Preparation Method
		4.08 (td, J=10.67, 3.92 Hz, 1 H) 7.37 - 7.56 (m, 1 H) 7.90 (d, J=5.31 Hz, 3 H) 8.12 (s, 1 H) 8.33 (s, 1 H) 9.48 (d, J=7.07 Hz, 1 H). Method A (Example 4).
102		6-(7-chloroimidazo[1,2-a]pyridin-3-yl)-N-[(2R,3R)-2-methylpiperidin-3-yl]pyrazin-2-amine <sup>1</sup> H NMR (400 MHz, DEUTERIUM OXIDE) δ ppm 1.23 (d, J=6.82 Hz, 3 H) 1.73 - 1.87 (m, 1 H) 1.93 (br. s., 3 H) 2.99 - 3.17 (m, 1 H) 3.23 - 3.39 (m, 1 H) 3.65 - 3.81 (m, 1 H) 4.38 - 4.51 (m, 1 H) 7.53 (d, J=7.07 Hz, 1H) 7.91 - 8.10 (m, 2 H) 8.12 - 8.25 (m, 1 H) 8.35 (s, 1 H) 9.47 (d, J=7.33 Hz, 1 H). Method A (Example 7).
103		6-(2-ethylimidazo[2,1-b][1,3]thiazol-5-yl)-N-[(3R,6S)-6-methylpiperidin-3-yl]pyrazin-2-amine <sup>1</sup> H NMR (400 MHz, DMSO-d <sub>6</sub> ) δ ppm 1.03 (d, J=6.29 Hz, 3 H) 1.20 - 1.40 (m, 6 H) 1.41 - 1.51 (m, 1 H) 1.90 - 2.02 (m, 1 H) 2.79 - 2.93 (m, 3 H) 3.00 (d, J=13.09 Hz, 1 H) 3.88 - 4.01 (m, J=9.06 Hz, 1 H) 7.09 (d, J=7.55 Hz, 1 H) 7.91 (d, J=8.81 Hz, 2 H) 8.17 (s, 1 H) 8.26 (s, 1 H). Method A (Example 7).
104		6-(7-chloroimidazo[1,2-a]pyridin-3-yl)-N-[(2S,3R)-2-methylpiperidin-3-yl]pyrazin-2-amine <sup>1</sup> H NMR (400 MHz, DEUTERIUM OXIDE) δ ppm 1.34 (d, J=6.57 Hz, 3 H) 1.48 - 1.69 (m, 1 H) 1.72 - 1.90 (m, 1 H) 1.94 - 2.08 (m, 1 H) 2.10 - 2.27 (m, 1 H) 2.87 - 3.09 (m, 1 H) 3.19 - 3.33 (m, 1 H) 3.39 (d, J=12.63 Hz, 1 H) 4.01 - 4.22 (m, 1 H) 7.49 - 7.68 (m, 1 H) 7.95 (s, 1 H) 8.08 (s, 1 H) 8.17 (s, 1 H) 8.39 (s, 1 H) 9.52 (d, J=7.33 Hz, 4 H). Method A (Example 7).

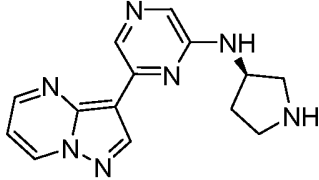
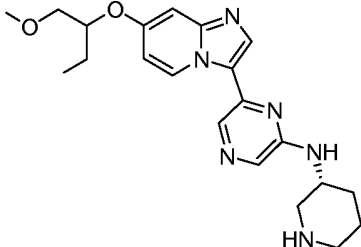
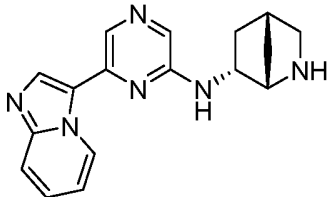
Ex.	Structure	Name, Data and Preparation Method
105		6-imidazo[1,2-a]pyridin-3-yl-N-[(2R,3R)-2-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DEUTERIUM OXIDE) $\delta$ ppm 1.21 (d, J=7.07 Hz, 3 H) 1.69 - 1.84 (m, 1 H) 1.85 - 2.02 (m, 3 H) 2.97 - 3.12 (m, 1 H) 3.20 - 3.34 (m, 1 H) 3.63 - 3.78 (m, 1 H) 4.36 - 4.51 (m, 1 H) 7.47 (t, J=6.82 Hz, 1 H) 7.84 - 8.03 (m, 3 H) 8.15 (s, 1 H) 8.33 (s, 1 H) 9.46 (d, J=7.07 Hz, 1 H). Method A (Example 4).
106		6-(2-ethylimidazo[2,1-b][1,3]thiazol-5-yl)-N-[(3R,6R)-6-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) $\delta$ ppm 1.29 (s, 1 H) 1.30 (s, 3 H) 1.32 (s, 2 H) 1.41 - 1.58 (m, 1 H) 1.67 - 1.84 (m, 1 H) 1.86 - 1.99 (m, 1 H) 2.15 (d, J=13.60 Hz, 1 H) 2.74 - 2.88 (m, J=11.58 Hz, 1 H) 3.01 - 3.11 (m, 2 H) 3.15 - 3.26 (m, J=9.57 Hz, 1 H) 3.38 (d, J=11.08 Hz, 1 H) 4.32 - 4.43 (m, 1 H) 7.89 (s, 1 H) 8.31 (s, 1 H) 8.35 (s, 1 H) 8.46 (s, 1 H) 9.24 - 9.42 (m, 1 H) 9.90 (d, J=12.34 Hz, 1 H). Method A (Example 7).
107		6-(2-ethylimidazo[2,1-b][1,3]thiazol-5-yl)-N-[(3R)-piperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) $\delta$ ppm 1.31 (t, 3 H) 1.39 - 1.59 (m, 2 H) 1.64 - 1.77 (m, 1 H) 1.98 - 2.05 (m, J=9.06 Hz, 1 H) 2.45 (dd, J=11.46, 8.94 Hz, 1 H) 2.81 - 2.91 (m, 3 H) 3.16 (d, J=11.58 Hz, 1 H) 3.69 - 3.90 (m, J=3.02 Hz, 1 H) 7.13 (d, J=7.30 Hz, 1 H) 7.76 (s, 1 H) 7.94 (s, 1 H) 8.18 (s, 1 H) 8.32 (s, 1 H). Method A (Example 7).

Ex.	Structure	Name, Data and Preparation Method
108		<p>6-(2-ethylimidazo[2,1-b][1,3]thiazol-5-yl)-N-[(2R,3R)-2-methylpiperidin-3-yl]pyrazin-2-amine</p> <p><sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 1.01 (d, J=6.55 Hz, 3 H) 1.30 (t, J=7.43 Hz, 3 H) 1.34 - 1.42 (m, 1 H) 1.51 - 1.68 (m, 2 H) 1.91 - 2.03 (m, 1 H) 2.56 - 2.65 (m, 1 H) 2.84 (q, 2 H) 2.90 - 3.00 (m, 2 H) 3.97 (d, J=2.52 Hz, 1 H) 6.99 (d, J=8.06 Hz, 1 H) 7.91 (s, 1 H) 7.97 (s, 1 H) 8.14 (s, 1 H) 8.25 (s, 1 H). Method A (Example 7).</p>
109		<p>6-(2-ethylimidazo[2,1-b][1,3]thiazol-5-yl)-N-[(2S,3R)-2-methylpiperidin-3-yl]pyrazin-2-amine</p> <p><sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 1.14 (d, J=6.29 Hz, 3 H) 1.32 (t, J=7.43 Hz, 3 H) 1.48 - 1.68 (m, 1 H) 1.69 - 1.82 (m, 1 H) 2.08 - 2.18 (m, J=12.34 Hz, 1 H) 2.61 - 2.71 (m, 1 H) 2.73 - 2.82 (m, 1 H) 2.87 (q, 2 H) 3.05 (d, J=12.34 Hz, 1 H) 3.67 (d, J=12.34 Hz, 1 H) 7.15 (d, J=8.31 Hz, 1 H) 7.76 (s, 1 H) 7.93 (s, 1 H) 8.19 (s, 1 H) 8.28 (s, 1 H). Method A (Example 7).</p>
110		<p>6-(2-isopropylimidazo[2,1-b][1,3]thiazol-5-yl)-N-[(3R,6R)-6-methylpiperidin-3-yl]pyrazin-2-amine</p> <p><sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 1.03 (d, J=6.29 Hz, 3 H) 1.14 - 1.28 (m, J=13.85 Hz, 1 H) 1.27 - 1.35 (m, 1 H) 1.37 (d, J=6.80 Hz, 6 H) 1.73 (d, J=12.59 Hz, 1 H) 2.05 (d, J=13.35 Hz, 1 H) 2.38 (t, J=10.70 Hz, 1 H) 2.58 - 2.70 (m, 1 H) 3.09 - 3.23 (m, 1 H) 3.69 - 3.85 (m, 1 H) 7.10 (d, J=7.55 Hz, 1 H) 7.73 (s, 1 H) 7.95 (s, 1 H) 8.19 (s, 1 H) 8.33 (s, 1 H). Method A (Example 7).</p>

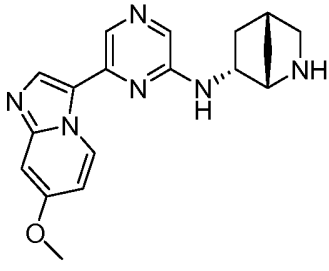
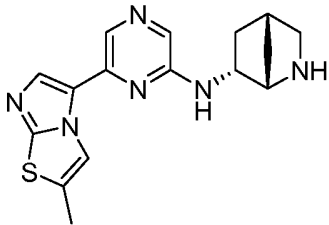
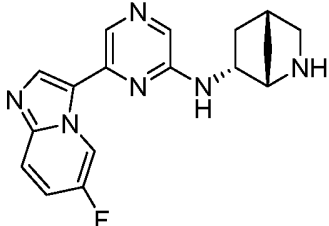
Ex.	Structure	Name, Data and Preparation Method
111		6-(2-isopropylimidazo[2,1-b][1,3]thiazol-5-yl)-N-[(2R,3R)-2-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) δ ppm 1.24 (d, J=6.80 Hz, 3 H) 1.33 (d, 6 H) 1.59 - 1.69 (m, J=6.04 Hz, 1 H) 1.70 - 1.82 (m, 1 H) 1.83 - 2.00 (m, 2 H) 2.95 (t, J=11.83 Hz, 1 H) 3.14 - 3.27 (m, 3 H) 3.46 - 3.59 (m, 1 H) 4.15 - 4.39 (m, 1 H) 7.61 (d, J=8.06 Hz, 1 H) 7.90 (s, 1 H) 7.96 (s, 1 H) 8.25 (s, 2 H). Method A (Example 7).
112		6-(2-isopropylimidazo[2,1-b][1,3]thiazol-5-yl)-N-[(2S,3R)-2-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) δ ppm 1.31 (d, J=6.55 Hz, 3 H) 1.34 (d, 6 H) 1.38 - 1.51 (m, 1 H) 1.66 - 1.97 (m, 2 H) 2.07 - 2.25 (m, 1 H) 2.76 - 3.00 (m, 1 H) 3.05 - 3.21 (m, 1 H) 3.34 - 3.42 (m, 1 H) 3.90 - 4.10 (m, 1 H) 7.32 (d, J=8.31 Hz, 1 H) 7.80 (s, 1 H) 7.95 (s, 1 H) 8.17 (s, 1 H) 8.24 (s, 1 H). Method A (Example 7).
113		6-(6-chloropyrazolo[1,5-a]pyridin-3-yl)-N-[(3R)-pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400MHz, CDCl <sub>3</sub> ): δ ppm 1.820- 1.711(m, 1H), 2.308-2.289 (m, 1H), 3.041-2.958 (m, 2H), 3.167-3.132 (m, 1H), 3.302-3.259 (m, 1H), 4.433-4.417 (m, 1H), 4.778-4.763 (d, 1H), 7.237-7.233 (d, 1H), 7.713 (s, 1H), 8.229 (s, 1H), 8.386 (s, 1H), 8.417-8.393 (d, 1H), 8.552-8.549 (d, 1H). Method A (Example 7).
114		6-(2-isopropylimidazo[2,1-b][1,3]thiazol-5-yl)-N-[(3R,6S)-6-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) δ ppm 1.04 (d, J=6.29 Hz, 3 H) 1.33 (d, J=6.80 Hz, 6 H) 1.42 - 1.52 (m, 1 H) 1.59 - 1.78 (m, 1 H) 1.93 - 2.03 (m,

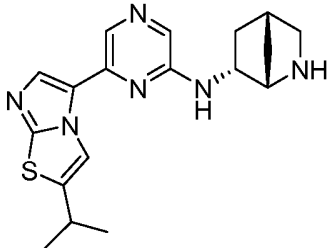
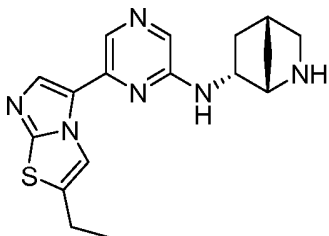
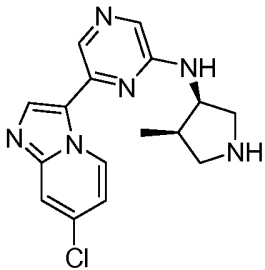
Ex.	Structure	Name, Data and Preparation Method
		1 H) 2.59 - 2.74 (m, 1 H) 2.87 (dd, J=12.46, 2.64 Hz, 1 H) 3.05 (d, J=12.34 Hz, 1 H) 3.11 - 3.22 (m, 1 H) 3.90 - 4.03 (m, 1 H) 7.13 (d, J=7.30 Hz, 1 H) 7.91 (s, 1 H) 7.93 (s, 1 H) 8.18 (s, 1 H) 8.24 (d, J=1.26 Hz, 1 H). Method A (Example 7).
115		6-pyrazolo[1,5-a]pyridin-3-yl-N-[(3R)-pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400MHz, MeOD): $\delta$ ppm 2.231-2.199 (m, 1H), 2.510-2.459 (m, 1H), 3.570-3.306 (m, 3H), 3.710-3.665 (m, 1H), 4.773-4.732 (m, 1H), 7.037-7.000 (m, 1H), 7.442-7.403 (m, 1H), 7.734 (s, 1H), 8.239 (s, 1H), 8.435-8.413 (d, 1H), 8.533 (s, 1H), 8.614-8.596 (d, 1H). Method A (Example 4).
116		6-(6-chloropyrazolo[1,5-a]pyridin-3-yl)-N-[(3R,4R)-4-methylpyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400MHz, CDCl <sub>3</sub> ): $\delta$ ppm 1.059-1.041 (m, 3H), 2.544-2.488 (m, 1H), 2.764-2.743 (m, 1H), 2.991-2.952 (m, 1H), 3.355-3.308 (m, 1H), 3.469-3.426 (m, 1H), 4.552-4.524 (m, 1H), 4.919-4.902 (m, 1H), 7.239-7.234 (d, 1H), 7.756 (s, 1H) 8.211 (s, 1H), 8.384-8.358 (m, 2H), 8.549-8.547 (d, 1H). Method A (Example 4).
117		6-(6-chloropyrazolo[1,5-a]pyridin-3-yl)-N-[(3R)-piperidin-3-yl]pyrazin-2-amine 1H NMR (400MHz, CDCl <sub>3</sub> ): $\delta$ ppm 1.719-1.700 (m, 2H), 2.012-1.910 (m, 1H), 2.898-2.760 (m, 3H), 3.249-3.220 (d, 1H), 4.015-4.007 (m, 1H), 5.004-4.996 (m, 1H), 7.240-7.236 (d, 1H), 7.717 (s, 1H), 8.184 (s, 1H), 8.409-8.380 (m, 2H), 8.543 (s, 1H). Method A (Example 4).

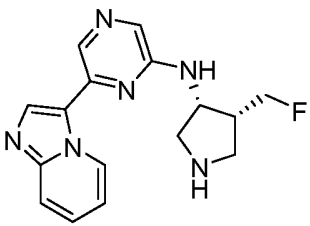
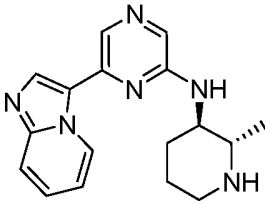
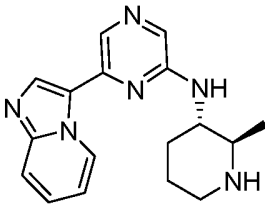
Ex.	Structure	Name, Data and Preparation Method
118		<p>N-[(3R)-piperidin-3-yl]-6-[7-(2,2,2-trifluoro-1-methylethoxy)imidazo[1,2-a]pyridin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO): <math>\delta</math> ppm 1.220-1.375 (m, 5H), 1.648(m, 1H), 1.922-2.022 (m, 1H), 2.402-2.492 (m, 1H), 2.824-2.898 (d, 1H), 3.116-3.158 (d, 2H), 3.726 (s, 1H), 4.093 (s, 0.324H), 5.467-5.531 (m, 1H), 6.892-6.917 (dd, 1H), 7.083-7.102 (d, 1H), 7.406-7.412 (s, 1H), 7.755 (s, 1H), 8.210-8.252 (d, 2H), 9.654-9.673(d, 1H). Method A (Example 32).</p>
119		<p>N-[(3R,4R)-4-methylpyrrolidin-3-yl]-6-pyrazolo[1,5-a]pyridin-3-ylpyrazin-2-amine 1H NMR (400MHz, CDCl<sub>3</sub>): <math>\delta</math> ppm 1.061-1.043 (m, 3H), 2.547-2.511 (m, 1H), 2.748-2.700 (m, 1H), 2.970-2.930 (m, 1H), 3.349-3.303 (m, 1H), 3.475-3.433 (m, 1H), 4.559-4.529 (m, 1H), 4.788-4.469 (m, 1H), 6.885-6.851 (m, 1H), 7.303-7.286 (d, 1H), 7.730 (s, 1H) 8.233 (s, 1H), 8.410 (s, 1H), 8.410-8.394 (d, 1H), 8.521-8.504 (d, 1H). Method A (Example 4).</p>
120		<p>6-(2-methylimidazo[2,1-b][1,3,4]thiadiazol-5-yl)-N-[(3R)-piperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d<sub>6</sub>) <math>\delta</math> ppm 1.50 - 1.71 (m, 1 H) 1.72 - 1.88 (m, 1 H) 1.88 - 2.06 (m, 2 H) 2.72 - 2.81 (m, 1 H) 2.83 (s, 3 H) 2.91 (d, J=14.60 Hz, 1 H) 3.22 (d, J=10.58 Hz, 1 H) 3.41 (d, J=20.40 Hz, 1 H) 3.46 - 3.60 (m, J=11.83 Hz, 1 H) 4.09 - 4.23 (m, 1 H) 7.90 (s, 1 H) 8.03 (s, 1 H) 8.51 (s, 1 H). Method A (Example 7).</p>

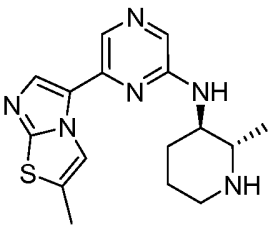
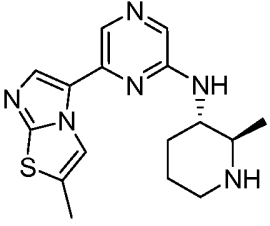
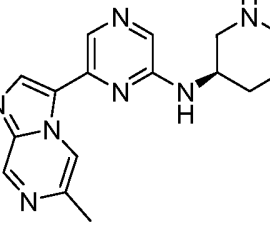
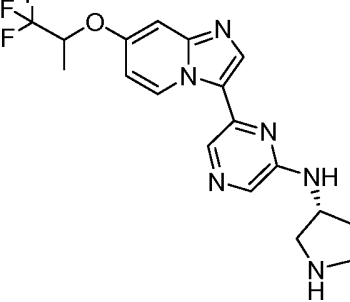
Ex.	Structure	Name, Data and Preparation Method
121		6-pyrazolo[1,5-a]pyrimidin-3-yl-N-[(3R)-pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400MHz, DMSO): $\delta$ ppm 1.945-1.929 (m, 1H), 2.332-2.241 (m, 1H), 3.093-3.052 (m, 1H), 3.236-3.172 (m, 2H), 3.552-3.506 (m, 1H), 4.486-4.473 (m, 1H), 7.209-7.181 (m, 1H), 7.699-7.386 (d, 1H), 7.818 (s, 1H), 8.771-8.758 (m, 2H), 8.816 (s, 1H), 9.250-9.229 (m, 1H). Method A (Example 23).
122		6-{7-[1-(methoxymethyl)propoxy]imidazo[1,2-a]pyridin-3-yl}-N-[(3R)-piperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO): $\delta$ ppm 0.902-0.996 (t, 3H), 1.467-1.888 (m, 8H), 1.998-2.067 (d, 2H), 2.926-2.957 (m, 2H), 3.510-3.557 (m, 3H), 3.959 (s, 1H), 4.625-4.649 (m, 1H), 6.792-6.812 (d, 1H), 7.144 (s, 2H), 7.716 (s, 1H), 8.206-8.369 (m, 3H), 9.545-9.565 (d, 1H). Method A (Example 32).
123		(1S,4R,6R)-N-(6-imidazo[1,2-a]pyridin-3-ylpyrazin-2-yl)-2-azabicyclo[2.2.1]heptan-6-amine 1H NMR (400 MHz, DMSO-d6) $\delta$ ppm 1.21 (d, J=9.82 Hz, 1 H) 1.64 (d, J=1.26 Hz, 1 H) 1.79 (d, J=10.07 Hz, 1 H) 2.19 (t, J=11.71 Hz, 1 H) 2.79 (d, J=9.57 Hz, 1 H) 2.96 (d, J=9.57 Hz, 1 H) 3.75 (s, 1 H) 4.22 (d, J=7.05 Hz, 1 H) 7.11 (t, J=6.80 Hz, 1 H) 7.29 - 7.54 (m, 2 H) 7.72 (d, J=9.06 Hz, 1 H) 7.89 (s, 1 H) 8.36 (d, J=3.27 Hz, 2 H) 9.69 (d, J=6.80 Hz, 1 H). Method A (Example 7).

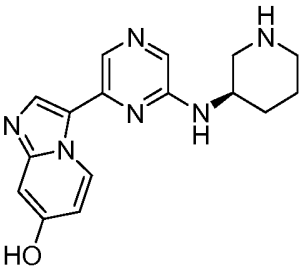
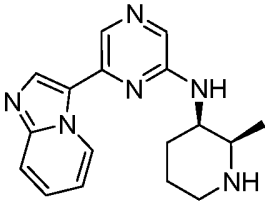
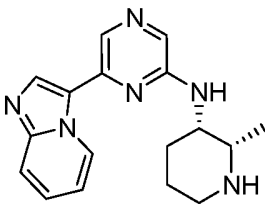


Ex.	Structure	Name, Data and Preparation Method
124		<p>(1S,4R,6R)-N-[6-(7-methoxyimidazo[1,2-a]pyridin-3-yl)pyrazin-2-yl]-2-azabicyclo[2.2.1]heptan-6-amine 1H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 1.11 - 1.28 (m, 1 H) 1.60 (d, J=11.58 Hz, 1 H) 1.79 (d, J=10.32 Hz, 1 H) 2.10 - 2.25 (m, 1 H) 2.77 (d, J=9.57 Hz, 1 H) 2.96 (d, J=9.57 Hz, 1 H) 3.73 (s, 1 H) 3.89 (s, 3 H) 4.10 - 4.22 (m, 1 H) 6.82 (dd, J=7.68, 2.64 Hz, 1 H) 7.10 (d, J=2.52 Hz, 1 H) 7.22 (d, J=6.04 Hz, 1 H) 7.84 (s, 1 H) 8.21 (s, 1 H) 8.32 (s, 1 H) 9.54 (d, J=7.81 Hz, 1 H) Method A (Example 7).</p>
125		<p>(1S,4R,6R)-N-[6-(2-methylimidazo[2,1-b][1,3]thiazol-5-yl)pyrazin-2-yl]-2-azabicyclo[2.2.1]heptan-6-amine 1H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 1.09 (d, J=15.61 Hz, 1 H) 1.45 - 1.62 (m, 1 H) 1.68 - 1.78 (m, J=9.32 Hz, 1 H) 2.06 - 2.20 (m, 1 H) 2.48 (d, J=1.26 Hz, 3 H) 2.64 - 2.71 (m, 1 H) 2.82 - 2.94 (m, J=9.82 Hz, 1 H) 3.51 - 3.63 (m, 1 H) 4.09 - 4.22 (m, J=9.82 Hz, 1 H) 7.15 (d, 1 H) 7.84 (s, 1 H) 7.94 (s, 1 H) 8.23 (s, 1 H) 8.28 (d, J=1.51 Hz, 1 H). Method A (Example 7).</p>
126		<p>(1S,4R,6R)-N-[6-(6-fluoroimidazo[1,2-a]pyridin-3-yl)pyrazin-2-yl]-2-azabicyclo[2.2.1]heptan-6-amine 1H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 1.05 - 1.21 (m, 1 H) 1.51 - 1.68 (m, 2 H) 2.07 - 2.23 (m, 1 H) 2.39 - 2.46 (m, 1 H) 2.59 - 2.70 (m, 1 H) 2.83 - 2.94 (m, 1 H) 3.53 - 3.60 (m, 1 H) 3.99 - 4.18 (m, 1 H) 7.29 (d, J=6.55 Hz, 1 H) 7.45 - 7.56 (m, 1 H) 7.79 (dd, J=9.82, 5.54 Hz, 1 H) 7.91 (s, 1 H) 8.37 (s, 1 H) 8.45 (s, 1 H) 9.85 (dd, J=5.67, 2.14 Hz, 1 H) Method A (Example 7).</p>

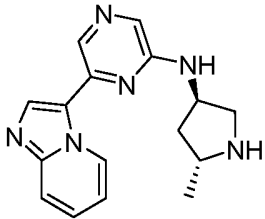
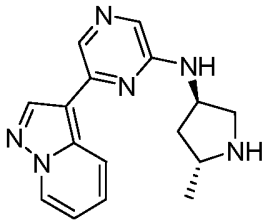
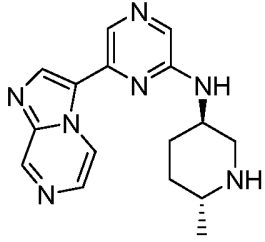
Ex.	Structure	Name, Data and Preparation Method
127		<p>(1S,4R,6R)-N-[6-(2-isopropylimidazo[2,1-b][1,3]thiazol-5-yl)pyrazin-2-yl]-2-azabicyclo[2.2.1]heptan-6-amine <sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 0.88 - 1.00 (m, 1 H) 1.25 (d, J=6.55 Hz, 6 H) 1.39 - 1.51 (m, 2 H) 2.03 (t, J=15.23 Hz, 1 H) 2.20 - 2.35 (m, 1 H) 2.49 - 2.55 (m, 1 H) 2.68 - 2.82 (m, 1 H) 3.95 - 4.14 (m, 1 H) 7.08 (d, J=7.05 Hz, 1 H) 7.76 (s, 1 H) 7.85 (s, 1 H) 8.11 (s, 1 H) 8.19 (s, 1 H). Method A (Example 7).</p>
128		<p>(1S,4R,6R)-N-[6-(2-ethylimidazo[2,1-b][1,3]thiazol-5-yl)pyrazin-2-yl]-2-azabicyclo[2.2.1]heptan-6-amine <sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 0.94 - 1.05 (m, 1 H) 1.27 (t, J=7.43 Hz, 3 H) 1.44 - 1.51 (m, 1 H) 1.53 - 1.62 (m, 1 H) 1.98 - 2.14 (m, 1 H) 2.32 - 2.36 (m, 1 H) 2.56 (d, J=8.81 Hz, 1 H) 2.74 - 2.87 (m, 3 H) 4.08 (d, J=6.80 Hz, 1 H) 7.10 (d, J=7.30 Hz, 1 H) 7.80 (s, 1 H) 7.89 (s, 1 H) 8.16 (s, 1 H) 8.25 (s, 1 H). Method A (Example 7).</p>
129		<p>6-(7-chloroimidazo[1,2-a]pyridin-3-yl)-N-[(3R,4R)-4-methylpyrrolidin-3-yl]pyrazin-2-amine <sup>1</sup>H NMR (400 MHz, DEUTERIUM OXIDE) δ ppm 1.06 (d, J=7.07 Hz, 3 H) 2.59 - 2.83 (m, 1 H) 3.04 - 3.23 (m, 1 H) 3.31 - 3.50 (m, 1 H) 3.50 - 3.62 (m, 1 H) 3.63 - 3.75 (m, 1 H) 4.08 (d, J=7.33 Hz, 0 H) 7.53 (dd, J=7.45, 1.89 Hz, 1 H) 8.02 (s, 1 H) 8.07 (d, J=1.52 Hz, 1 H) 8.20 (s, 1 H) 8.37 (s, 1 H) 9.53 (d, J=7.58 Hz, 1 H). Method A (Example 7).</p>

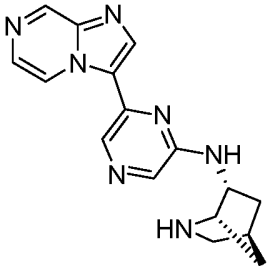
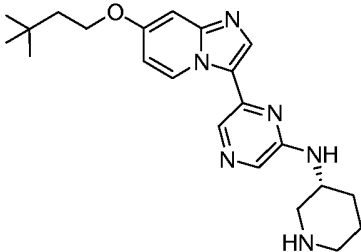
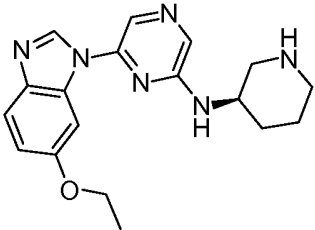
Ex.	Structure	Name, Data and Preparation Method
130		<p>N-[(3R,4R)-4-(fluoromethyl)pyrrolidin-3-yl]-6-imidazo[1,2-a]pyridin-3-ylpyrazin-2-amine <sup>1</sup>H NMR (400 MHz, MeOD) δ ppm 2.99 - 3.18 (m, 1 H) 3.42 (dd, J=11.37, 7.33 Hz, 1 H) 3.56 (dd, J=12.13, 6.82 Hz, 1 H) 3.70 - 3.88 (m, 2 H) 4.57 - 4.82 (m, 2 H) 5.15 (q, J=7.07 Hz, 1 H) 7.75 (t, J=6.82 Hz, 1 H) 8.02 - 8.19 (m, 2 H) 8.21 (br. s., 1 H) 8.48 (br. s., 1 H) 8.78 (s, 1 H) 9.91 (d, J=6.82 Hz, 1 H). Method A (Example 4).</p>
131		<p>6-imidazo[1,2-a]pyridin-3-yl-N-[(2S,3R)-2-methylpiperidin-3-yl]pyrazin-2-amine <sup>1</sup>H NMR (400 MHz, DMSO-<i>d</i><sub>6</sub>) δ ppm 1.11 (d, J=6.29 Hz, 3 H) 1.19 - 1.38 (m, 2 H) 1.48 - 1.64 (m, 1 H) 1.71 (d, J=12.59 Hz, 1 H) 2.11 (d, J=9.06 Hz, 1 H) 2.55 - 2.73 (m, 2 H) 2.99 (d, J=11.58 Hz, 1 H) 7.05 - 7.20 (m, 2 H) 7.31 - 7.48 (m, 1 H) 7.72 (d, J=9.06 Hz, 1 H) 7.79 (s, 1 H) 8.29 (s, 1 H) 8.36 (s, 1 H) 9.75 (d, J=6.80 Hz, 1H). Method A (Example 4).</p>
132		<p>6-imidazo[1,2-a]pyridin-3-yl-N-[(2R,3S)-2-methylpiperidin-3-yl]pyrazin-2-amine <sup>1</sup>H NMR (400 MHz, DMSO-<i>d</i><sub>6</sub>) δ ppm 1.09 (d, J=6.04 Hz, 3 H) 1.18 - 1.38 (m, 1 H) 1.47 - 1.60 (m, 1 H) 1.69 (d, J=12.59 Hz, 1 H) 1.99 - 2.26 (m, 1 H) 2.54 - 2.77 (m, 2 H) 2.96 (d, J=11.58 Hz, 1 H) 6.87 - 7.17 (m, 2 H) 7.40 (dd, J=8.31, 7.30 Hz, 1 H) 7.72 (d, J=9.06 Hz, 1 H) 7.78 (s, 1 H) 8.29 (s, 1 H) 8.36 (s, 1 H) 9.76 (d, J=7.30 Hz, 1 H). Method A (Example 4).</p>

Ex.	Structure	Name, Data and Preparation Method
133		6-(2-methylimidazo[2,1-b][1,3]thiazol-5-yl)-N-[(2S,3R)-2-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) δ ppm 1.05 (d, J=6.29 Hz, 3 H) 1.16 - 1.33 (m, 1 H) 1.42 - 1.58 (m, 1 H) 1.67 (d, J=12.84 Hz, 1 H) 2.01 - 2.18 (m, 1 H) 2.52 - 2.59 (m, 2 H) 2.91 (d, J=11.83 Hz, 1 H) 3.26 (s, 3 H) 3.38 - 3.47 (m, 2 H) 6.92 - 7.18 (m, 1 H) 7.73 (s, 1 H) 7.92 (s, 1 H) 8.14 (s, 1 H) 8.31 (d, 1 H). Method A (Example 7).
134		6-(2-methylimidazo[2,1-b][1,3]thiazol-5-yl)-N-[(2R,3S)-2-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) δ ppm 1.05 (d, J=6.29 Hz, 3 H) 1.16 - 1.30 (m, 1 H) 1.45 - 1.58 (m, 1 H) 1.63 - 1.78 (m, 1 H) 2.04 - 2.20 (m, 1 H) 2.92 (d, J=13.60 Hz, 1 H) 7.04 (d, J=8.56 Hz, 1 H) 7.74 (s, 1 H) 7.93 (s, 1 H) 8.15 (s, 1 H) 8.31 (s, 1 H). Method A (Example 7).
135		6-(6-methylimidazo[1,2-a]pyrazin-3-yl)-N-[(3R)-piperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) δ ppm 1.53 - 1.70 (m, 1 H), 1.74 - 1.89 (m, 1 H), 1.92 - 2.04 (m, 1 H), 2.08 - 2.20 (m, 1 H), 2.58 (s, 3 H), 2.92 - 3.07 (m, 2 H), 3.13 - 3.25 (m, 1 H), 3.38 - 3.41 (m, 1 H), 4.26 (br. s., 1 H), 7.73 (br. s., 1 H), 7.96 (s, 1 H), 8.47 (s, 1 H), 8.63 (s, 1 H), 9.20 (s, 2 H), 9.35 (s, 1 H). Method A (Example 7).
136		N-[(3R)-pyrrolidin-3-yl]-6-[7-(2,2,2-trifluoro-1-methylethoxy)imidazo[1,2-a]pyridin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO): δ ppm 1.541-1.556 (d, 3H), 1.753-1.844 (m, 1H), 2.171-2.393(m, 1H), 2.910-3.276(m, 4H), 4.476 (s, 1H), 5.540-5.602 (m, 1H), 6.934-6.992 (m, 1H), 7.402-

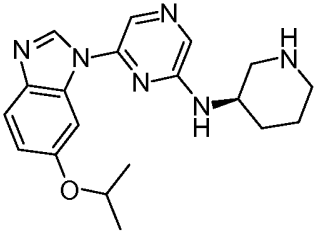
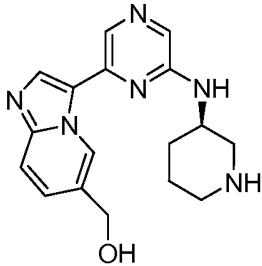
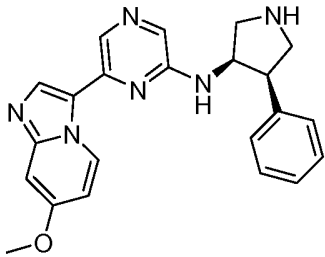
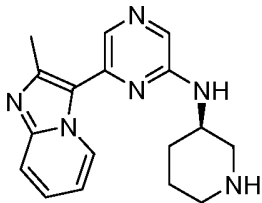
Ex.	Structure	Name, Data and Preparation Method
		7.564 (m, 2H), 7.841-7.859 (m, 1H), 8.339-8.403 (m, 2H), 9.711-9.730 (d, 1H). Method A (Example 32).
137		3-{6-[(3R)-piperidin-3-ylamino]pyrazin-2-yl}imidazo[1,2-a]pyridin-7-ol 1H NMR (400 MHz, DMSO): $\delta$ ppm 1.435-1.523 (m, 2H), 1.692-1.702 (s, 1H), 2.0240-2.029 (d, 1H), 2.840-2.870 (d, 2H), 3.182-3.341 (m, 2H), 3.930 (s, 1H), 6.706-6.724 (d, 1H), 6.828 (s, 1H), 7.033-7.050 (d, 1H), 7.724 (s, 1H), 8.159 (s, 1H), 8.236 (s, 1H), 9.514-9.609(d, 1H). Method A (Example 7).
138		6-imidazo[1,2-a]pyridin-3-yl-N-[(2R,3R)-2-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) $\delta$ ppm 1.16 (t, J=7.30 Hz, 2 H) 1.22 (d, J=6.55 Hz, 3 H) 1.60 - 1.73 (m, 1 H) 1.76 - 1.97 (m, 2 H) 2.80 - 3.01 (m, 2 H) 4.18 - 4.43 (m, 1 H) 7.14 (d, J=7.05 Hz, 1 H) 7.42 (d, J=6.80 Hz, 1 H) 7.49 (d, J=7.81 Hz, 1 H) 7.71 (d, J=9.32 Hz, 1 H) 7.93 (s, 1 H) 8.36 (s, 2 H) 9.64 (d, J=7.05 Hz, 1 H). Method A (Example 4).
139		6-imidazo[1,2-a]pyridin-3-yl-N-[(2S,3S)-2-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) $\delta$ ppm 1.10 - 1.23 (m, 5 H) 1.48 - 1.64 (m, 1 H) 1.67 - 1.83 (m, 2 H) 1.84 - 1.94 (m, J=8.31 Hz, 1 H) 2.88 (q, J=7.30 Hz, 2 H) 3.10 (d, J=12.59 Hz, 1 H) 4.23 (s, 1 H) 7.10 (t, J=6.80 Hz, 1 H) 7.24 - 7.44 (m, 2 H) 7.68 (d, J=9.06 Hz, 1 H) 7.91 (s, 1 H) 8.32 (d, J=5.79 Hz, 2 H) 9.62 (d, J=7.05 Hz, 1 H). Method A (Example 4).

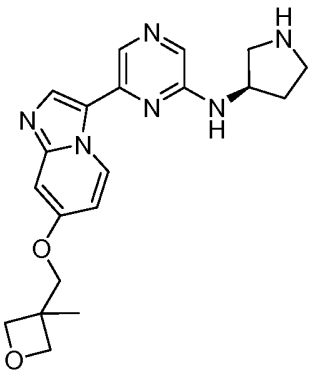
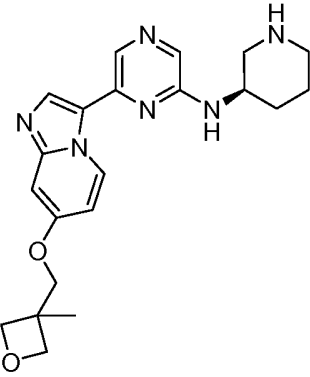
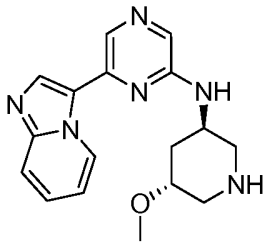
Ex.	Structure	Name, Data and Preparation Method
140		6-(2-methylimidazo[2,1-b][1,3]thiazol-5-yl)-N-[(3S,4S)-4-methylpyrrolidin-3-yl]pyrazin-2-amine <sup>1</sup> H NMR (400 MHz, MeOD) δ ppm 1.14 (d, J=7.05 Hz, 3 H) 2.54 (d, J=1.51 Hz, 3 H) 2.68 - 2.81 (m, 1 H) 3.05 - 3.16 (m, 1 H) 3.54 (dd, J=11.58, 7.55 Hz, 1 H) 3.66 (dd, J=12.09, 6.55 Hz, 1 H) 4.71 - 4.80 (m, 1 H) 7.85 (s, 1 H) 7.87 (s, 1 H) 8.23 (s, 1 H) 8.26 (d, J=1.51 Hz, 1 H). Method A (Example 7).
141		6-(6-fluoroimidazo[1,2-a]pyridin-3-yl)-N-[(3S,4S)-4-methylpyrrolidin-3-yl]pyrazin-2-amine <sup>1</sup> H NMR (400 MHz, MeOD) δ ppm 1.14 (d, J=7.05 Hz, 3 H) 2.54 (d, J=1.51 Hz, 3 H) 2.68 - 2.81 (m, 1 H) 3.05 - 3.16 (m, 1 H) 3.54 (dd, J=11.58, 7.55 Hz, 1 H) 3.66 (dd, J=12.09, 6.55 Hz, 1 H) 4.71 - 4.80 (m, 1 H) 7.85 (s, 1 H) 7.87 (s, 1 H) 8.23 (s, 1 H) 8.26 (d, J=1.51 Hz, 1 H). Method A (Example 7).
142		6-(6-methoxy-1H-benzimidazol-1-yl)-N-[(3R)-piperidin-3-yl]pyrazin-2-amine <sup>1</sup> H NMR (400 MHz, CDCl <sub>3</sub> ): δ ppm 1.610 (s, 1H), 1.858 (m, 9H), 2.886-2.831 (m, 3H), 3.195 (d, 1H) 3.892 (s, 3H), 4.118 (s, 1H), 5.551 (s, 1H), 7.012 (d, 1H), 7.550 (s, 1H), 7.735-7.713 (d, 1H), 7.885 (s, 1H), 8.099 (s, 1H), 8.425 (s, 1H). Method A (Example 7).
143		6-(6-chloropyrazolo[1,5-a]pyridin-3-yl)-N-[(3R,5R)-5-methylpyrrolidin-3-yl]pyrazin-2-amine <sup>1</sup> H NMR (400MHz, DMSO): δ ppm 1.40-1.32 (d, 3H), 2.029-1.987 (m, 1H), 2.225-2.181 (m, 1H), 3.242-3.140 (m, 1H), 3.3.972-3.653 (m, 2H), 4.605-4.508 (m, 1H), 7.457-7.430 (m, 2H), 8.366 (s, 1H), 8.439-8.415 (d, 1H), 8.618-8.523 (m,

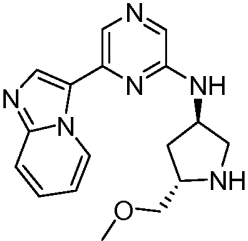
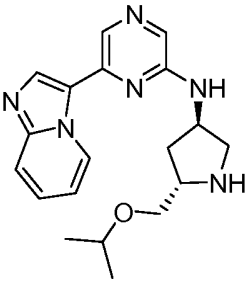
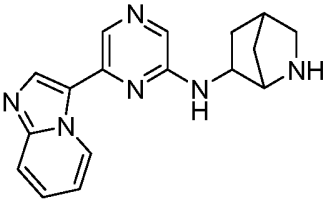
Ex.	Structure	Name, Data and Preparation Method
		1H), 8.757 (s, 1H), 8.788 (s, 1H), 9.002 (m, 1H), 9.152 (s, 1H). Method A (Example 4).
144		6-imidazo[1,2-a]pyridin-3-yl-N-[(3R,5R)-5-methylpyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400MHz, MeOD): $\delta$ ppm 1.589-1.573 (d, 3H), 2.273-2.196 (m, 1H), 2.499-2.454 (m, 1H), 3.518-3.432 (m, 1H), 3.892-3.845 (m, 1H), 4.119-4.061 (m, 1H), 4.973-4.861 (m, 1H), 7.618-7.580 (m, 1H), 8.095-8.019 (m, 3H) 8.472 (s, 1H), 8.689 (s, 1H), 9.927-9.909 (d, 1H). Method A (Example 4).
145		N-[(3R,5R)-5-methylpyrrolidin-3-yl]-6-pyrazolo[1,5-a]pyridin-3-ylpyrazin-2-amine 1H NMR (400MHz, MeOD): $\delta$ ppm 1.524-1.425 (d, 3H), 2.207-2.130 (m, 1H), 2.418-2.372 (m, 1H), 3.471-3.433 (m, 1H), 3.845-3.800 (m, 1H), 4.067-3.976 (m, 1H), 4.811-4.789 (m, 1H), 7.058-7.025 (t, 1H), 7.458-7.440 (t, 1H), 7.740 (s, 1H), 8.335 (s, 1H) 8.464-8.418 (d, 1H), 8.569 (s, 1H), 8.643-8.626 (d, 1H). Method A (Example 4).
146		6-imidazo[1,2-a]pyrazin-3-yl-N-[(3R,6R)-6-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) $\delta$ ppm 1.03 (d, J=6.29 Hz, 3 H) 1.13 - 1.27 (m, 1 H) 1.30 - 1.42 (m, 1 H) 1.62 - 1.74 (m, 1 H) 2.04 - 2.13 (m, 1 H) 2.34 - 2.42 (m, 1 H) 2.53 - 2.59 (m, 1 H) 3.19 - 3.28 (m, 1 H) 3.63 - 3.79 (m, 1 H) 7.21 (d, J=7.30 Hz, 1 H) 7.85 (s, 1 H) 8.06 (d, J=4.78 Hz, 1 H) 8.39 (s, 1 H) 8.58 (s, 1 H) 9.19 (d, J=1.26 Hz, 1 H) 9.61 (dd, J=4.53, 1.26 Hz, 1 H). Method A (Example 4).

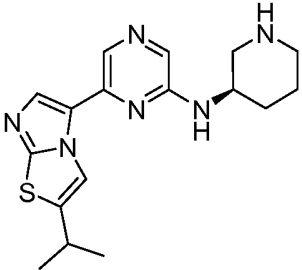
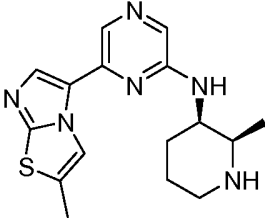
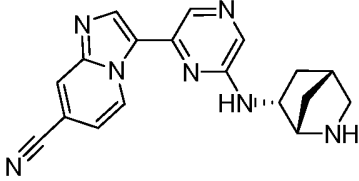
Ex.	Structure	Name, Data and Preparation Method
147		<p>(1S,4R,6R)-N-(6-imidazo[1,2-a]pyrazin-3-ylpyrazin-2-yl)-2-azabicyclo[2.2.1]heptan-6-amine</p> <p><sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 1.02 - 1.09 (m, 1 H) 1.48 - 1.58 (m, J=2.77 Hz, 1 H) 1.67 (d, J=9.82 Hz, 1 H) 2.09 - 2.20 (m, 1 H) 2.40 (br. s., 1 H) 2.61 (d, J=9.06 Hz, 1 H) 2.80 - 2.92 (m, 1 H) 3.46 (br. s., 1 H) 3.93 - 4.20 (m, 1 H) 7.33 (d, J=7.05 Hz, 1 H) 7.97 (s, 1 H) 8.09 (d, J=4.78 Hz, 1 H) 8.40 (s, 1 H) 8.57 (s, 1 H) 9.18 (d, J=1.26 Hz, 1 H) 9.57 (dd, J=4.66, 1.38 Hz, 1 H). Method A (Example 4).</p>
148		<p>6-[7-(3,3-dimethylbutoxy)imidazo[1,2-a]pyridin-3-yl]-N-[(3R)-piperidin-3-yl]pyrazin-2-amine</p> <p><sup>1</sup>H NMR (400 MHz, DMSO): δ ppm 0.984 (s, 9H), 1.566-1.785 (m, 4H), 1.954-2.087 (m, 2H), 2.873-2.979 (m, 2H), 3.202-3.233 (d, 1H), 3.459 (d, 1H), 4.130-4.165 (t, 1H), 6.754-6.779 (dd, 2H), 7.171-7.1771 (d, 1H), 7.298-7.314 (d, 1H), 7.789 (s, 1H), 8.129 (s, 0.21H), 8.250 (s, 1H), 8.346 (s, 1H), 8.661 (s, 1H), 9.452-9.471 (d, 1H). Method A (Example 32).</p>
149		<p>6-(6-ethoxy-1H-benzimidazol-1-yl)-N-[(3R)-piperidin-3-yl]pyrazin-2-amine</p> <p><sup>1</sup>H NMR (400 MHz, MeOD): δ ppm 1.407(t, 3H), 2.296-1.749 (m, 4H), 3.056 (m, 2H), 3.807-3.709 (m, 2H), 4.216-4.199 (m, 2H), 4.396 (m, 1H), 7.387 (d, 1H), 7.623-7.618 (d, 1H), 7.867-7.844 (d, 1H), 8.247 (s, 1H), 8.362 (s, 1H), 10.006 (s, 1H). Method A (Example 7).</p>

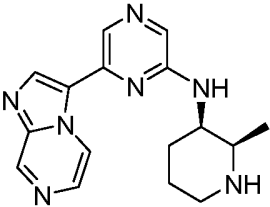
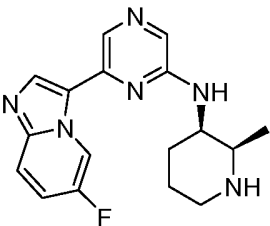
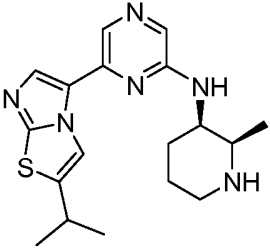


Ex.	Structure	Name, Data and Preparation Method
150		6-(6-isopropoxy-1H-benzimidazol-1-yl)-N-[(3R)-piperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, MeOD): $\delta$ ppm 1.407(d, 6H), 2.296-1.749 (m, 4H), 3.210-3.056 (m, 2H), 3.807-3.547 (m, 3H), 4.396 (m, 1H), 4.807-4.723 (m, 1H), 7.357 (d, 1H), 7.605 (s, 1H), 7.854 (d, 1H), 8.228 (s, 1H), 8.375 (s, 1H), 9.987 (s, 1H). Method A (Example 7).
151		(3-{6-[(3R)-piperidin-3-ylamino]pyrazin-2-yl}imidazo[1,2-a]pyridin-6-yl)methanol 1H NMR (400 MHz, DMSO-d <sub>6</sub> ): $\delta$ ppm 1.63-1.66 (m, 1H), 1.88-2.04 (m, 3H), 2.94 (m, 2H), 3.16 (m, 1H), 3.39 (m, 1H), 3.86 (br m, 1H), 4.32 (br s, 1H), 4.76 (s, 2H), 7.87 (d, J = 6.8 Hz, 1H), 7.93-8.06 (m, 3 H), 8.42 (s, 1H), 8.94 (s, 1H), 9.21 (br s, 2H), 9.81 (s, 1H). LCMS: M+1 325.2. Method B (Example 5).
152		6-(7-methoxyimidazo[1,2-a]pyridin-3-yl)-N-[(3R,4R)-4-phenylpyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) $\delta$ ppm 2.90 (s, 1 H) 3.06 (s, 1 H) 3.31 (s, 3 H) 3.50 (s, 1 H) 3.89 (s, 3 H) 4.66 (s, 1 H) 6.88 (s, 1 H) 6.98 - 7.08 (m, 5 H) 7.21 (d, J=7.05 Hz, 2 H) 7.53 (s, 1 H) 8.08 (d, J=15.61 Hz, 2 H) 9.51 (d, J=7.81 Hz, 1 H); LCMS: M + 1 387.2. Method A (Example 7).
153		6-(2-methylimidazo[1,2-a]pyridin-3-yl)-N-[(3R)-piperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) $\delta$ ppm 1.53 (s, 1 H) 1.64 (s, 1 H) 1.85 (s, 1 H) 2.02 (s, 1 H) 2.55 (s, 3 H) 2.79 (s, 2 H) 3.06 (s, 1 H) 3.29 (s, 1H) 4.04 (s, 1 H), 6.99 (s, 1 H) 7.35 (s, 2 H) 7.57 (s, 1 H) 7.91 (s, 1 H) 8.00 (s, 1 H) 9.13 (s, 1 H); LCMS: M + 1

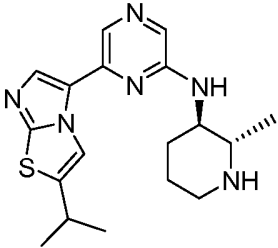
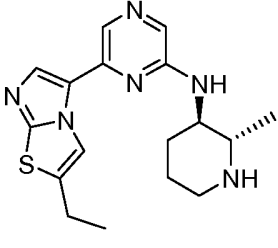
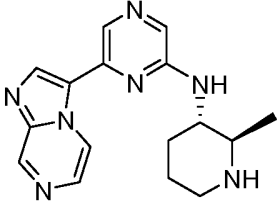
Ex.	Structure	Name, Data and Preparation Method
		309.1. Method B (Example 5).
154		6-{7-[(3-methyloxetan-3-yl)methoxy]imidazo[1,2-a]pyridin-3-yl}-N-[(3R)-pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) δ ppm 1.40 (s, 3 H) 1.89 - 2.18 (m, 1 H) 2.31 (dd, J=13.26, 6.69 Hz, 1 H) 3.15 - 3.21 (m, 1 H) 3.31 - 3.40 (m, 2 H) 3.52 (dd, J=12.00, 6.19 Hz, 1 H) 4.20 (s, 2 H) 4.35 (d, J=5.81 Hz, 2 H) 4.53 (d, J=5.81 Hz, 3 H) 6.87 (dd, J=7.58, 2.27 Hz, 1 H) 7.19 (d, J=2.02 Hz, 1 H) 7.61 (d, J=5.31 Hz, 1 H) 7.80 (s, 1 H) 8.12 - 8.32 (m, 2 H) 8.39 (s, 1 H) 9.55 (d, J=7.83 Hz, 1 H). Method A (Example 32).
155		6-{7-[(3-methyloxetan-3-yl)methoxy]imidazo[1,2-a]pyridin-3-yl}-N-[(3R)-piperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) δ ppm 1.39 (s, 3 H) 1.46 - 1.56 (m, 1 H) 1.55 - 1.66 (m, 1 H) 1.73 - 1.85 (m, 1 H) 1.97 - 2.12 (m, 1 H) 2.54 - 2.56 (m, 1 H) 2.60 - 2.77 (m, 2 H) 2.93 - 3.06 (m, 1 H) 3.86 - 3.97 (m, 1 H) 4.19 (s, 2 H) 4.34 (d, J=5.81 Hz, 2 H) 4.52 (d, J=5.56 Hz, 2 H) 6.87 (d, J=1.77 Hz, 1 H) 7.09 - 7.27 (m, 2 H) 7.77 (s, 1 H) 8.23 (s, 1 H) 8.30 (s, 1 H) 9.58 (d, J=7.58 Hz, 1 H). Method A (Example 32).
156		6-(imidazo[1,2-a]pyridin-3-yl)-N-[(3R,5R)-5-methoxypiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, METHANOL-d <sub>4</sub> ) δ ppm 1.75-1.80 (m, 1H) 2.42 - 2.56 (m, 1 H) 2.91 - 3.04 (m, 1 H) 3.14 (d, J=12.63 Hz, 1 H) 3.43 - 3.50 (m, 3 H) 3.56 (d, J=13.14 Hz, H) 3.66 (s, 3 H) 3.92 (br. s., 1 H) 4.54 - 4.70 (m, 1 H) 7.63 (t, J=6.69 Hz, 1 H) 7.98 - 8.17 (m, 3 H) 8.39 (br. s., 1 H) 8.72 (s, 1 H)

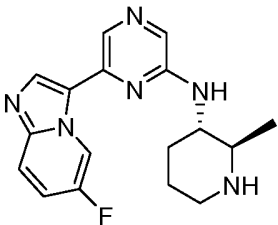
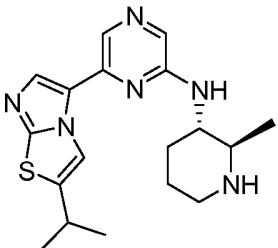
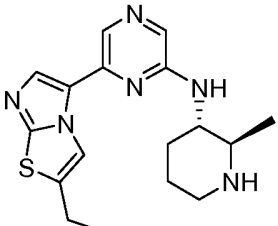
Ex.	Structure	Name, Data and Preparation Method
		9.88 (d, J=6.82 Hz, 1 H). Method A (Example 7).
157		6-(imidazo[1,2-a]pyridin-3-yl)-N-[(3R,5S)-5-(methoxymethyl)pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d6) $\delta$ ppm 2.05 - 2.24 (m, 2 H), 3.24 (dd, J=10.6, 4.8 Hz, 1 H), 3.36 (s, 3 H), 3.54 - 3.77 (m, 3 H), 4.05 (br. s., 1 H), 4.70 (br. s., 1 H), 7.70 (t, J=6.8 Hz, 1 H), 7.99 - 8.15 (m, 3 H), 8.22 (br. s., 1 H), 8.49 (s, 1 H), 9.02 (s, 1 H), 9.58 (br. s., 1 H), 9.79 - 9.98 (m, 2 H); LCMS: M + 1 325. Method A (Example 7).
158		6-(imidazo[1,2-a]pyridin-3-yl)-N-[(3R,5S)-5-[(propan-2-yloxy)methyl]pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (500 MHz, DMSO-d6) $\delta$ ppm 1.14 (d, J=5.9 Hz, 6 H), 1.99 - 2.22 (m, 2 H), 3.53 - 3.72 (m, 5 H), 3.97 (br. s., 1 H), 4.65 (br. s., 1 H), 7.22 (t, J=6.8 Hz, 1 H), 7.56 (t, J=7.8 Hz, 1 H), 7.73 (d, J=4.9 Hz, 1 H), 7.80 (d, J=8.8 Hz, 1 H), 7.90 (s, 1 H), 8.43 (s, 1 H), 8.50 (s, 1 H), 9.02 (br. s., 1 H), 9.57 (br. s., 1 H), 9.70 (d, J=6.8 Hz, 1 H); LCMS: M + 1 353. Method A (Example 7).
159		N-[6-(imidazo[1,2-a]pyridin-3-yl)pyrazin-2-yl]-2-azabicyclo[2.2.1]heptan-6-amine 1H NMR (400 MHz, DMSO-d6) $\delta$ ppm 1.43 - 1.56 (m, 1 H), 1.71 - 1.82 (m, 1 H), 1.94 - 2.03 (m, 1 H), 2.13 - 2.33 (m, 1 H), 2.63 - 2.70 (m, 1 H), 2.94 - 3.20 (m, 2 H), 4.18 (br. s., 1 H), 4.32 - 4.50 (m, 1 H), 7.53 - 7.70 (m, 1 H), 7.96 - 8.16 (m, 4 H), 8.34 (br. s., 1 H), 8.46 (s, 1 H), 8.94 (s, 1 H), 9.74 - 9.89 (m, 2 H); LCMS: M + 1 307. Method A (Example 7).

Ex.	Structure	Name, Data and Preparation Method
160		<p>N-[(3R)-piperidin-3-yl]-6-[2-(propan-2-yl)imidazo[2,1-b][1,3]thiazol-5-yl]pyrazin-2-amine</p> <p><sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 1.36 (d, J=6.8 Hz, 6 H), 1.54 - 1.69 (m, 1 H), 1.75 - 1.88 (m, 1 H), 1.90 - 2.01 (m, 1 H), 2.01 - 2.12 (m, 1 H), 2.89 - 3.05 (m, 2 H), 3.12 - 3.22 (m, 1 H), 3.30 - 3.39 (m, 1 H), 3.39 - 3.50 (m, 1 H), 4.31 (br. s., 1 H), 7.75 (br. s., 1 H), 7.92 (s, 1 H), 8.27 (s, 1 H), 8.34 (s, 1 H), 8.37 (s, 1 H), 9.21 (br. s., 1 H), 9.51 (br. s., 1 H); LCMS: M + 1 343. Method A (Example 7).</p>
161		<p>6-(2-methylimidazo[2,1-b][1,3]thiazol-5-yl)-N-[(2R,3R)-2-methylpiperidin-3-yl]pyrazin-2-amine</p> <p><sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 1.30 (d, J=6.8 Hz, 3 H), 1.63 - 2.04 (m, 4 H), 2.58 (d, J=1.3 Hz, 3 H), 2.92 - 3.02 (m, 1 H), 3.19 - 3.28 (m, 1 H), 3.60 (s, 1 H), 4.36 (br. s., 1 H), 7.99 (s, 1 H), 8.20 (d, J=9.1 Hz, 1 H), 8.39 (s, 2 H), 9.46 (br. s., 2 H); LCMS: M + 1 329. Method A (Example 7).</p>
162		<p>3-{6-[(1S,4R,6R)-2-azabicyclo[2.2.1]hept-6-ylamino]pyrazin-2-yl}imidazo[1,2-a]pyridine-7-carbonitrile</p> <p><sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 0.96 - 1.09 (m, 1 H), 1.46 - 1.57 (m, 1 H), 1.62 - 1.70 (m, 1 H), 1.81 (s, 2 H), 2.00 - 2.21 (m, 1 H), 2.85 (br. s., 1 H), 4.09 (br. s., 1 H), 7.27 - 7.37 (m, 1 H), 7.43 (dd, J=7.3, 1.0 Hz, 1 H), 7.97 (s, 1 H), 8.39 (s, 1 H), 8.47 (s, 1 H), 8.61 (s, 1 H), 9.82 (d, J=7.1 Hz, 1 H); LCMS: M + 1 332. Method A (Example 7).</p>

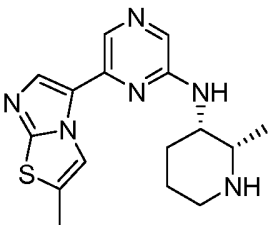
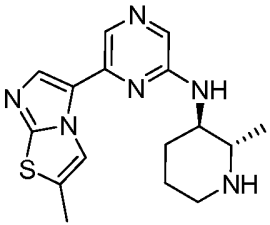
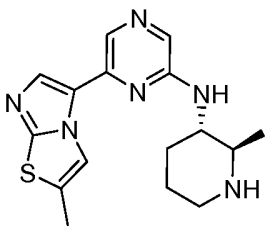
Ex.	Structure	Name, Data and Preparation Method
163		<p>6-(imidazo[1,2-a]pyrazin-3-yl)-N-[(2R,3R)-2-methylpiperidin-3-yl]pyrazin-2-amine <sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 1.02 (d, J=6.55 Hz, 3 H) 1.25 - 1.44 (m, 1 H) 1.51 - 1.69 (m, 2 H) 1.93 - 2.05 (m, 1 H) 2.59 - 2.70 (m, 1 H) 2.94 (dd, J=6.55, 2.27 Hz, 2 H) 4.00 (d, J=6.29 Hz, 1 H) 7.13 (d, J=8.31 Hz, 1 H) 8.05 - 8.12 (m, 2 H) 8.35 (s, 1 H) 8.58 (s, 1 H) 9.17 (d, J=1.51 Hz, 1 H) 9.53 (d, J=4.03 Hz, 1 H); LCMS: M + 1 310.2. Method A (Example 7).</p>
164		<p>6-(6-fluoroimidazo[1,2-a]pyridin-3-yl)-N-[(2R,3R)-2-methylpiperidin-3-yl]pyrazin-2-amine <sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 1.03 (d, J=6.55 Hz, 4 H) 1.39 (dd, J=5.92, 2.90 Hz, 1 H) 1.53 - 1.68 (m, 2 H) 2.00 (d, J=8.06 Hz, 1 H) 2.57 - 2.70 (m, 1 H) 2.88 - 3.04 (m, 2 H) 3.98 (d, J=5.79 Hz, 1 H) 7.20 (d, J=8.31 Hz, 1 H) 7.41 - 7.52 (m, 1 H) 7.70 - 7.85 (m, 1 H) 8.03 (s, 1 H) 8.30 (s, 1 H) 8.42 (s, 1 H) 9.78 (dd, J=5.54, 2.27 Hz, 1 H); LCMS: M + 1 327.2. Method A (Example 7).</p>
165		<p>N-[(2R,3R)-2-methylpiperidin-3-yl]-6-[2-(propan-2-yl)imidazo[2,1-b][1,3]thiazol-5-yl]pyrazin-2-amine <sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 1.00 (d, J=6.55 Hz, 3 H) 1.33 (d, J=6.80 Hz, 3 H) 1.34 - 1.39 (m, 1 H) 1.51 - 1.62 (m, 1 H) 1.98 (d, J=9.32 Hz, 1 H) 2.55 - 2.69 (m, 2 H) 2.84 - 2.97 (m, 2 H) 3.12 - 3.22 (m, 2 H) 3.96 (d, J=11.58 Hz, 1 H) 6.97 (d, J=8.81 Hz, 1 H) 7.91 (s, 1 H) 7.98 (s, 1 H) 8.14 (s, 1 H) 8.26 (d, J=1.51 Hz, 1 H); LCMS: M + 1 357.2. Method A (Example 7).</p>

Ex.	Structure	Name, Data and Preparation Method
166		6-(2-ethylimidazo[2,1-b][1,3]thiazol-5-yl)-N-[(2R,3R)-2-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) δ ppm 1.03 (d, J=6.55 Hz, 3 H) 1.31 (t, 3 H) 1.39 (dd, J=9.06, 3.02 Hz, 1 H) 1.52 - 1.70 (m, 2 H) 1.92 - 2.02 (m, 1 H) 2.58 - 2.70 (m, 1 H) 2.79 - 2.88 (m, 2 H) 2.91 - 3.05 (m, 2 H) 4.00 (d, J=5.54 Hz, 1 H) 7.17 (d, J=7.81 Hz, 1 H) 7.91 (s, 1 H) 7.97 (s, 1 H) 8.15 (s, 1 H) 8.26 (br. s., 1 H); LCMS: M + 1 343.2. Method A (Example 7).
167		6-(imidazo[1,2-a]pyrazin-3-yl)-N-[(2S,3R)-2-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) δ ppm 1.07 (d, J=6.04 Hz, 3 H) 1.16 - 1.34 (m, J=11.08, 4.03 Hz, 1 H) 1.44 - 1.60 (m, 1 H) 1.62 - 1.70 (m, 1 H) 2.05 - 2.18 (m, J=13.09 Hz, 1 H) 2.54 - 2.60 (m, 1 H) 2.83 - 2.99 (m, 1 H) 3.33 - 3.56 (m, J=11.08 Hz, 1 H) 7.24 (d, J=8.81 Hz, 1 H) 7.87 (s, 1 H) 8.09 (d, J=4.78 Hz, 1 H) 8.37 (s, 1 H) 8.59 (s, 1 H) 9.19 (d, J=1.51 Hz, 1 H) 9.60 (d, J=4.53 Hz, 1 H); LCMS: M + 1 310.2. Method A (Example 7).
168		6-(6-fluoroimidazo[1,2-a]pyridin-3-yl)-N-[(2S,3R)-2-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) δ ppm 1.07 (d, J=6.29 Hz, 3 H) 1.18 - 1.32 (m, 1 H) 1.46 - 1.58 (m, J=12.34 Hz, 1 H) 1.60 - 1.71 (m, 1 H) 2.17 (d, J=12.09 Hz, 1 H) 2.55 - 2.61 (m, 2 H) 2.92 (d, J=11.83 Hz, 1 H) 7.19 (d, J=8.56 Hz, 1 H) 7.44 - 7.56 (m, 1 H) 7.73 - 7.85 (m, 2 H) 7.81 (s, 1 H) 8.31 (s, 1 H) 8.44 (s, 1 H) 9.86 (dd, J=5.67, 2.39 Hz, 1 H); LCMS: M + 1 327.2. Method A (Example 7).

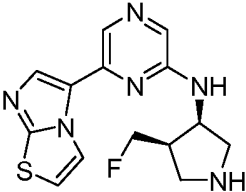
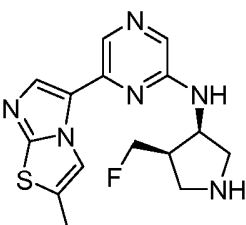
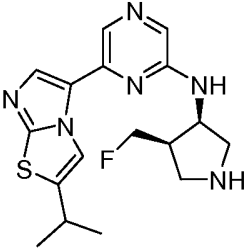
Ex.	Structure	Name, Data and Preparation Method
169		<p>N-[(2S,3R)-2-methylpiperidin-3-yl]-6-[2-(propan-2-yl)imidazo[2,1-b][1,3]thiazol-5-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d<sub>6</sub>) <math>\delta</math> ppm 1.04 (d, J=6.04 Hz, 3 H) 1.14 - 1.30 (m, 1 H) 1.29 - 1.35 (m, 1 H) 1.36 (dd, J=6.80, 1.01 Hz, 6 H) 1.40 - 1.53 (m, 1 H) 1.60 - 1.70 (m, 1 H) 2.01 - 2.11 (m, J=10.32 Hz, 1 H) 2.84 - 2.96 (m, J=11.83 Hz, 1 H) 3.09 - 3.24 (m, 1 H) 3.33 - 3.57 (m, 1 H) 7.06 (d, J=8.81 Hz, 1 H) 7.74 (s, 1 H) 7.93 (s, 1 H) 8.14 (s, 1 H) 8.31 (d, J=1.26 Hz, 1 H); LCMS: M + 1 357.2. Method A (Example 7).</p>
170		<p>6-(2-ethylimidazo[2,1-b][1,3]thiazol-5-yl)-N-[(2S,3R)-2-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d<sub>6</sub>) <math>\delta</math> ppm 1.04 (d, J=6.04 Hz, 3 H) 1.15 - 1.30 (m, 1 H) 1.33 (t, J=7.43 Hz, 3 H) 1.41 - 1.55 (m, 1 H) 1.61 - 1.73 (m, 1 H) 2.03 - 2.16 (m, J=15.86 Hz, 1 H) 2.75 - 2.86 (m, 2 H) 2.88 - 2.94 (m, J=11.83 Hz, 1 H) 7.05 (d, J=8.31 Hz, 1 H) 7.74 (s, 1 H) 7.93 (s, 1 H) 8.15 (s, 1 H) 8.32 (s, 1 H); LCMS: M + 1 343.2. Method A (Example 7).</p>
171		<p>6-(imidazo[1,2-a]pyrazin-3-yl)-N-[(2R,3S)-2-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d<sub>6</sub>) <math>\delta</math> ppm 1.07 (d, J=6.29 Hz, 3 H) 1.18 - 1.35 (m, 1 H) 1.44 - 1.60 (m, J=11.83 Hz, 1 H) 1.62 - 1.70 (m, 1 H) 2.11 (d, J=10.58 Hz, 1 H) 2.93 (d, J=11.83 Hz, 1 H) 3.39 - 3.57 (m, 1 H) 7.23 (d, J=8.56 Hz, 1 H) 7.86 (s, 1 H) 8.09 (d, J=4.53 Hz, 1 H) 8.37 (s, 1 H) 8.58 (s, 1 H) 9.19 (d, J=1.51 Hz, 1 H) 9.60 (d, J=3.78 Hz, 1 H); LCMS: M + 1 310.2. Method A (Example 7).</p>

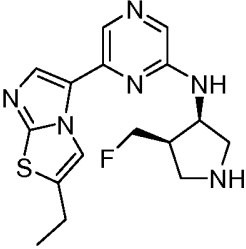
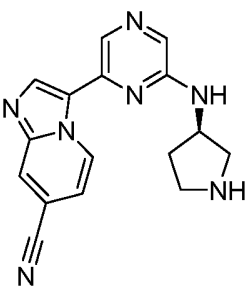
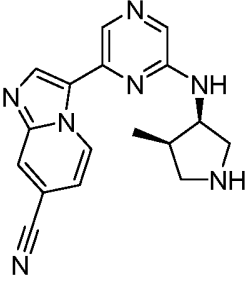
Ex.	Structure	Name, Data and Preparation Method
172		<p>6-(6-fluoroimidazo[1,2-a]pyridin-3-yl)-N-[(2R,3S)-2-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 1.07 (d, J=6.29 Hz, 3 H) 1.15 - 1.33 (m, 1 H) 1.41 - 1.59 (m, J=11.83 Hz, 1 H) 1.61 - 1.70 (m, 1 H) 2.10 - 2.23 (m, 1 H) 2.54 - 2.62 (m, 1 H) 2.83 - 3.00 (m, 1 H) 3.31 - 3.51 (m, 1 H) 7.19 (d, J=8.56 Hz, 1 H) 7.41 - 7.53 (m, 1 H) 7.75 - 7.85 (m, 1 H) 7.80 (s, 1 H) 8.31 (s, 1 H) 8.44 (s, 1 H) 9.86 (dd, J=5.79, 2.27 Hz, 1 H); LCMS: M + 1 327.2. Method A (Example 7).</p>
173		<p>N-[(2R,3S)-2-methylpiperidin-3-yl]-6-[2-(propan-2-yl)imidazo[2,1-b][1,3]thiazol-5-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 1.03 (d, J=6.29 Hz, 3 H) 1.17 - 1.32 (m, 1 H) 1.36 (dd, J=6.80, 1.26 Hz, 6 H) 1.40 - 1.54 (m, 1 H) 1.59 - 1.72 (m, 1 H) 2.02 - 2.12 (m, J=15.86 Hz, 1 H) 2.79 - 2.94 (m, 1 H) 3.11 - 3.21 (m, 1 H) 3.43 - 3.56 (m, 1 H) 7.05 (d, J=9.06 Hz, 1 H) 7.74 (s, 1 H) 7.93 (s, 1 H) 8.14 (s, 1 H) 8.32 (d, J=1.26 Hz, 1 H); LCMS: M + 1 357.2. Method A (Example 7).</p>
174		<p>6-(2-ethylimidazo[2,1-b][1,3]thiazol-5-yl)-N-[(2R,3S)-2-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 1.04 (d, J=6.29 Hz, 3 H) 1.16 - 1.28 (m, 1 H) 1.33 (t, 3 H) 1.39 - 1.56 (m, 1 H) 1.58 - 1.73 (m, 1 H) 2.01 - 2.14 (m, J=14.86 Hz, 1 H) 2.80 - 2.86 (m, 2 H) 2.86 - 2.93 (m, 1 H) 3.40 - 3.50 (m, 2 H) 7.05 (d, J=8.56 Hz, 1 H) 7.74 (s, 1 H) 7.93 (s, 1 H) 8.15 (s, 1 H) 8.32 (s, 1 H); LCMS: M + 1 343.2. Method A (Example 7).</p>

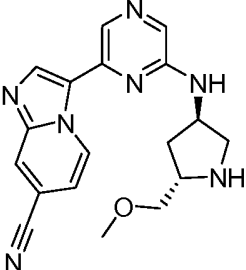
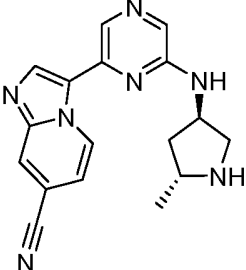
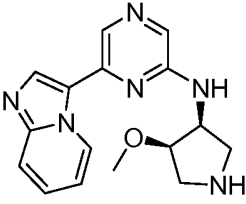


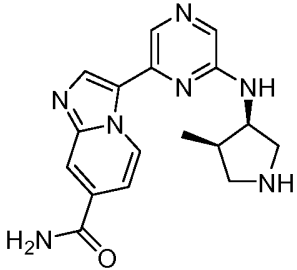
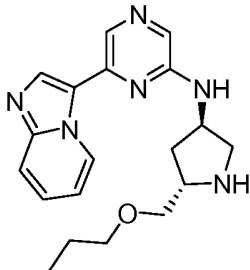
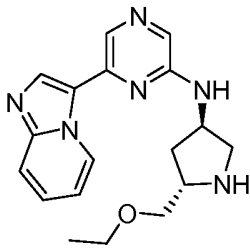
Ex.	Structure	Name, Data and Preparation Method
175		6-(2-methylimidazo[2,1-b][1,3]thiazol-5-yl)-N-[(2S,3S)-2-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) δ ppm 1.00 (d, J=6.55 Hz, 3 H) 1.29 - 1.43 (m, 1 H) 1.55 - 1.67 (m, 2 H) 1.90 - 2.04 (m, 1 H) 2.47 (s, 3 H) 2.55 - 2.70 (m, 1 H) 2.88 - 2.99 (m, 2 H) 3.94 (d, J=6.29 Hz, 1 H) 6.92 (d, J=7.55 Hz, 1 H) 7.91 (s, 1 H) 7.96 (s, 1 H) 8.14 (s, 1 H) 8.23 (br. s., 1 H); LCMS: M + 1 329.2. Method A (Example 7).
176		6-(2-methylimidazo[2,1-b][1,3]thiazol-5-yl)-N-[(2S,3R)-2-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) δ ppm 1.05 (d, J=6.04 Hz, 3 H) 1.15 - 1.30 (m, 1 H) 1.43 - 1.60 (m, 1 H) 1.67 (d, J=3.02 Hz, 1 H) 2.05 - 2.18 (m, 1 H) 2.93 (d, J=14.35 Hz, 1 H) 3.37 - 3.50 (m, J=28.96 Hz, 1 H) 7.05 (d, J=8.06 Hz, 1 H) 7.74 (s, 1 H) 7.93 (s, 1 H) 8.15 (s, 1 H) 8.31 (br. s., 1 H); LCMS: M + 1 329.2. Method A (Example 7).
177		6-(2-methylimidazo[2,1-b][1,3]thiazol-5-yl)-N-[(2R,3S)-2-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) δ ppm 1.05 (d, J=6.29 Hz, 3 H) 1.15 - 1.30 (m, 1 H) 1.39 - 1.57 (m, 1 H) 1.63 - 1.72 (m, 1 H) 2.01 - 2.19 (m, 1 H) 2.53 - 2.59 (m, 1 H) 2.92 (d, J=12.09 Hz, 1 H) 3.41 (d, J=10.58 Hz, 1 H) 7.04 (d, J=8.31 Hz, 1 H) 7.74 (s, 1 H) 7.93 (s, 1 H) 8.15 (s, 1 H) 8.31 (br. s., 1 H); LCMS: M + 1 329.2. Method A (Example 7).

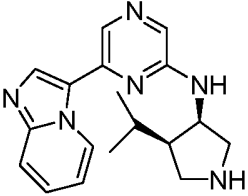
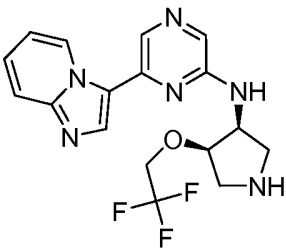
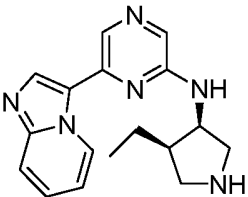
Ex.	Structure	Name, Data and Preparation Method
178		6-(2-methylimidazo[2,1-b][1,3]thiazol-5-yl)-N-[(3R,5R)-5-methylpyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) δ ppm 1.28 - 1.36 (m, 1 H) 1.40 (d, J=6.55 Hz, 3 H) 1.90 - 2.06 (m, 1 H) 2.14 - 2.24 (m, J=2.77 Hz, 1 H) 2.58 (s, 3 H) 3.61 - 3.73 (m, J=7.30 Hz, 1 H) 3.79 - 3.93 (m, 1 H) 4.55 - 4.72 (m, 1 H) 7.92 (s, 1 H) 8.33 (s, 1 H) 8.38 (s, 1 H) 8.46 (s, 1 H) 9.38 (br. s., 1 H) 9.71 (br. s., 1 H); LCMS: M + 1 315.2. Method A (Example 7).
179		6-(imidazo[2,1-b][1,3]thiazol-5-yl)-N-[(2S,3S)-2-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) δ ppm 0.98 (d, J=6.67 Hz, 3 H) 1.18 - 1.27 (m, 2 H) 1.29 - 1.40 (m, 1 H) 1.52 - 1.65 (m, J=4.28 Hz, 1 H) 1.83 - 1.98 (m, 1 H) 2.85 - 2.97 (m, J=13.85 Hz, 2 H) 3.84 - 3.99 (m, 1 H) 6.91 (s, 1 H) 7.44 (dd, J=4.41, 1.13 Hz, 1 H) 7.95 - 8.01 (m, 1 H) 8.16 (s, 1 H) 8.47 (s, 1 H); LCMS: M + 1 315.2. Method A (Example 7).
180		6-(imidazo[2,1-b][1,3]thiazol-5-yl)-N-[(2R,3R)-2-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) d ppm 0.99 (d, J=6.55 Hz, 3 H) 1.28 - 1.44 (m, 1 H) 1.52 - 1.64 (m, 1 H) 1.88 - 1.97 (m, 1 H) 2.85 - 2.99 (m, 2 H) 3.87 - 4.05 (m, 1 H) 6.93 (d, J=7.55 Hz, 1 H) 7.44 (dd, J=4.41, 1.13 Hz, 1 H) 7.89 - 8.03 (m, 2 H) 8.16 (s, 1 H) 8.48 (d, J=2.27 Hz, 1 H); LCMS: M + 1 315.2. Method A (Example 7).
181		6-(imidazo[2,1-b][1,3]thiazol-5-yl)-N-[(3R,4R)-4-methylpyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) δ ppm 0.86 (d, 3 H) 2.33 (t, J=1.89 Hz, 1 H) 2.64 - 2.75 (m, 1 H) 3.03 -

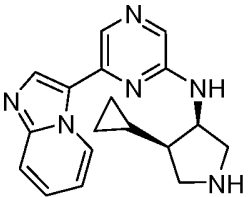
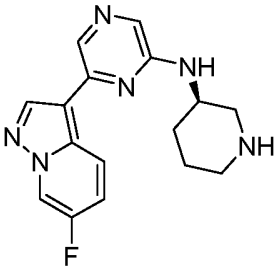
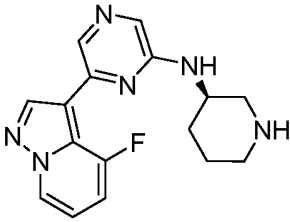
Ex.	Structure	Name, Data and Preparation Method
		3.14 (m, 1 H) 7.16 (d, J=8.56 Hz, 1 H) 7.46 (dd, J=4.53, 1.01 Hz, 1 H) 7.83 (s, 1 H) 8.01 (s, 1 H) 8.21 (s, 1 H) 8.55 (d, J=4.03 Hz, 1 H); LCMS: M + 1 301.2. Method A (Example 7).
182		N-[(3R,4R)-4-(fluoromethyl)pyrrolidin-3-yl]-6-(imidazo[2,1-b][1,3]thiazol-5-yl)pyrazin-2-amine 1H NMR (400 MHz, MeOD) $\delta$ ppm 2.93 - 3.12 (m, 1 H) 3.38 (dd, J=7.55, 1.01 Hz, 1 H) 3.55 (dd, J=12.21, 6.67 Hz, 1 H) 3.69 - 3.81 (m, 2 H) 4.58 - 4.62 (m, 1 H) 4.70 - 4.75 (m, 1 H) 5.05 (q, J=7.39 Hz, 1 H) 7.39 (d, J=4.53 Hz, 1 H) 7.91 (s, 1 H) 8.05 (s, 1 H) 8.31 (s, 1 H) 8.56 (d, J=4.53 Hz, 1 H); LCMS: M + 1 319.2. Method A (Example 7).
183		N-[(3R,4R)-4-(fluoromethyl)pyrrolidin-3-yl]-6-(2-methylimidazo[2,1-b][1,3]thiazol-5-yl)pyrazin-2-amine 1H NMR (400 MHz, MeOD) $\delta$ ppm 2.55 (s, 3 H) 2.94 - 3.14 (m, 1 H) 3.37 (dd, J=11.20, 7.93 Hz, 1 H) 3.56 (dd, J=12.34, 6.55 Hz, 1 H) 3.68 - 3.79 (m, 1 H) 4.61 (t, J=3.90 Hz, 1 H) 4.73 (t, J=3.90 Hz, 1 H) 5.01 (q, J=7.47 Hz, 1 H) 7.90 (s, 1 H) 7.95 (s, 1 H) 8.26 (d, J=1.51 Hz, 1 H) 8.28 (s, 1 H); LCMS: M + 1 333.2. Method A (Example 7).
184		N-[(3R,4R)-4-(fluoromethyl)pyrrolidin-3-yl]-6-[2-(propan-2-yl)imidazo[2,1-b][1,3]thiazol-5-yl]pyrazin-2-amine 1H NMR (400 MHz, MeOD) $\delta$ ppm 1.44 (d, J=6.80 Hz, 6 H) 2.97 - 3.16 (m, 1 H) 3.33 - 3.37 (m, 1 H) 3.37 - 3.46 (m, 1 H) 3.54 (dd, J=12.21, 7.18 Hz, 1 H) 3.69 (dd, J=12.21, 8.18 Hz, 1 H) 3.76 (dd, J=11.96, 7.43 Hz, 1 H) 4.61 (dd, J=4.78, 1.76 Hz, 1 H) 4.73 (dd, J=4.78, 1.76 Hz, 1 H) 5.03 (q, J=6.80 Hz, 1 H) 7.98 (s, 1 H)

Ex.	Structure	Name, Data and Preparation Method
		8.14 (br. s., 1 H) 8.32 (s, 1 H) 8.39 (s, 1 H); LCMS: M + 1 361.2. Method A (Example 7).
185		6-(2-ethylimidazo[2,1-b][1,3]thiazol-5-yl)-N-[(3R,4R)-4-(fluoromethyl)pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, MeOD) $\delta$ ppm 1.40 (t, J=7.43 Hz, 3 H) 2.93 (q, 2 H) 2.97 - 3.16 (m, 1 H) 3.40 (dd, J=11.83, 1.26 Hz, 1 H) 3.52 - 3.60 (m, 1 H) 3.65 - 3.80 (m, 2 H) 4.62 (dd, J=4.41, 3.15 Hz, 1 H) 4.74 (t, 1 H) 5.01 (q, J=7.30 Hz, 1 H) 7.89 (s, 1 H) 7.93 (s, 1 H) 8.26 (s, 1 H) 8.29 (s, 1 H); LCMS: M + 1 347.2. Method A (Example 7).
186		3-{6-[(3R)-pyrrolidin-3-ylamino]pyrazin-2-yl}imidazo[1,2-a]pyridine-7-carbonitrile 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) $\delta$ ppm 1.59 - 1.77 (m, 1 H) 2.02 - 2.17 (m, 1 H) 2.70 - 2.78 (m, 1 H) 2.80 - 2.89 (m, 1 H) 2.89 - 2.99 (m, 1 H) 3.06 - 3.18 (m, J=6.04 Hz, 1 H) 4.19 - 4.32 (m, 1 H) 7.41 (dd, J=7.30, 1.76 Hz, 1 H) 7.46 (d, J=6.04 Hz, 1 H) 7.87 (s, 1 H) 8.40 (s, 1 H) 8.48 (d, J=1.01 Hz, 1 H) 8.63 (s, 1 H) 9.88 (d, J=7.30 Hz, 1 H); LCMS: M + 1 306.2. Method A (Example 7).
187		3-(6-[[[(3R,4R)-4-methylpyrrolidin-3-yl]amino]pyrazin-2-yl]imidazo[1,2-a]pyridine-7-carbonitrile 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) $\delta$ ppm 0.87 (d, J=6.80 Hz, 3 H) 2.26 - 2.39 (m, 1 H) 2.73 (dd, J=11.20, 5.67 Hz, 1 H) 3.11 (dd, J=10.58, 7.05 Hz, 1 H) 3.19 - 3.26 (m, 2 H) 4.26 - 4.44 (m, 1 H) 7.31 (d, J=7.30 Hz, 1 H) 7.41 (dd, J=7.30, 1.51 Hz, 1 H) 7.95 (s, 1 H) 8.39 (s, 1 H) 8.47 (d, J=1.01 Hz, 1 H) 8.62 (s, 1 H) 9.84 (d, J=7.55 Hz, 1 H); LCMS: M + 1 320.2. Method A (Example 7).

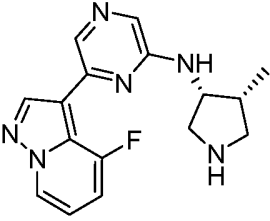
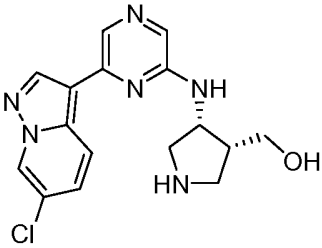
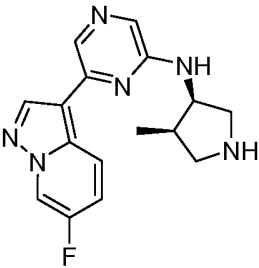
Ex.	Structure	Name, Data and Preparation Method
188		<p>3-(6-(((3R,5S)-5-(methoxymethyl)pyrrolidin-3-yl)amino)pyrazin-2-yl)imidazo[1,2-a]pyridine-7-carbonitrile 1H NMR (400 MHz, ACETONITRILE-d<sub>3</sub>) δ ppm 1.73 - 1.79 (m, 1 H), 1.81 - 1.88 (m, 2 H), 2.08 - 2.12 (m, 2 H), 2.83 (dd, J=11.08, 4.03 Hz, 1 H), 3.27 (dd, J=11.08, 5.79 Hz, 1 H), 3.30 (s, 1 H), 3.32 (s, 3 H), 3.41 - 3.49 (m, J=5.79 Hz, 1 H), 4.25 - 4.46 (m, 1 H), 5.75 - 5.96 (m, 1 H), 7.17 (dd, J=7.30, 1.76 Hz, 1 H), 7.83 (s, 1 H), 8.14 (s, 1 H), 8.31 (s, 1 H), 9.88 (dd, J=7.30, 1.01 Hz, 1 H); LCMS: M + 1 350.2. Method A (Example 7).</p>
189		<p>3-(6-(((3R,5R)-5-methylpyrrolidin-3-yl)amino)pyrazin-2-yl)imidazo[1,2-a]pyridine-7-carbonitrile 1H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 1.15 (d, J=6.29 Hz, 3 H), 1.52 - 1.73 (m, 1 H), 1.84 - 1.96 (m, 1 H), 2.25 - 2.35 (m, 1 H), 2.72 - 2.80 (m, J=16.37 Hz, 1 H), 3.41 (dd, J=4.78 Hz, 1 H), 4.20 - 4.44 (m, 1 H), 7.42 (dd, J=7.43, 1.64 Hz, 1 H), 7.55 (d, J=6.04 Hz, 1 H), 7.87 (s, 1 H), 8.42 (s, 1 H), 8.50 (d, J=1.76 Hz, 1 H), 8.64 (s, 1 H), 9.87 (d, J=7.05 Hz, 1 H); LCMS: M + 1 320.2. Method A (Example 7).</p>
190		<p>6-(imidazo[1,2-a]pyridin-3-yl)-N-((3S,4R)-4-methoxypyrrolidin-3-yl)pyrazin-2-amine 1H NMR (400 MHz, MeOD) δ ppm 2.94 (dd, J=11.08, 8.06 Hz, 1 H), 3.13 - 3.28 (m, 2 H), 3.34 - 3.37 (m, 2 H), 3.43 (s, 3 H), 4.01 - 4.09 (m, 1 H), 4.48 - 4.60 (m, 1 H), 7.11 - 7.18 (m, 1 H), 7.45 - 7.53 (m, 1 H), 7.69 (d, J=9.06 Hz, 1 H), 7.92 (s, 1 H), 8.25 (s, 1 H), 8.29 (s, 1 H), 9.75 (d, J=7.05 Hz, 1 H); LCMS: M + 1 311.2. Method A (Example 7).</p>

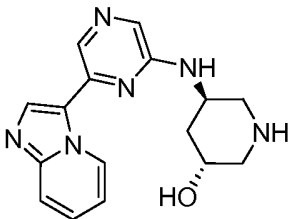
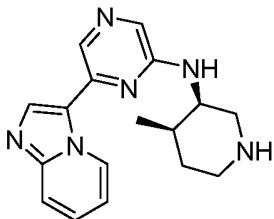
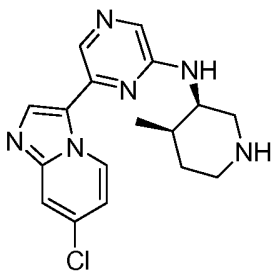
Ex.	Structure	Name, Data and Preparation Method
191		<p>3-(6-(((3R,4R)-4-methylpyrrolidin-3-yl)amino)pyrazin-2-yl)imidazo[1,2-a]pyridine-7-carboxamide 1H NMR (400 MHz, MeOD) <math>\delta</math> ppm 1.16 (d, J=7.05 Hz, 3 H), 2.69 - 2.83 (m, 1 H), 3.14 (dd, J=11.71, 9.19 Hz, 1 H), 3.34 - 3.39 (m, 1 H), 3.57 (dd, J=11.58, 7.30 Hz, 1 H), 3.69 (dd, J=12.09, 6.29 Hz, 1 H), 4.77 - 4.84 (m, J=5.04 Hz, 1 H), 7.56 (dd, J=7.30, 1.76 Hz, 1 H), 7.94 (s, 1 H), 8.22 (d, J=1.76 Hz, 1 H), 8.39 (s, 1 H), 8.52 (s, 1 H), 9.73 (d, J=7.30 Hz, 1 H); LCMS: M + 1 338.2. Method A (Example 7).</p>
192		<p>6-(imidazo[1,2-a]pyridin-3-yl)-N-((3R,5S)-5-(propoxymethyl)pyrrolidin-3-yl)pyrazin-2-amine 1H NMR (400 MHz, MeOD) <math>\delta</math> ppm 0.86 - 0.98 (m, 3 H), 1.47 - 1.65 (m, 2 H), 1.91 - 2.08 (m, 2 H), 2.90 (dd, J=11.33, 5.04 Hz, 1 H), 3.37 - 3.59 (m, 6 H), 4.32 - 4.59 (m, 1 H), 7.02 - 7.11 (m, 1 H), 7.39 - 7.48 (m, 1 H), 7.62 - 7.68 (m, 1 H), 7.74 (s, 1 H), 8.22 (s, 1 H), 8.24 (s, 1 H), 9.82 (d, J=7.05 Hz, 1 H); LCMS: M + 1 353.2. Method A (Example 7).</p>
193		<p>N-((3R,5S)-5-(ethoxymethyl)pyrrolidin-3-yl)-6-(imidazo[1,2-a]pyridin-3-yl)pyrazin-2-amine 1H NMR (400 MHz, MeOD) <math>\delta</math> ppm 1.18 (dd, 6 H), 1.91 - 2.13 (m, 2 H), 2.91 (dd, J=11.46, 4.91 Hz, 1 H), 3.41 - 3.56 (m, 4 H), 3.60 - 3.70 (m, 1 H), 4.34 - 4.61 (m, 1 H), 7.02 - 7.16 (m, 1 H), 7.41 - 7.52 (m, 1 H), 7.63 - 7.72 (m, 1 H), 7.76 (s, 1 H), 8.25 (s, 1 H), 8.27 (s, 1 H), 9.85 (d, J=7.05 Hz, 1 H); LCMS: M + 1 339.2. Method A (Example 7).</p>

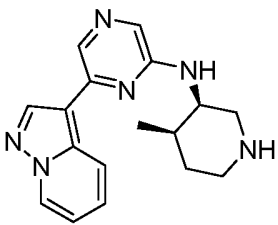
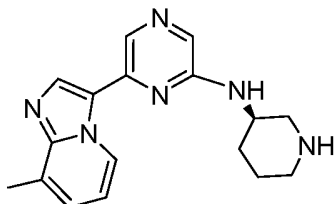
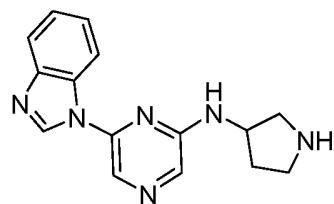
Ex.	Structure	Name, Data and Preparation Method
194		<p>6-(imidazo[1,2-a]pyridin-3-yl)-N-[(3R,4R)-4-(propan-2-yl)pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, MeOD) <math>\delta</math> ppm 0.89 - 1.03 (m, 6 H), 2.12 - 2.30 (m, 1 H), 3.22 - 3.25 (m, 1 H), 3.26 - 3.32 (m, 1 H), 3.40 - 3.48 (m, 1 H), 3.48 - 3.58 (m, 2 H), 4.75 (t, J=4.53 Hz, 1 H), 6.94 - 7.07 (m, 1 H), 7.26 - 7.43 (m, 1 H), 7.57 (d, J=8.81 Hz, 1 H), 7.83 (s, 1 H), 8.12 (s, 1 H), 8.21 (s, 1 H), 9.56 (d, J=7.05 Hz, 1 H); LCMS: M + 1 323.2. Method A (Example 7).</p>
195		<p>6-(imidazo[1,2-a]pyridin-3-yl)-N-[(3S,4R)-4-(2,2,2-trifluoroethoxy)pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, MeOD) <math>\delta</math> ppm 3.21 - 3.34 (m, 2 H), 3.48 - 3.66 (m, 2 H), 3.67 - 3.79 (m, 1 H), 4.04 - 4.18 (m, 2 H), 4.53 (br. s., 1 H), 4.80 - 4.91 (m, 1 H), 7.11 (t, J=6.80 Hz, 1 H), 7.35 - 7.52 (m, 1 H), 7.65 (d, J=9.06 Hz, 1 H), 7.92 (s, 1 H), 8.20 (s, 1 H), 8.28 (s, 1 H), 9.59 (d, J=7.05 Hz, 1 H); LCMS: M + 1 379.1. Method A (Example 7).</p>
196		<p>N-[(3R,4R)-4-ethylpyrrolidin-3-yl]-6-(imidazo[1,2-a]pyridin-3-yl)pyrazin-2-amine 1H NMR (400 MHz, MeOD) <math>\delta</math> ppm 0.90 - 0.97 (m, 3 H), 1.37 - 1.50 (m, 1 H), 1.51 - 1.64 (m, 1 H), 2.23 - 2.36 (m, J=8.06 Hz, 1 H), 2.71 - 2.85 (m, 1 H), 2.95 (dd, J=11.58, 4.28 Hz, 1 H), 3.25 (dd, J=10.95, 7.68 Hz, 2 H), 4.52 - 4.71 (m, 1 H), 7.10 (t, J=6.42 Hz, 1 H), 7.36 - 7.53 (m, 1 H), 7.59 - 7.76 (m, 1 H), 7.84 (s, 1 H), 8.19 - 8.28 (m, 2 H), 9.79 (d, J=7.05 Hz, 1 H); LCMS: M + 1 309.2. Method A (Example 7).</p>

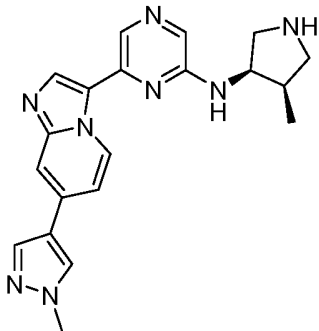
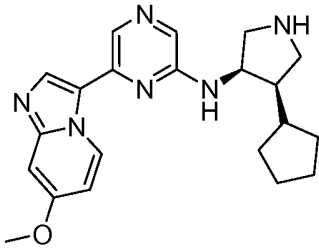
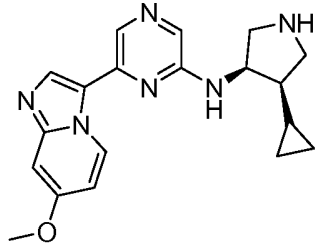
Ex.	Structure	Name, Data and Preparation Method
197		<p>N-[(3R,4R)-4-cyclopropylpyrrolidin-3-yl]-6-(imidazo[1,2-a]pyridin-3-yl)pyrazin-2-amine 1H NMR (400MHz, METHANOL-d<sub>4</sub>) δ ppm 9.68 (d, J = 7.1 Hz, 1 H), 8.28 (s, 1 H), 8.15 (s, 1 H), 7.84 (s, 1 H), 7.72 - 7.62 (m, J = 9.1 Hz, 1 H), 7.33 - 7.18 (m, 1 H), 6.91 (t, J = 6.4 Hz, 1 H), 5.83 (d, J = 7.1 Hz, 1 H), 4.57 - 4.40 (m, 1 H), 3.44 (dd, J = 5.7, 10.7 Hz, 1 H), 3.29 (dd, J = 8.3, 10.3 Hz, 1 H), 3.13 - 2.93 (m, 1 H), 1.76 - 1.59 (m, 1 H), 0.86 - 0.70 (m, 1 H), 0.54 - 0.39 (m, 2 H), 0.26 - 0.12 (m, 2 H); LCMS: M + 1 321.1. Method A (Example 7).</p>
198		<p>6-(6-fluoropyrazolo[1,5-a]pyridin-3-yl)-N-[(3R)-piperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, MeOD) δ ppm 1.71 - 1.90 (m, 1 H) 2.02 (dd, J=10.48, 4.17 Hz, 1 H) 2.14 (br. s., 1 H) 2.26 (br. s., 1 H) 3.04 - 3.23 (m, 2 H) 3.38 (d, J=12.88 Hz, 1 H) 3.57 - 3.73 (m, 1 H) 4.40 - 4.57 (m, 1 H) 7.54 - 7.69 (m, 1 H) 7.78 (s, 1 H) 8.37 (s, 1 H) 8.50 (dd, J=9.60, 5.56 Hz, 1 H) 8.71 (s, 1 H) 8.79 - 8.90 (m, 1 H); LCMS: M + 1 313. Method E (Example 6).</p>
199		<p>6-(4-fluoropyrazolo[1,5-a]pyridin-3-yl)-N-[(3R)-piperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, D<sub>2</sub>O) δ ppm 2.76 (br. s., 1 H) 2.92 (br. s., 1 H) 3.14 (br. s., 2 H) 3.94 - 4.18 (m, 2 H) 4.36 (br. s., 1 H) 4.56 (br. s., 1 H) 5.24 (br. s., 1 H) 7.94 - 8.05 (m, 1 H) 8.13 - 8.24 (m, 1 H) 8.65 (s, 1 H) 8.95 (s, 1 H) 9.34 - 9.45 (m, 2 H); LCMS: M + 1 313. Method E (Example 6).</p>

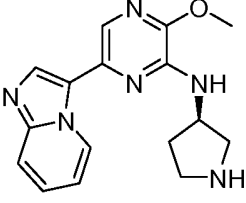
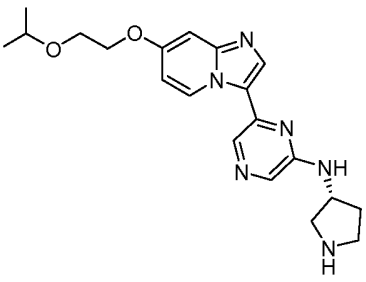
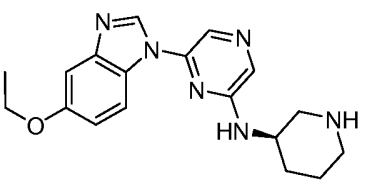
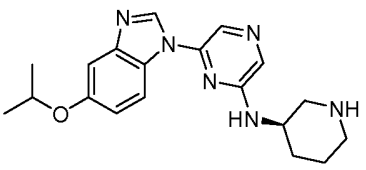


Ex.	Structure	Name, Data and Preparation Method
200		<p>6-(4-fluoropyrazolo[1,5-a]pyridin-3-yl)-N-[(3R,4R)-4-methylpyrrolidin-3-yl]pyrazin-2-amine</p> <p><sup>1</sup>H NMR (400 MHz, MeOD) <math>\delta</math> ppm 1.19 (d, J=6.82 Hz, 3 H) 2.72 - 2.87 (m, 1 H) 3.19 - 3.28 (m, 1 H) 3.45(dd, J=12.51, 3.92 Hz, 1 H) 3.61 (dd, J=11.62, 7.33 Hz, 1 H) 3.75 (dd, J=12.51, 6.44 Hz, 1 H) 4.95 - 5.08 (m, 1 H) 7.05 - 7.17 (m, 1 H) 7.27 - 7.39 (m, 1 H) 8.00 (br. s., 1 H) 8.29 (s, 1 H) 8.62 (d, J=6.82 Hz, 1 H) 8.69 (s, 1H); LCMS: M + 1 313. Method E (Example 6).</p>
201		<p>[(3R,4R)-4-{[6-(6-chloropyrazolo[1,5-a]pyridin-3-yl)pyrazin-2-yl]amino}pyrrolidin-3-yl]methanol</p> <p><sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) <math>\delta</math> ppm 2.66 (br. s., 1 H) 3.14 - 3.37 (m, 2 H) 3.38 - 3.64 (m, 5 H) 4.74 - 4.92(m, 1 H) 7.52 (d, J=9.60 Hz, 1 H) 7.55 - 7.66 (m, 1 H) 7.89 (s, 1 H) 8.37 (s, 1 H) 8.48 (d, J=9.35 Hz, 1 H) 8.78(s, 1 H) 9.14 (s, 1 H) 9.26 (br. s., 1 H) 9.61 (br. s., 1 H); LCMS: M + 1 345. Method A (Example 7).</p>
202		<p>6-(6-fluoropyrazolo[1,5-a]pyridin-3-yl)-N-[(3R,4R)-4-methylpyrrolidin-3-yl]pyrazin-2-amine</p> <p><sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) <math>\delta</math> ppm 1.02 (d, J=6.57 Hz, 3 H) 2.61 (d, J=7.07 Hz, 1 H) 2.99 - 3.13 (m, 1 H) 3.13 - 3.29 (m, 1 H) 3.35 - 3.50 (m, 1 H) 3.51 - 3.64 (m, 1 H) 4.64 - 4.80 (m, 1 H) 7.44 - 7.71 (m, 2 H) 7.89 (s, 1 H) 8.37 (s, 1 H) 8.42 - 8.59 (m, 1 H) 8.77 (s, 1 H) 9.12 (br. s., 1 H) 9.39 (br. s., 1 H) 9.55 (br. s., 1 H); LCMS: M + 1 313. Method E (Example 6).</p>

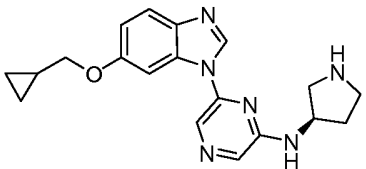
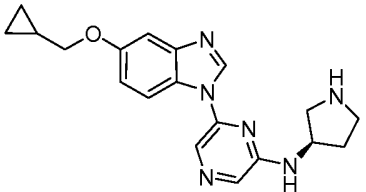
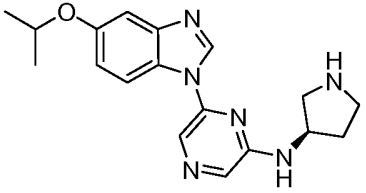
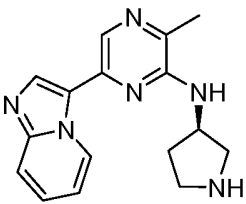
Ex.	Structure	Name, Data and Preparation Method
203		(3R,5R)-5-[[6-(imidazo[1,2-a]pyridin-3-yl)pyrazin-2-yl]amino]piperidin-3-ol 1H NMR (400 MHz, MeOD) $\delta$ ppm 1.25 - 1.48 (m, 1 H) 1.68 - 1.93 (m, 1 H) 2.17 - 2.50 (m, 1 H) 2.60 - 2.84 (m, 1 H) 2.98 (br. s., 1 H) 3.11 - 3.28 (m, 1 H) 3.48 - 3.67 (m, 1 H) 4.22 - 4.52 (m, 1 H) 4.69 - 4.84 (m, 1 H) 6.99 - 7.23 (m, 1 H) 7.37 - 7.56 (m, 1 H) 7.59 - 7.72 (m, 1 H) 7.79 (br. s., 1 H) 8.20 - 8.38 (m, 2 H) 8.53 (br. s., 1 H) 9.69 - 9.93 (m, 1 H); LCMS: M + 1 311. Method A (Example 7).
204		6-(imidazo[1,2-a]pyridin-3-yl)-N-[(3R,4R)-4-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, CD3OD) $\delta$ ppm 1.17 (d, J=7.07 Hz, 3 H) 1.82 - 2.13 (m, 2 H) 2.34 (d, J=3.54 Hz, 1 H) 3.05 - 3.23 (m, 1 H) 3.35 - 3.48 (m, 2 H) 3.63 (dd, J=12.88, 3.54 Hz, 1 H) 4.51 (br. s., 1 H) 7.70 (t, J=6.69 Hz, 1 H) 8.00 - 8.19 (m, 2 H) 8.29 (br. s., 1 H) 8.45 (br. s., 1 H) 8.77 (s, 1 H) 9.86 (d, J=6.82 Hz, 1 H); LCMS: M + 1 309. Method A (Example 7).
205		6-(7-chloroimidazo[1,2-a]pyridin-3-yl)-N-[(3R,4R)-4-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, MeOD) $\delta$ ppm 1.19 (d, J=7.07 Hz, 3 H) 1.87 - 2.11 (m, 2 H) 2.27 - 2.45 (m, 1 H) 3.10 - 3.24 (m, 1 H) 3.36 - 3.48 (m, 2 H) 3.55 - 3.71 (m, 1 H) 4.40 - 4.60 (m, 1 H) 7.60 - 7.84 (m, 1 H) 8.20 (s, 1 H) 8.27 (s, 1 H) 8.44 (s, 1 H) 8.77 (s, 1 H) 9.87 (d, J=7.33 Hz, 1 H); LCMS: M + 1 343/345. Method A (Example 7).

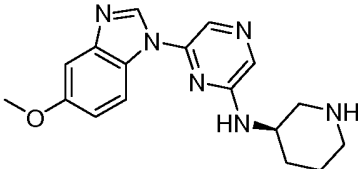
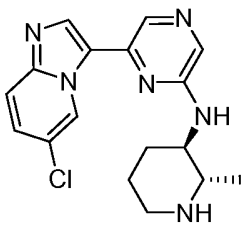
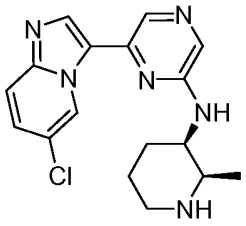
Ex.	Structure	Name, Data and Preparation Method
206		<p>N-[(3R,4R)-4-methylpiperidin-3-yl]-6-(pyrazolo[1,5-a]pyridin-3-yl)pyrazin-2-amine 1H NMR (400 MHz, MeOD) <math>\delta</math> ppm 1.20 (d, J=6.82 Hz, 3 H) 1.83 - 2.08 (m, 2 H) 2.26 - 2.45 (m, 1 H) 3.09 -3.22 (m, 1 H) 3.36 - 3.45 (m, 2 H) 3.73 (dd, J=12.63, 3.54 Hz, 1 H) 4.50 (d, J=2.02 Hz, 1 H) 7.04 (t, J=6.69Hz, 1 H) 7.45 (t, J=7.83 Hz, 1 H) 7.90 (s, 1 H) 8.27 (s, 1 H) 8.40 (d, J=9.09 Hz, 1 H) 8.57 (s, 1 H) 8.63 (d,J=7.07 Hz, 1 H); LCMS: M + 1 309. Method A (Example 7).</p>
207		<p>6-(8-methylimidazo[1,2-a]pyridin-3-yl)-N-[(3R)-piperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d<sub>6</sub>) <math>\delta</math> ppm 1.48 (br. s., 2 H), 1.71 (br. s., 2 H), 2.02 (br. s., 1 H), 2.53 - 2.57 (m, 4 H), 2.86 (br. s., 1 H), 3.18 (br. s., 1 H), 3.81 (br. s., 1 H), 7.00 (s, 1 H), 7.15 (br. s., 1 H), 7.23 (s, 1 H), 7.80 (s, 1 H), 8.32 (d, J=7.81 Hz, 2 H), 9.61 (br. s., 1 H); LCMS: M + 1 309.2. Method A (Example 4).</p>
208		<p>6-(1H-benzimidazol-1-yl)-N-(pyrrolidin-3-yl)pyrazin-2-amine 1H NMR (400 MHz, MeOD) <math>\delta</math> ppm 1.90 (br. s., 1 H) 2.30 (br. s., 1 H) 2.95 (br. s., 1 H) 3.11 (br. s., 2 H) 3.35 (s, 1 H) 4.52 (br. s., 1 H) 7.41 (br. s, 2 H) 7.76 (br. s., 1 H) 7.92 (s, 1 H) 8.18 (s, 2 H) 8.81 (s, 1 H); LCMS: M + 1 281.2. Method B (Example 1).</p>

Ex.	Structure	Name, Data and Preparation Method
209		<p>6-[7-(1-methyl-1H-pyrazol-4-yl)imidazo[1,2-a]pyridin-3-yl]-N-[(3R,4R)-4-methylpyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, MeOD) <math>\delta</math> ppm 1.17 (d, J=7.05 Hz, 3 H), 2.80 (t, J=5.79 Hz, 1 H), 3.22 (dd, J=11.58, 9.06 Hz, 1 H), 3.42 (dd, J=12.34, 4.78 Hz, 1 H), 3.57 - 3.68 (m, 3 H), 3.77 (dd, J=12.09, 6.55 Hz, 1 H), 4.01 (s, 3 H), 4.89 (q, J=5.88 Hz, 1 H), 7.94 (dd, J=7.30, 1.76 Hz, 1 H), 8.08 (d, J=1.01 Hz, 1 H), 8.16 (d, J=11.08 Hz, 2 H), 8.42 (d, J=13.60 Hz, 2 H), 8.64 (s, 1 H), 9.81 (d, J=7.55 Hz, 1 H); LCMS: M + 1 375.2. Method B (Example 5).</p>
210		<p>N-[(3R,4R)-4-cyclopentylpyrrolidin-3-yl]-6-(7-methoxyimidazo[1,2-a]pyridin-3-yl)pyrazin-2-amine 1H NMR (400 MHz, MeOD) <math>\delta</math> ppm 1.18 - 1.31 (m, 8 H), 1.56 (br. s., 2 H), 1.79 (br. s., 1 H), 3.05 (s, 1 H), 3.94 (s, 4 H) 3.13 (s, 1 H), 6.81 (dd, J=7.81, 2.52 Hz, 1 H), 7.00 (d, J=2.52 Hz, 1 H), 7.83 (s, 1 H), 8.10 (s, 1 H), 8.26 (s, 1 H), 9.58 (d, J=8.06 Hz, 1 H); LCMS: M + 1 379.2. Method A (Example 7).</p>
211		<p>N-[(3R,4R)-4-cyclopropylpyrrolidin-3-yl]-6-(7-methoxyimidazo[1,2-a]pyridin-3-yl)pyrazin-2-amine 1H NMR (400 MHz, MeOD) <math>\delta</math> ppm 0.25 (br. s., 2 H), 0.58 (br. s., 2 H), 3.48 - 3.68 (m, 2 H), 3.94 (s, 4 H), 6.80 (dd, J=7.68, 2.64 Hz, 1 H), 7.00 (d, J=2.77 Hz, 1 H), 7.87 (s, 1 H), 8.12 (s, 1 H), 8.31 (s, 1 H), 9.56 (d, J=8.31 Hz, 1 H); LCMS: M + 1 351.2. Method A (Example 7).</p>

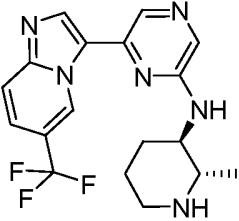
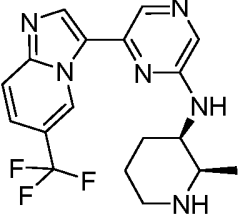
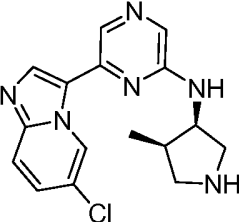
Ex.	Structure	Name, Data and Preparation Method
212		<p>6-(imidazo[1,2-a]pyridin-3-yl)-3-methoxy-N-[(3R)-pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, D<sub>2</sub>O) <math>\delta</math> ppm 2.270~2.160 (m, 1H), 2.501~2.381 (m, 1H), 3.650~3.361 (m, 4H), 3.998 (s, 3H), 4.65 (m, 1H), 7.431~7.365 (t, 1H), 7.640 (s, 1H), 7.921~7.830 (m, 2H), 8.069 (s, 1H), 9.201~9.150 (d, 1H). Method B (Example 36).</p>
213		<p>6-{7-[2-(propan-2-yloxy)ethoxy]imidazo[1,2-a]pyridin-3-yl}-N-[(3R)-pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO): <math>\delta</math> ppm 1.241-1.275 (m, 6H), 1.670-1.682 (m, 1H), 2.049-2.137 (m, 1H), 2.677-3.125 (m, 3H), 3.624-3.685 (m, 2H), 3.698-3.758 (m, 2H), 4.200-4.412 (m, 3H), 6.831-6.850 (d, 1H), 7.113 (s, 1H), 7.244-7.260 (d, 2H), 7.742-7.779 (m, 1H), 8.219-8.331 (m, 2H), 9.663-9.731 (d, 1H); LCMS: M + 1 383.5. Method A (Example 32).</p>
214		<p>6-(5-ethoxy-1H-benzimidazol-1-yl)-N-[(3R)-piperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, MeOD): <math>\delta</math> ppm 1.913-1.684 (m, 2H), 2.110-2.056 (m, 2H), 2.957 (m, 2H), 3.584 (d, 1H), 3.854 (s, 3H), 4.259 (m, 1H), 4.605 (s, 1H), 7.056 (d, 1H), 7.256 (s, 1H), 7.942-7.935 (d, 2H), 8.211 (s, 1H), 8.495 (s, 1H), 8.758 (s, 1H); LCMS: M + 1 339.3. Method A (Example 15).</p>
215		<p>N-[(3R)-piperidin-3-yl]-6-[5-(propan-2-yloxy)-1H-benzimidazol-1-yl]pyrazin-2-amine 1H NMR (400 MHz, MeOD): <math>\delta</math> ppm 1.407 (d, 6H), 2.296-1.749 (m, 4H), 3.056 (m, 2H), 3.807-3.609 (m, 3H), 4.396 (s, 1H), 4.875-4.723 (m, 1H), 7.389 (d, 2H), 8.228 (t, 2H), 8.375 (s, 1H), 10.064 (s, 1H);</p>

Ex.	Structure	Name, Data and Preparation Method
		LCMS: M + 1 353.4. Method A (Example 15).
216		6-(6-methoxy-1H-benzimidazol-1-yl)-N-[(3R)-pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO): $\delta$ ppm 1.81 (m, 1H), 2.19 (m, 1H), 3.23-3.32 (m, 4H), 3.82 (s, 3H), 4.40 (m, 1H), 6.90-7.00 (d, 1H), 7.63 (d, 1H), 7.76 (m, 2H), 7.92 (s, 1H), 8.25 (s, 1H), 8.78 (s, 1H); LCMS: M + 1 311.1. Method A (Example 15).
217		6-(5-ethoxy-1H-benzimidazol-1-yl)-N-[(3R)-pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400MHz, DMSO): $\delta$ ppm 1.3 (m, 3H), 1.5-2.0 (m, 1H), 2.2 (m, 1H), 2.7-3.4 (m, 4H), 4.0 (m, 2H), 4.34 (m, 1H), 7.0 (m, 1H), 7.3 (m, 1H), 7.88 (s, 1H), 8.0-8.4 (m, 2H), 8.8 (s, 1H); LCMS: M + 1 325.1. Method A (Example 15).
218		6-(5-methoxy-1H-benzimidazol-1-yl)-N-[(3R)-pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400MHz, DMSO): $\delta$ ppm 1.5-2.3 (m, 2H), 2.5-3.2 (m, 4H), 3.8 (s, 3H), 4.0-4.3 (d, 1H), 7.0 (m, 1H), 7.3 (m, 1H), 7.5-8.0 (d, 2H), 8.0-8.4 (m, 2H), 8.8 (s, 1H); LCMS: M + 1 311.1. Method A (Example 15).
219		6-(6-ethoxy-1H-benzimidazol-1-yl)-N-[(3R)-pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO): $\delta$ ppm 1.35 (m, 3H), 1.78 (m, 1H), 2.15 (m, 1H), 2.78-3.26 (m, 4H), 4.10 (m, 2H), 4.40 (m, 1H), 6.95 (d, 1H), 7.63 (d, 1H), 7.74 (m, 2H), 7.94 (s, 1H), 8.28 (s, 1H), 8.77 (s, 1H); LCMS: M + 1 325.1. Method A (Example 15).

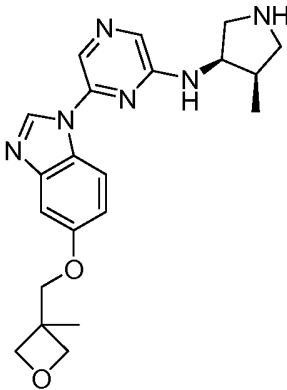
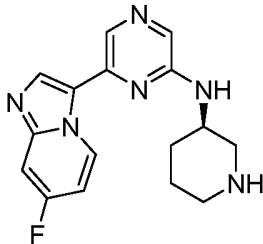
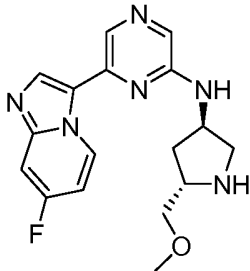
Ex.	Structure	Name, Data and Preparation Method
220		6-[6-(cyclopropylmethoxy)-1H-benzimidazol-1-yl]-N-[(3R)-pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO): $\delta$ ppm 0.32 (m, 2H), 0.58 (m, 2H), 1.22 (m, 1H), 1.65 (m, 1H), 2.12 (m, 1H), 2.70-3.26 (m, 4H), 3.89 (m, 2H), 4.40 (m, 1H), 6.95 (d, 1H), 7.61 (d, 1H), 7.74 (m, 2H), 7.93 (s, 1H), 8.31 (s, 1H), 8.79 (s, 1H); LCMS: M + 1 351.2. Method A (Example 15).
221		6-[5-(cyclopropylmethoxy)-1H-benzimidazol-1-yl]-N-[(3R)-pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400MHz, DMSO): $\delta$ ppm 0.35 (d, 2H), 0.59 (d, 2H), 1.3 (m, 1H), 1.5-2.0 (m, 1H), 2.2 (m, 1H), 2.7-3.4 (m, 4H), 3.5-3.9 (m, 4H), 4.4 (m, 1H), 7.0 (m, 1H), 7.3 (m, 1H), 7.7-8.0 (m, 2H), 8.0-8.4 (m, 2H), 8.8 (s, 1H); LCMS: M + 1 351.1. Method A (Example 15).
222		6-[5-(propan-2-yloxy)-1H-benzimidazol-1-yl]-N-[(3R)-pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400MHz, DMSO): $\delta$ ppm 1.3 (d, 6H), 1.5-2.0 (m, 1H), 2.2 (m, 1H), 2.7-3.4 (m, 5H), 4.4 (m, 1H), 4.6 (m, 1H), 7.0 (m, 1H), 7.3 (m, 1H), 7.7-8.0 (m, 2H), 8.0-8.4 (m, 2H), 8.8 (s, 1H); LCMS: M + 1 339.1. Method A (Example 15).
223		6-(imidazo[1,2-a]pyridin-3-yl)-3-methyl-N-[(3R)-pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, MeOD): $\delta$ ppm 2.228 (m, 1H), 2.423 (m, 4H), 3.555 (m, 4H), 4.569 (s, 1H), 7.107 (t, 1H), 7.447 (t, 1H), 7.681 (d, 1H), 8.249 (d, 2H), 9.631 (d, 1H); LCMS: M + 1 295.3. Method A (Example 16).

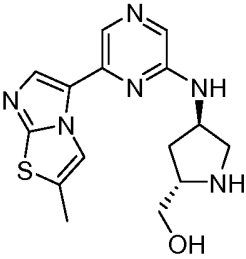
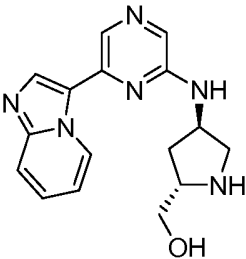
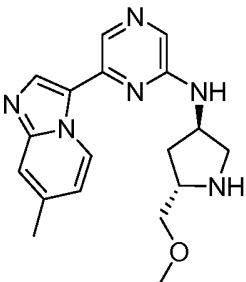
Ex.	Structure	Name, Data and Preparation Method
224		6-(5-methoxy-1H-benzimidazol-1-yl)-N-[(3R)-piperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, MeOD): $\delta$ ppm 1.913-1.684 (m, 2H), 2.110-2.056 (m, 2H), 2.957 (m, 2H), 3.584 (d, 1H), 3.854 (s, 3H), 4.259 (m, 1H), 4.605 (s, 1H), 7.056 (d, 1H), 7.256 (s, 1H), 7.942-7.935 (d, 2H), 8.211 (s, 1H), 8.495 (s, 1H), 8.758 (s, 1H); LCMS: M + 1 325. Method A (Example 15).
225		6-(6-chloroimidazo[1,2-a]pyridin-3-yl)-N-[(2S,3R)-2-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (300 MHz, DMSO-d <sub>6</sub> ) $\delta$ ppm 1.35 (d, J=6.2 Hz, 3 H) 1.42 - 1.61 (m, 1 H) 1.93 (br. s., 2 H) 2.13 - 2.30 (m, 1 H) 2.80 - 3.03 (m, 1 H) 3.19 - 3.33 (m, 2 H) 3.87 - 4.07 (m, 1 H) 7.77 (d, J=8.1 Hz, 1 H) 7.84 (dd, J=9.6, 1.1 Hz, 1 H) 7.94 - 8.08 (m, 1 H) 8.39 (s, 1 H) 8.76 (s, 1 H) 8.98 - 9.26 (m, 1 H) 9.60 (d, J=12.6 Hz, 1 H) 9.78 (s, 1 H). Method D (Example 13).
226		6-(6-chloroimidazo[1,2-a]pyridin-3-yl)-N-[(2R,3R)-2-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (300 MHz, DMSO-d <sub>6</sub> ) $\delta$ ppm 1.07 (d, J=6.0 Hz, 3 H) 1.22 - 1.40 (m, 1 H) 1.42 - 1.62 (m, 1 H) 1.64 - 1.76 (m, 1 H) 2.02 - 2.16 (m, 1 H) 2.59 - 2.73 (m, 2 H) 2.90 - 3.06 (m, 2 H) 7.29 (d, J=8.9 Hz, 1 H) 7.63 (d, J=9.4 Hz, 1 H) 7.86 (s, 1 H) 7.93 (d, J=9.4 Hz, 1 H) 8.28 (br. s., 1 H) 8.31 (s, 1 H) 8.50 (s, 1 H) 10.15 (s, 1 H). Method D (Example 13).

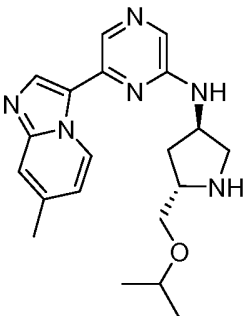
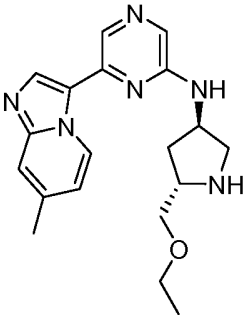
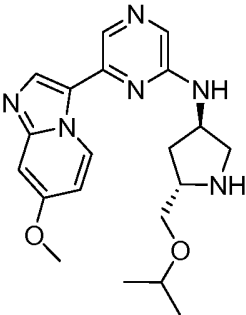


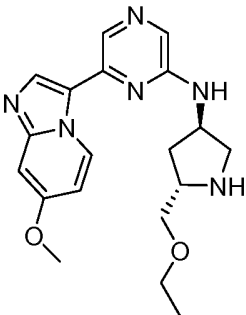
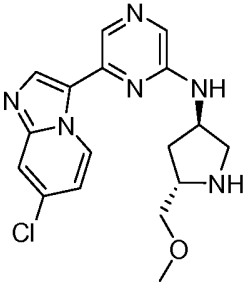
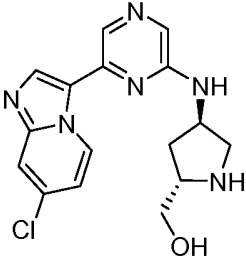
Ex.	Structure	Name, Data and Preparation Method
227		<p>N-[(2S,3R)-2-methylpiperidin-3-yl]-6-[6-(trifluoromethyl)imidazo[1,2-a]pyridin-3-yl]pyrazin-2-amine 1H NMR (300 MHz, DMSO-d<sub>6</sub>) δ ppm 1.07 (d, J=6.0 Hz, 3 H) 1.22 - 1.40 (m, 1 H) 1.42 - 1.62 (m, 1 H) 1.64 - 1.76 (m, 1 H) 2.02 - 2.16 (m, 1 H) 2.59 - 2.73 (m, 2 H) 2.90 - 3.06 (m, 2 H) 7.29 (d, J=8.9 Hz, 1 H) 7.63 (d, J=9.4 Hz, 1 H) 7.86 (s, 1 H) 7.93 (d, J=9.4 Hz, 1 H) 8.28 (br. s., 1 H) 8.31 (s, 1 H) 8.50 (s, 1 H) 10.15 (s, 1 H). Method D (Example 13).</p>
228		<p>N-[(2R,3R)-2-methylpiperidin-3-yl]-6-[6-(trifluoromethyl)imidazo[1,2-a]pyridin-3-yl]pyrazin-2-amine 1H NMR (300 MHz, DMSO-d<sub>6</sub>) δ ppm 1.30 (d, J=6.4 Hz, 3 H) 1.59 - 1.91 (m, 2 H) 2.01 (d, J=13.2 Hz, 2 H) 3.02 (d, J=14.1 Hz, 1 H) 3.28 (d, J=10.4 Hz, 1 H) 3.59 (br. s., 1 H) 4.35 (br. s., 1 H) 7.91 - 8.04 (m, 1 H) 8.04 - 8.21 (m, 2 H) 8.45 (s, 1 H) 8.56 (d, J=9.2 Hz, 1 H) 8.84 (s, 1 H) 9.26 - 9.41 (m, 1 H) 9.43 - 9.76 (m, 1 H) 10.23 (s, 1 H). Method D (Example 13).</p>
229		<p>6-(6-chloroimidazo[1,2-a]pyridin-3-yl)-N-[(3R,4R)-4-methylpyrrolidin-3-yl]pyrazin-2-amine 1H NMR (300 MHz, DMSO-d<sub>6</sub>) δ ppm 1.04 (d, J=7.0 Hz, 3 H) 2.56 - 2.83 (m, 1 H) 2.98 - 3.20 (m, 1 H) 3.22 - 3.48 (m, 2 H) 3.47 - 3.71 (m, 1 H) 4.45 - 4.72 (m, 1 H) 7.95 - 8.02 (m, 1 H) 8.04 - 8.11 (m, 2 H) 8.13 (s, 1 H) 8.47 (s, 1 H) 8.94 (s, 1 H) 9.68 (br. s., 2 H) 9.99 (d, J=1.3 Hz, 1 H). Method D (Example 13).</p>

Ex.	Structure	Name, Data and Preparation Method
230		6-(6-chloroimidazo[1,2-a]pyridin-3-yl)-N-(4,4-difluoropiperidin-3-yl)pyrazin-2-amine 1H NMR (300 MHz, DMSO-d <sub>6</sub> ) δ ppm 2.54 - 2.72 (m, 2 H) 2.87 - 3.29 (m, 2 H) 3.32 - 3.61 (m, 2 H) 4.85 - 5.21 (m, 1 H) 7.93 - 8.03 (m, 1 H) 8.04 - 8.11 (m, 1 H) 8.12 (s, 1 H) 8.28 (d, J=8.7 Hz, 1 H) 8.51 (s, 1 H) 8.94 (s, 1 H) 9.84 (s, 1 H) 9.96 (br. s., 1 H). Method D (Example 13).
231		N-(4,4-difluoropiperidin-3-yl)-6-[6-(trifluoromethyl)imidazo[1,2-a]pyridin-3-yl]pyrazin-2-amine 1H NMR (300 MHz, DMSO-d <sub>6</sub> ) δ ppm 2.25 - 2.66 (m, 2 H) 3.00 - 3.29 (m, 2 H) 3.29 - 3.54 (m, 2 H) 4.84 - 5.19 (m, 1 H) 7.99 - 8.06 (m, 1 H) 8.13 (s, 1 H) 8.13 - 8.18 (m, 1 H) 8.30 (d, J=8.9 Hz, 1 H) 8.49 (s, 1 H) 8.87 (s, 1 H) 9.72 - 9.94 (m, 2 H) 9.97 (s, 1 H). Method D (Example 13).
232		2-(3-{6-[(3R)-piperidin-3-ylamino]pyrazin-2-yl}imidazo[1,2-a]pyridin-6-yl)propan-2-ol 1H NMR (300 MHz, DMSO-d <sub>6</sub> ) δ ppm 1.57 (d, J=1.70 Hz, 6 H) 1.62 - 2.13 (m, 4 H) 2.99 (br. s., 2 H) 3.08 - 3.45 (m, 2 H) 4.36 (br. s., 1 H) 7.91 (d, J=6.22 Hz, 1 H) 7.99 - 8.16 (m, 3 H) 8.42 (s, 1 H) 8.95 (s, 1 H) 9.15 (br. s., 1 H) 9.33 (br. s., 1 H) 10.00 (s, 1 H). Method A (Example 14).
233		3-{6-[(3R)-piperidin-3-ylamino]pyrazin-2-yl}imidazo[1,2-a]pyridin-6-amine 1H NMR (300 MHz, DMSO-d <sub>6</sub> ) δ ppm 1.37 - 1.63 (m, 1 H) 1.79 - 1.97 (m, 2 H) 2.01 - 2.18 (m, 1 H) 2.85 - 3.06 (m, 2 H) 3.11 - 3.27 (m, 1 H) 3.30 - 3.47 (m, 1 H) 4.44 (br. s., 1 H) 7.54 (dd, J=9.5, 2.0 Hz, 1 H) 7.81 (s, 1 H) 7.84 (s, 1 H) 8.00 (s, 1 H) 8.38 (s, 1

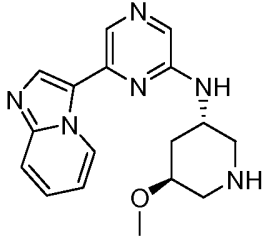
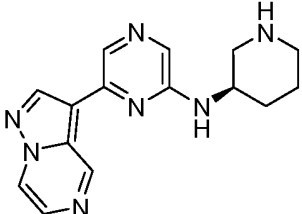
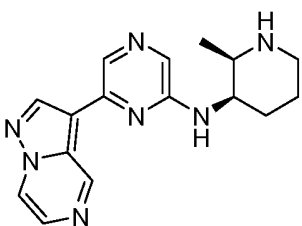
Ex.	Structure	Name, Data and Preparation Method
		H) 8.79 (s, 1 H) 9.13 (br. s., 1 H) 9.22 (br. s., 1 H) 9.79 (br. s., 1 H). Method D (Example 13).
234		6-{5-[(3-methyloxetan-3-yl)methoxy]-1H-benzimidazol-1-yl}-N-[(3R,4R)-4-methylpyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, METHANOL-d <sub>4</sub> ) δ ppm 0.96 (d, J=7.1 Hz, 3 H), 1.40 (s, 3 H), 2.44 - 2.53 (m, 1 H), 2.62 - 2.70 (m, 1 H), 2.83 - 2.91 (m, 1 H), 3.17 - 3.22 (m, 1 H), 3.32 - 3.38 (m, 1 H), 4.06 (s, 2 H), 4.41 (d, J=5.8 Hz, 2 H), 4.57 (q, J=6.7 Hz, 1 H), 4.64 (d, J=5.8 Hz, 2 H), 7.05 (dd, J=9.0, 2.4 Hz, 1 H), 7.25 (d, J=2.3 Hz, 1 H), 7.89 (s, 1 H), 8.03 (d, J=8.8 Hz, 1 H), 8.10 (s, 1 H), 8.70 (s, 1 H); LCMS: M + 1 395. Method A (Example 7).
235		6-(7-fluoroimidazo[1,2-a]pyridin-3-yl)-N-[(3R)-piperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) δ ppm 1.60 - 1.70 (m, 1 H), 1.74 - 1.87 (m, 1 H), 1.90 - 2.02 (m, 1 H), 2.05 - 2.18 (m, 1 H), 2.89 - 3.03 (m, 2 H), 3.14 - 3.21 (m, 1 H), 3.31 - 3.40 (m, 1 H), 4.24 (br. s., 1 H), 8.02 (br. s., 1 H), 8.07 (s, 1 H), 8.09 - 8.20 (m, 2 H), 8.46 (s, 1 H), 9.02 (s, 1 H), 9.41 (br. s., 2 H), 9.90 (br. s., 1 H); LCMS: M + 1 313. Method D (Example 13).
236		6-(7-fluoroimidazo[1,2-a]pyridin-3-yl)-N-[(3R,5S)-5-(methoxymethyl)pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) δ ppm 2.04 - 2.25 (m, 2 H), 3.28 - 3.40 (m, 4 H) 3.58 (s, 1 H) 3.64 (d, J=5.6 Hz, 2 H) 3.97 - 4.11 (m, 1 H) 4.63 (br. s., 1 H) 8.00 - 8.11 (m, 2 H) 8.11 - 8.17 (m, 1 H) 8.21 (br. s., 1 H) 8.50 (s, 1 H) 8.97 (s, 1 H) 9.35 (br. s., 1 H) 9.92 (br. s., 1 H) 9.98 (br. s., 1 H);

Ex.	Structure	Name, Data and Preparation Method
		LCMS: M + 1 343.2. Method D (Example 13).
237		<p>[(2S,4R)-4-([6-(2-methylimidazo[2,1-b][1,3]thiazol-5-yl)pyrazin-2-yl]amino)pyrrolidin-2-yl]methanol 1H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 2.01 - 2.13 (m, 1 H), 2.13 - 2.24 (m, 1 H), 2.59 (s, 3 H), 3.19 - 3.28 (m, 1 H), 3.54 - 3.59 (m, 2 H), 3.61 - 3.68 (m, 1 H), 3.72 - 3.80 (m, 1 H), 3.90 (br. s., 1 H), 4.68 (br. s., 1 H), 7.95 (s, 1 H), 8.10 (br. s., 1 H), 8.41 (s, 1 H), 8.44 (s, 1 H), 8.50 (br. s., 1 H), 9.33 (br. s., 1 H), 9.86 (br. s., 1 H); LCMS: M + 1 331. Method A (Example 7).</p>
238		<p>[(2S,4R)-4-([6-(imidazo[1,2-a]pyridin-3-yl)pyrazin-2-yl]amino)pyrrolidin-2-yl]methanol 1H NMR (400 MHz, DMSO-d<sub>6</sub>) δ ppm 2.03 - 2.23 (m, 2 H), 3.17 - 3.25 (m, 1 H), 3.50 - 3.67 (m, 2 H), 3.71 - 3.79 (m, 1 H), 3.88 (br. s., 1 H), 4.67 (br. s., 1 H), 7.59 - 7.72 (m, 1 H), 7.96 - 8.15 (m, 4 H), 8.47 (s, 1 H), 8.97 (s, 1 H), 9.24 (br. s., 1 H), 9.73 (br. s., 1 H), 9.89 (d, J=7.1 Hz, 1 H); LCMS: M + 1 310. Method A (Example 7).</p>
239		<p>N-[(3R,5S)-5-(methoxymethyl)pyrrolidin-3-yl]-6-(7-methylimidazo[1,2-a]pyridin-3-yl)pyrazin-2-amine 1H NMR (500 MHz, DMSO-d<sub>6</sub>) δ ppm 1.87 - 2.15 (m, 2 H), 2.46 (s, 3 H), 3.09 (s, 3 H), 3.30 - 3.50 (m, 1 H), 3.36 - 3.62 (m, 3 H), 3.93 (br. s., 1 H), 4.55 (br. s., 1 H), 7.10 (d, J=6.8 Hz, 1 H), 7.59 (br. s., 1 H), 7.62 (d, J=5.9 Hz, 1 H), 7.84 (s, 1 H), 8.34 (s, 1 H), 8.47 (s, 1 H), 8.91 (br. s., 1 H), 9.39 (br. s., 1 H), 9.52 (d, J=6.8 Hz, 1 H); LCMS: M + 1 339. Method A (Example 7).</p>

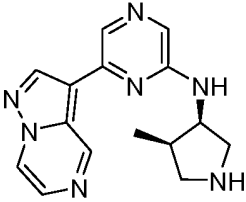
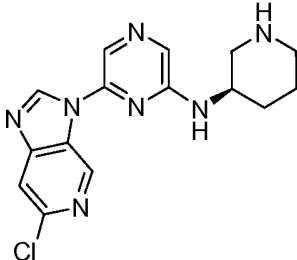
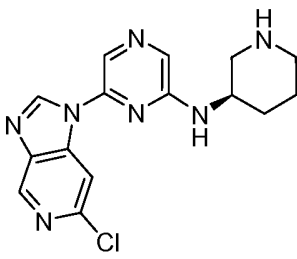
Ex.	Structure	Name, Data and Preparation Method
240		<p>6-(7-methylimidazo[1,2-a]pyridin-3-yl)-N-((3R,5S)-5-[(propan-2-yloxy)methyl]pyrrolidin-3-yl)pyrazin-2-amine <sup>1</sup>H NMR (500 MHz, DMSO-d<sub>6</sub>) δ ppm 1.14 (d, J=5.9 Hz, 6 H), 1.96 - 2.21 (m, 2 H), 2.50 - 2.54 (m, 3 H), 3.49 - 3.76 (m, 5 H), 3.97 (br. s., 1 H), 4.65 (br. s., 1 H), 7.25 (d, J=6.8 Hz, 1 H), 7.71 (s, 1 H), 7.84 (d, J=4.9 Hz, 1 H), 7.95 (s, 1 H), 8.42 (s, 1 H), 8.61 (s, 1 H), 9.12 (br. s., 1 H), 9.60 (br. s, 1 H), 9.63 (d, J=7.8 Hz, 1 H); LCMS: M + 1 367. Method A (Example 7).</p>
241		<p>N-[(3R,5S)-5-(ethoxymethyl)pyrrolidin-3-yl]-6-(7-methylimidazo[1,2-a]pyridin-3-yl)pyrazin-2-amine <sup>1</sup>H NMR (500 MHz, DMSO-d<sub>6</sub>) δ ppm 1.16 (t, J=6.8 Hz, 3 H), 2.01 - 2.21 (m, 2 H), 2.50 (s, 3 H), 3.47 - 3.68 (m, 6 H), 4.01 (br. s., 1 H), 4.64 (br. s., 1 H), 7.26 (d, J=6.8 Hz, 1 H), 7.71 (s, 1 H), 7.85 (d, J=5.9 Hz, 1 H), 7.95 (s, 1 H), 8.42 (s, 1 H), 8.62 (s, 1 H), 9.19 (br. s., 1 H), 9.64 (d, J=6.8 Hz, 2 H); LCMS: M + 1 353. Method A (Example 7).</p>
242		<p>6-(7-methoxyimidazo[1,2-a]pyridin-3-yl)-N-((3R,5S)-5-[(propan-2-yloxy)methyl]pyrrolidin-3-yl)pyrazin-2-amine <sup>1</sup>H NMR (500 MHz, DMSO-d<sub>6</sub>) δ ppm 1.12 (br. s., 6 H), 1.95 - 2.19 (m, 2 H), 3.19 (br. s., 1 H), 3.53 - 3.72 (m, 4 H), 3.87 - 4.08 (m, 4 H), 4.65 (s, 1 H), 7.33 (br. s., 2 H), 8.03 (br. s., 1 H), 8.43 (br. s., 1 H), 8.74 (br. s., 1 H), 9.36 (br. s., 1 H), 9.69 (br. s., 2 H); LCMS: M + 1 383. Method A (Example 7).</p>

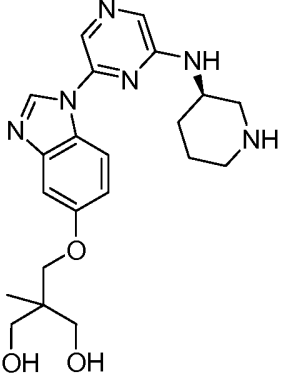
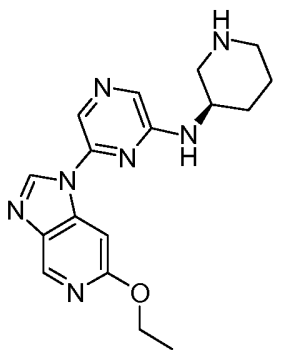
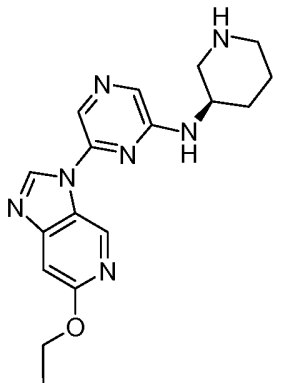
Ex.	Structure	Name, Data and Preparation Method
243		<p>N-[(3R,5S)-5-(ethoxymethyl)pyrrolidin-3-yl]-6-(7-methoxyimidazo[1,2-a]pyridin-3-yl)pyrazin-2-amine 1H NMR (500 MHz, DMSO-d<sub>6</sub>) <math>\delta</math> ppm 1.15 (t, J=7.3 Hz, 3 H), 2.04 - 2.19 (m, 2 H), 3.15 - 3.24 (m, 1 H), 3.28 - 3.38 (m, 1 H), 3.49 - 3.61 (m, 3 H), 3.63 - 3.71 (m, 2 H), 4.01 (s, 3 H), 4.65 (br. s., 1 H), 7.25 - 7.35 (m, 2 H), 7.94 - 8.07 (m, 1 H), 8.43 (br. s., 1 H), 8.73 (br. s., 1 H), 9.39 (br. s., 1 H), 9.68 (d, J=6.8 Hz, 1 H), 9.73 (br. s., 1 H); LCMS: M + 1 369. Method A (Example 7).</p>
244		<p>6-(7-chloroimidazo[1,2-a]pyridin-3-yl)-N-[(3R,5S)-5-(methoxymethyl)pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (500 MHz, DMSO-d<sub>6</sub>) <math>\delta</math> ppm 2.03 - 2.19 (m, 2 H), 3.17 - 3.28 (m, 4 H), 3.53 - 3.59 (m, 1 H), 3.61 (d, J=4.9 Hz, 2 H), 3.93 - 4.04 (m, 1 H), 4.62 (br. s., 1 H), 7.19 (d, J=7.8 Hz, 1 H), 7.69 (d, J=4.9 Hz, 1 H), 7.88 (s, 2 H), 8.43 (s, 2 H), 9.67 (d, J=6.8 Hz, 1 H); LCMS: M + 1 359. Method D (Example 13).</p>
245		<p>[(2S,4R)-4-{[6-(7-chloroimidazo[1,2-a]pyridin-3-yl)pyrazin-2-yl]amino}pyrrolidin-2-yl]methanol 1H NMR (500 MHz, DMSO-d<sub>6</sub>) <math>\delta</math> ppm 1.96 - 2.22 (m, 2 H), 3.11 - 3.26 (m, 2 H), 3.53 - 3.69 (m, 2 H), 3.74 - 3.76 (m, 1 H), 3.85 - 3.93 (m, 1 H), 4.60 - 4.69 (m, 1 H), 5.41 (br. s., 1 H), 7.19 (d, J=5.9 Hz, 1 H), 7.68 (d, J=5.9 Hz, 1 H), 7.88 (s, 2 H), 8.44 (s, 2 H), 9.68 (d, J=6.8 Hz, 1 H); LCMS: M + 1 345. Method D (Example 13).</p>

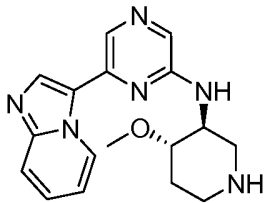
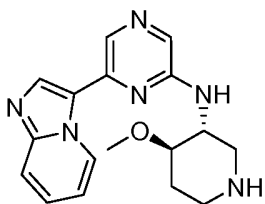
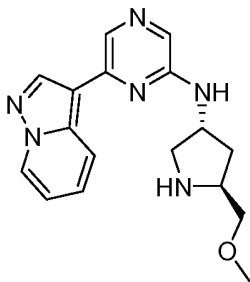
Ex.	Structure	Name, Data and Preparation Method
246		6-(6-chloroimidazo[1,2-a]pyridin-3-yl)-N-[(3R,5S)-5-(methoxymethyl)pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (500 MHz, DMSO-d <sub>6</sub> ) δ ppm 2.09 - 2.27 (m, 2 H.), 3.28 (br. s, 3 H), 3.51 - 3.69 (m, 4 H), 3.96 - 4.08 (m, 1 H), 4.57 (br. s., 1 H), 7.46 (d, J=7.8 Hz, 1 H), 7.73 - 7.82 (m, 2 H), 7.90 (s, 1 H), 8.42 - 8.50 (m, 2 H), 9.82 (s, 1 H); LCMS: M + 1 359. Method D (Example 13).
247		6-(imidazo[1,2-a]pyridin-3-yl)-5-methyl-N-[(3R)-piperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, MeOD) δ ppm 1.810 (m, 2H), 2.116 (m, 2H), 2.608 (s, 3H), 3.076 (m, 2H), 3.284 (m, 1H), 3.518 (m, 1H), 4.236 (m, 1H), 7.665 (t, 1H), 8.117 (m, 3H), 8.523 (s, 1H), 9.234 (d, 1H). Method A (Example 16, use 16b-1).
248		N-[(3R)-4,4-difluoropiperidin-3-yl]-6-(imidazo[1,2-a]pyridin-3-yl)pyrazin-2-amine 1H NMR (400 MHz, MeOD) δ ppm 1.93 - 2.16 (m, 1 H) 2.16 - 2.35 (m, 1 H) 2.71 - 2.97 (m, 2 H) 3.00 - 3.16(m, 1 H) 3.16 - 3.25 (m, 1 H) 4.40 - 4.70 (m, 1 H) 6.98 - 7.22 (m, 1 H) 7.47 (t, J=7.83 Hz, 1 H) 7.67 (d, J=9.09Hz, 1 H) 7.86 (s, 1 H) 8.22 (s, 1 H) 8.28 (s, 1 H) 9.71 (d, J=6.82 Hz, 1 H); LCMS: M + 1 331. Method A (Example 11).
249		N-[(3S)-4,4-difluoropiperidin-3-yl]-6-(imidazo[1,2-a]pyridin-3-yl)pyrazin-2-amine 1H NMR (400 MHz, MeOD) δ ppm 1.96 - 2.19 (m, 1 H) 2.18 - 2.38 (m, 1 H) 2.71 - 3.00 (m, 2 H) 3.02 - 3.18(m, 1 H) 3.17 - 3.27 (m, 1 H) 4.44 - 4.69 (m, 1 H) 7.04 - 7.28 (m, 1 H) 7.44 - 7.56 (m, 1 H) 7.62 - 7.76 (m, 1H) 7.88 (s, 1 H) 8.25 (s, 1 H) 8.30 (s, 1 H) 9.73 (d, J=6.82 Hz, 1 H); LCMS: M + 1 331.

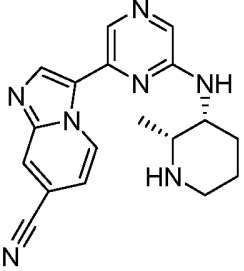
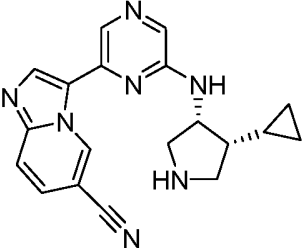
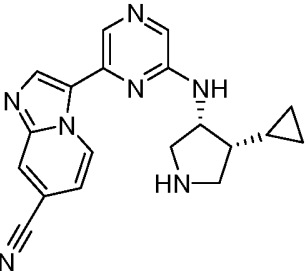
Ex.	Structure	Name, Data and Preparation Method
		Method A (Example 11).
250		6-(imidazo[1,2-a]pyridin-3-yl)-N-[(3S,5S)-5-methoxypiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) δ ppm 0.79 - 0.93 (m, 1 H) 1.22 - 1.29 (m, 1 H) 1.61 - 1.77 (m, 1 H) 2.23 - 2.36 (m, 1 H) 2.79 - 2.92 (m, 1 H) 3.06 - 3.15 (m, 1 H) 3.37 (s, 3 H) 3.78 - 3.90 (m, 1 H) 4.33 - 4.47 (m, 1 H) 7.31 - 7.53 (m, 1 H) 7.62 - 7.75 (m, 1 H) 7.81 - 7.93 (m, 1 H) 7.98 (br. s., 2 H) 8.44 (s, 1 H) 8.81 (br. s., 2 H) 9.38 (br. s., 1 H) 9.71 - 9.87 (m, 1 H). Method A (Example 7).
251		N-[(3R)-piperidin-3-yl]-6-(pyrazolo[1,5-a]pyrazin-3-yl)pyrazin-2-amine, acetate salt 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) δ ppm 1.43 - 1.54 (m, 1 H) 1.54 - 1.70 (m, 1 H) 1.73 - 1.86 (m, 1 H) 1.92 (s, 3 H) 2.00 - 2.14 (m, 1 H) 2.57 - 2.73 (m, 2 H) 2.95 - 3.05 (m, 1 H) 3.21 - 3.23 (m, 1 H) 3.92 - 4.06 (m, 1 H) 7.11 - 7.26 (m, 1 H) 7.85 (s, 1 H) 8.03 (d, J=4.80 Hz, 1 H) 8.37 (s, 1 H) 8.81 - 8.92 (m, 2 H) 9.85 (s, 1 H). Method E (Example 6).
252		N-[(2R,3R)-2-methylpiperidin-3-yl]-6-(pyrazolo[1,5-a]pyrazin-3-yl)pyrazin-2-amine, acetate salt 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) δ ppm 1.04 (d, J=6.32 Hz, 3 H) 1.32 - 1.47 (m, 1 H) 1.56 - 1.68 (m, 2 H) 1.91 (s, 3 H) 1.94 - 2.04 (m, 1 H) 2.58 - 2.73 (m, 1 H) 2.95 - 3.05 (m, 2 H) 4.07 - 4.16 (m, 1 H) 6.96 - 7.12 (m, 1 H) 7.96 - 8.05 (m, 2 H) 8.30 (s, 1 H) 8.79 - 8.88 (m, 2 H) 9.82 (s, 1 H). Method E (Example 6).

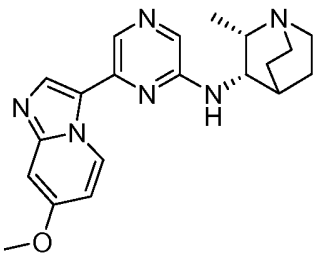
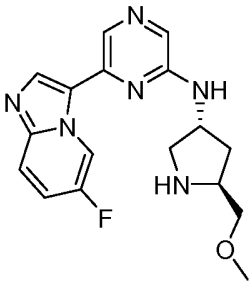
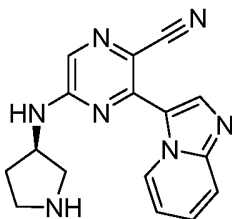


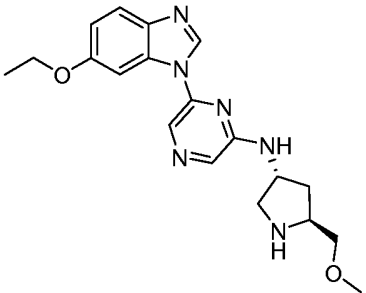
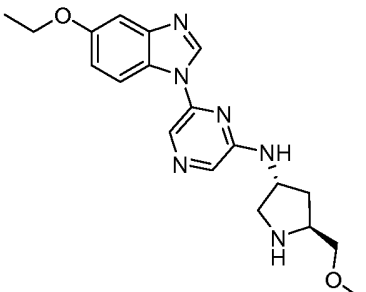
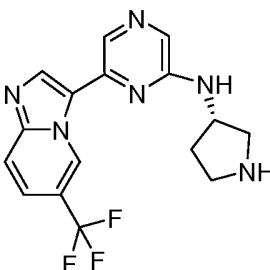
Ex.	Structure	Name, Data and Preparation Method
253		<p>N-[(3R,4R)-4-methylpyrrolidin-3-yl]-6-(pyrazolo[1,5-a]pyrazin-3-yl)pyrazin-2-amine, acetate salt 1H NMR (400 MHz, DMSO-d<sub>6</sub>) <math>\delta</math> ppm 0.89 (d, J=7.07 Hz, 3 H) 1.89 (s, 3 H) 2.35 - 2.45 (m, 1 H) 2.55 - 2.58 (m, 1 H) 2.74 - 2.85 (m, 1 H) 3.13 - 3.19 (m, 2 H) 3.20-3.30 (m, 2H) 4.44 - 4.58 (m, 1 H) 7.32 (br. s., 1 H) 7.89 (s, 1 H) 8.02 (d, J=4.80 Hz, 1 H) 8.34 (s, 1 H) 8.80 - 8.89 (m, 2 H) 9.88 (s, 1 H). Method E (Example 6).</p>
254		<p>6-(6-chloro-3H-imidazo[4,5-c]pyridin-3-yl)-N-[(3R)-piperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d<sub>6</sub>) <math>\delta</math> ppm 1.43 - 1.54 (m, 2 H) 1.66 - 1.72 (m, 1 H) 1.85 - 1.92 (m, 4 H) 1.98 - 2.03 (m, 1 H) 2.42 - 2.47 (m, 1 H) 2.80 - 2.85 (m, 1 H) 3.11 - 3.15 (m, 1 H) 3.78 - 3.85 (m, 1 H) 7.55 - 7.63 (m, 1 H) 7.96 (d, J=13.89 Hz, 2 H) 8.33 (s, 1 H) 9.30 (s, 1 H) 9.40 (s, 1 H). Method A (Example 17/18).</p>
255		<p>6-(6-chloro-1H-imidazo[4,5-c]pyridin-1-yl)-N-[(3R)-piperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d<sub>6</sub>) <math>\delta</math> ppm 1.40 - 1.58 (m, 2 H) 1.65 - 1.70 (m, 1 H) 1.82 - 1.91 (m, 4 H) 1.99 - 2.07 (m, 1 H) 2.44 - 2.47 (m, 1 H) 2.78 - 2.87 (m, 1 H) 3.09 (dd, J=11.87, 3.03 Hz, 1 H) 3.72 - 3.82 (m, 1 H) 7.60 (d, J=7.33 Hz, 1 H) 7.97 (s, 1 H) 8.29 (s, 2 H) 8.89 (s, 1 H) 9.17 (s, 1 H). Method A (Example 17/18).</p>

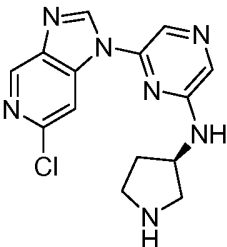
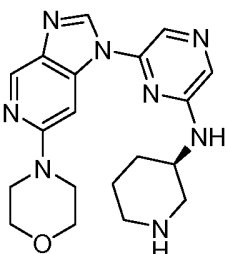
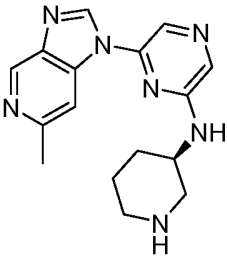
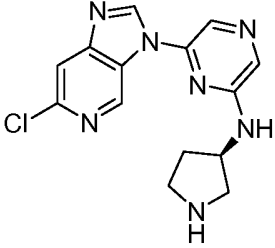
Ex.	Structure	Name, Data and Preparation Method
256		<p>2-methyl-2-([(1-{6-[(3R)-piperidin-3-ylamino]pyrazin-2-yl}-1H-benzimidazol-5-yl)oxy]methyl)propane-1,3-diol 1H NMR (400 MHz, DMSO-d<sub>6</sub>) <math>\delta</math> ppm 0.92 (s, 3 H) 1.42 - 1.62 (m, 2 H) 1.67 - 1.79 (m, 1 H) 1.91 (s, 3 H) 1.95 - 2.07 (m, 1 H) 2.79 - 2.94 (m, 1 H) 3.12 - 3.22 (m, 1 H) 3.23 - 3.29 (m, 1 H) 3.34 - 3.47 (m, 5 H) 3.84 (s, 3 H) 4.47 (t, J=5.31 Hz, 2 H) 6.99 (dd, J=9.09, 2.27 Hz, 1 H) 7.24 (d, J=2.53 Hz, 1 H) 7.44 (s, 1 H) 7.90 (s, 1 H) 8.14 (d, J=9.09 Hz, 1 H) 8.22 (s, 1 H) 8.88 (s, 1 H). Method C (Example 9, then treat with 0.25N HCl to open ring).</p>
257		<p>6-(6-ethoxy-1H-imidazo[4,5-c]pyridin-1-yl)-N-[(3R)-piperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, METHANOL-d<sub>4</sub>) <math>\delta</math> ppm 1.43 (t, J=6.69 Hz, 3 H) 1.49 - 1.65 (m, 1 H) 1.65 - 1.77 (m, 1 H) 1.77 - 1.88 (m, 1 H) 2.10 - 2.22 (m, 1 H) 2.49 - 2.71 (m, 2 H) 2.90 - 3.07 (m, 1 H) 3.22 - 3.29 (m, 1 H) 3.92 - 4.07 (m, 1 H) 4.34 - 4.44 (m, 2 H) 7.45 (s, 1 H) 7.89 (s, 1 H) 8.11 (s, 1 H) 8.57 (s, 1 H) 8.80 (s, 1 H). Method A (Example 17/18).</p>
258		<p>6-(6-ethoxy-3H-imidazo[4,5-c]pyridin-3-yl)-N-[(3R)-piperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, METHANOL-d<sub>4</sub>) <math>\delta</math> ppm 1.22 - 1.37 (m, 1 H) 1.45 (t, J=7.07 Hz, 3 H) 1.52 - 1.67 (m, 1 H) 1.66 - 1.76 (m, 1 H) 1.81 - 1.97 (m, 1 H) 2.12 - 2.23 (m, 1 H) 2.50 - 2.75 (m, 2 H) 3.01 (d, J=12.88 Hz, 1 H) 3.92 - 4.10 (m, 1 H) 4.37 (q, J=7.07 Hz, 2 H) 7.08 (s, 1 H) 7.89 (s, 1 H) 8.20 (s, 1 H) 9.03 (s, 1 H) 9.16 (s, 1 H). Method A (Example 17/18).</p>

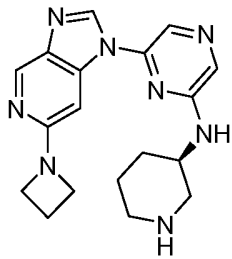
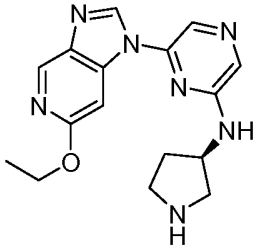
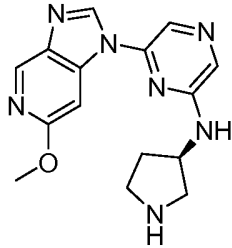
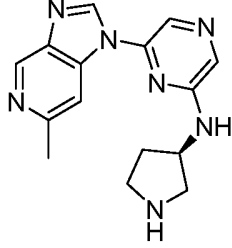
Ex.	Structure	Name, Data and Preparation Method
259		6-(imidazo[1,2-a]pyridin-3-yl)-N-[(3S,4S)-4-methoxypiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) δ ppm 1.79 - 1.95 (m, 1 H) 2.19 - 2.36 (m, 1 H) 2.87 - 3.09 (m, 2 H) 3.18 - 3.29 (m, 1 H) 3.32 (s, 3 H) 3.35 - 3.52 (m, 3 H) 3.69 (dd, J=13.64, 5.31 Hz, 1 H) 4.38 - 4.47 (m, 1 H) 7.81 (t, J=6.32 Hz, 1 H) 7.99 - 8.13 (m, 4 H) 8.44 (s, 1 H) 8.99 (s, 1 H) 9.29 (br. s., 1 H) 9.82 - 10.01 (m, 2 H). Method A (Example 7).
260		6-(imidazo[1,2-a]pyridin-3-yl)-N-[(3R,4R)-4-methoxypiperidin-3-yl]pyrazin-2-amine (HCl salt) 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) δ ppm 1.80 - 1.93 (m, 1 H) 2.18 - 2.34 (m, 1 H) 2.88 - 3.10 (m, 2 H) 3.16 - 3.30 (m, 1 H) 3.32 (s, 3 H) 3.37 - 3.44 (m, 1 H) 3.44 - 3.54 (m, 2 H) 3.66 - 3.73 (m, 1 H) 4.38 - 4.46 (m, 1 H) 7.80 (t, J=6.32 Hz, 1 H) 7.96 - 8.20 (m, 4 H) 8.45 (s, 1 H) 8.99 (s, 1 H) 9.28 (br. s., 1 H) 9.92 (d, J=6.82 Hz, 2 H). Method A (Example 7).
261		N-[(3R,5S)-5-(methoxymethyl)pyrrolidin-3-yl]-6-(pyrazolo[1,5-a]pyridin-3-yl)pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) δ ppm 1.81 - 1.93 (m, 5 H) 2.83 - 2.91 (m, 1 H) 3.23 - 3.34 (m, 6 H) 3.43 - 3.48 (m, 1 H) 4.25 - 4.33 (m, 1 H) 7.42 - 7.54 (m, 2 H) 7.72 - 7.85 (m, 2 H) 8.37 (s, 1 H) 8.46 (s, 1 H) 9.88 (d, J=2.02 Hz, 1 H). Method E (Example 6).

Ex.	Structure	Name, Data and Preparation Method
262		<p>3-(6-(((2R,3R)-2-methylpiperidin-3-yl)amino)pyrazin-2-yl)imidazo[1,2-a]pyridine-7-carbonitrile 1H NMR (400 MHz, METHANOL-d<sub>4</sub>) <math>\delta</math> ppm 1.35 (d, J=6.82 Hz, 3 H) 1.84 - 2.20 (m, 5 H) 3.16 - 3.20 (m, 1 H) 3.81 (br. s., 1 H) 4.40 - 4.53 (m, 1 H) 7.33 (s, 1 H) 7.99 (s, 1 H) 8.24 (s, 1 H) 8.41 (s, 1 H) 8.44 - 8.55 (m, 1 H) 9.73 (s, 1 H). Method A (Example 7).</p>
263		<p>3-(6-(((3R,4R)-4-cyclopropylpyrrolidin-3-yl)amino)pyrazin-2-yl)imidazo[1,2-a]pyridine-6-carbonitrile 1H NMR (400 MHz, METHANOL-d<sub>4</sub>) <math>\delta</math> ppm 0.11 (s, 1 H) 0.16 - 0.23 (m, 1 H) 0.43 (br. s., 1 H) 0.53 (br. s., 1 H) 0.87 (br. s., 2 H) 1.73 - 1.85 (m, 1 H) 3.04 - 3.13 (m, 1 H) 3.20 - 3.28 (m, 1 H) 3.37 - 3.43 (m, 1 H) 3.65 (br. s., 1 H) 4.66 - 4.74 (m, 1 H) 7.57 - 7.66 (m, 1 H) 7.82 (d, J=9.85 Hz, 1 H) 7.96 (s, 1 H) 8.37 (s, 1 H) 8.45 (s, 1 H) 10.47 (s, 1 H). Method A (Example 7).</p>
264		<p>3-(6-(((3R,4R)-4-cyclopropylpyrrolidin-3-yl)amino)pyrazin-2-yl)imidazo[1,2-a]pyridine-7-carbonitrile 1H NMR (400 MHz, METHANOL-d<sub>4</sub>) <math>\delta</math> ppm 0.00 - 0.11 (m, 1 H) 0.11 - 0.23 (m, 1 H) 0.39 (m, 1 H) 0.44 - 0.58 (m, 1 H) 0.74 - 0.90 (m, 1 H) 1.75 - 1.82 (m, 1 H) 3.2-3.25 (m, 1H) 3.30 - 3.33 (m, 1 H) 3.42 - 3.49 (m, 1 H) 3.51 - 3.60 (m, 1 H) 4.67 - 4.74 (m, 1 H) 7.22 (d, J=7.33 Hz, 1 H) 7.92 (s, 1 H) 8.15 (s, 1 H) 8.35 (s, 1 H) 8.43 (s, 1 H) 9.78 (d, J=7.07 Hz, 1 H). Method A (Example 7).</p>

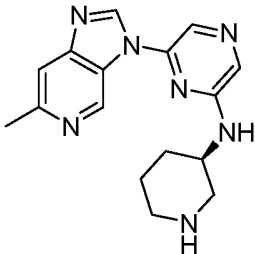
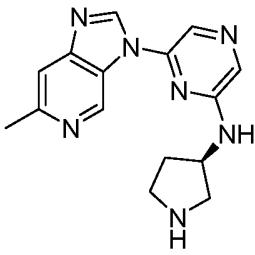
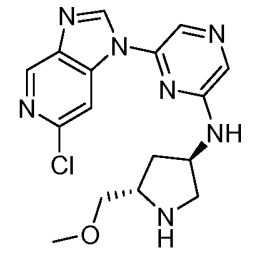
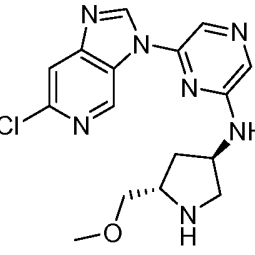
Ex.	Structure	Name, Data and Preparation Method
265		(2S,3S)-N-[6-(7-methoxyimidazo[1,2-a]pyridin-3-yl)pyrazin-2-yl]-2-methyl-1-azabicyclo[2.2.2]octan-3-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) δ ppm 1.05 (d, J=7.07 Hz, 3 H) 1.25 - 1.35 (m, 1 H) 1.62 - 1.70 (m, 2 H) 1.79 - 1.90 (m, 2 H) 2.54 - 2.63 (m, 1 H) 2.74 - 2.86 (m, 1 H) 2.96 - 3.04 (m, 1 H) 3.20 - 3.25 (m, 1 H) 3.88 (s, 3 H) 4.07 - 4.16 (m, 1 H) 6.84 (dd, J=7.58, 2.27 Hz, 1 H) 7.10 (d, J=1.77 Hz, 1 H) 7.17 (d, J=8.08 Hz, 1 H) 7.90 (s, 1 H) 8.20 (s, 1 H) 8.24 (s, 1 H) 9.56 (d, J=7.58 Hz, 1 H). Method A (Example 19).
266		6-(6-fluoroimidazo[1,2-a]pyridin-3-yl)-N-[(3R,5S)-5-(methoxymethyl)pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d <sub>6</sub> ) δ ppm 1.81 - 1.93 (m, 5 H) 2.83 - 2.91 (m, 1 H) 3.23 - 3.34 (m, 6 H) 3.43 - 3.48 (m, 1 H) 4.25 - 4.33 (m, 1 H) 7.42 - 7.54 (m, 2 H) 7.72 - 7.85 (m, 2 H) 8.37 (s, 1 H) 8.46 (s, 1 H) 9.88 (d, J=2.02 Hz, 1 H). Method E (Example 6).
267		3-(imidazo[1,2-a]pyridin-3-yl)-5-[(3R)-pyrrolidin-3-ylamino]pyrazine-2-carbonitrile 1H NMR (400 MHz, DMSO) δ ppm 2.05 (m, 1H), 2.25 (m, 1H), 3.3-3.1 (m, 2H), 3.5-3.3 (m, 2H), 4.62 (m, 1H), 7.61 (m, 1H), 8.01 (m, 1H), 8.08 (m, 1H), 8.17 (s, 1H), 8.55 (s, 1H), 9.38 (s, 2H), 9.58 (s, 1H), 9.71 (s, 1H). Method A (Example 19).

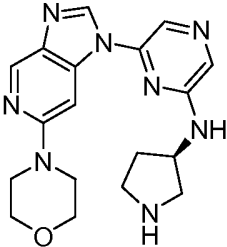
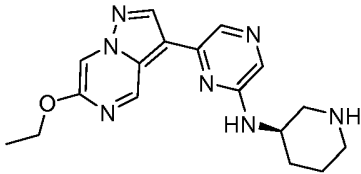
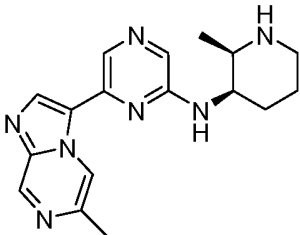
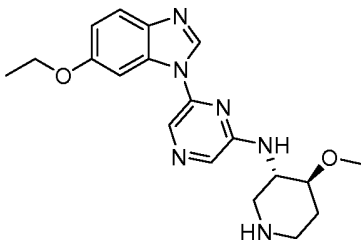
Ex.	Structure	Name, Data and Preparation Method
268		6-(6-ethoxy-1H-benzimidazol-1-yl)-N-[(3R,5S)-5-(methoxymethyl)pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, D2O): $\delta$ ppm 1.429-1.394 (m, 3H), 2.344-2.237 (m, 2H), 3.419 (m, 3H), 3.516-3.447 (m, 1H), 3.715-3.625 (m, 2H), 3.798-3.761 (m, 2H), 4.223-4.109 (m, 3H), 4.652-4.621 (m, 3H), 7.297-7.269 (m, 1H), 7.470 (s, 1H), 7.782-7.759 (d, 1H) 8.119 (s, 1H), 8.161 (s, 1H), 9.530 (s, 1H). Method A (Example 15).
269		6-(5-ethoxy-1H-benzimidazol-1-yl)-N-[(3R,5S)-5-(methoxymethyl)pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, D2O): $\delta$ ppm 1.459-1.424 (m, 3H), 2.334-2.281 (m, 2H), 3.507-3.41 (m, 4H), 3.733-3.636 (m, 2H), 3.807-3.771 (m, 1H), 4.222-4.170 (m, 3H), 7.282-7.253 (m, 1H), 7.365 (s, 1H), 8.011-7.988 (d, 1H) 8.112 (s, 1H), 8.195 (s, 1H), 9.556 (s, 1H). Method A (Example 15).
270		N-[(3S)-pyrrolidin-3-yl]-6-[6-(trifluoromethyl)imidazo[1,2-a]pyridin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d6) $\delta$ ppm 1.59 - 1.76 (m, 1 H), 2.05 (dd, J=12.99, 6.77 Hz, 1 H), 2.72 - 2.84 (m, 2 H), 2.94 (ddd, J=10.43, 7.32, 7.14 Hz, 1 H), 3.03 (dd, J=11.35, 6.22 Hz, 1 H), 4.26 (dt, J=6.68, 3.43 Hz, 1 H), 7.45 (d, J=6.22 Hz, 1 H), 7.62 (dd, J=9.33, 1.65 Hz, 1 H), 7.84 (s, 1 H), 7.91 (d, J=9.52 Hz, 1 H), 8.38 (s, 1 H), 8.55 (s, 1 H), 10.34 (s, 1 H); LCMS: M + 1 349.1. Method A (Example 7).

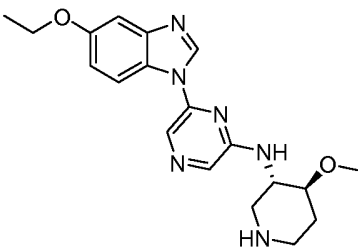
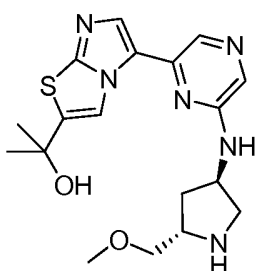
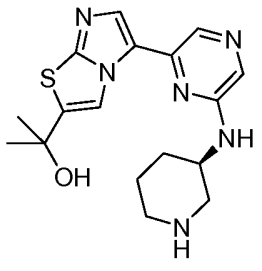
Ex.	Structure	Name, Data and Preparation Method
271		6-(6-chloro-1H-imidazo[4,5-c]pyridin-1-yl)-N-[(3R)-pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, MeOD) $\delta$ ppm 1.799 (m, 1H), 2.195 (m, 1H), 2.872 (m, 1H), 2.948 (m, 1H), 3.189 (m, 1H), 3.038 (m, 1H), 4.343 (m, 1H), 7.847 (s, 1H), 8.095 (s, 1H), 8.207 (s, 1H), 8.698 (s, 1H), 8.912 (s, 1H). Method A (Example 17/18).
272		6-[6-(morpholin-4-yl)-1H-imidazo[4,5-c]pyridin-1-yl]-N-[(3R)-piperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, MeOD) $\delta$ ppm 1.668 (m, 2H), 1.900 (m, 1H), 2.854-2.804 (m, 2H), 2.900 (m, 1H), 3.115 (m, 1H), 3.426-3.370 (m, 5H), 3.769-3.745 (m, 4H), 4.100 (m, 1H), 7.121 (s, 1H), 7.887 (s, 1H), 8.084 (s, 1H), 8.531 (s, 1H), 8.587 (s, 1H). Method A (Example 17/18).
273		6-(6-methyl-1H-imidazo[4,5-c]pyridin-1-yl)-N-[(3R)-piperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, MeOD) $\delta$ ppm 1.604-1.547 (m, 1H), 1.704-1.644 (m, 1H), 1.870-1.837 (m, 2H), 2.202-2.179 (m, 1H), 2.702-2.588 (m, 5H), 3.015-2.984 (m, 1H), 3.285 (m, 1H), 4.006-3.959 (m, 1H), 7.915 (s, 1H), 8.013 (s, 1H), 8.171 (s, 1H), 8.855(s, 1H), 8.898 (s, 1H). Method A (Example 17/18).
274		6-(6-chloro-3H-imidazo[4,5-c]pyridin-3-yl)-N-[(3R)-pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, MeOD) $\delta$ ppm 1.817-1.766 (m, 1H), 2.218-2.166 (m, 1H), 2.842-2.802 (m, 1H), 3.042-2.940 (m, 2H), 3.239 (m, 1H), 4.373 (m, 1H), 7.704 (s, 1H), 7.842 (s, 1H), 8.146 (s, 1H), 9.020 (s, 1H), 9.298 (s, 1H). Method A (Example 17/18).

Ex.	Structure	Name, Data and Preparation Method
275		6-[6-(azetidin-1-yl)-1H-imidazo[4,5-c]pyridin-1-yl]-N-[(3R)-piperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, MeOD) $\delta$ ppm 1.549 (m, 2H), 1.719 (m, 1H), 2.027-2.005 (m, 1H), 2.357-2.301 (m, 2H), 2.579-2.471 (m, 2H), 2.861-2.830 (m, 1H), 3.162 (m, 1H), 3.901 (m, 1H), 4.008 (m, 4H), 6.793 (s, 1H), 7.795 (s, 1H), 7.970 (s, 1H), 8.412 (s, 1H), 8.539 (s, 1H). Method A (Example 17/18).
276		6-(6-ethoxy-1H-imidazo[4,5-c]pyridin-1-yl)-N-[(3R)-pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, CDCl <sub>3</sub> ) $\delta$ ppm 1.384 (m, 3H), 1.778 (m, 2H), 2.296 (m, 1H), 3.041 (m, 2H), 3.143 (m, 1H), 3.246 (m, 1H), 4.395 (m, 3H), 5.284 (m, 1H), 7.244 (s, 1H), 7.817 (s, 1H), 8.048 (s, 1H), 8.393 (s, 1H), 8.644 (s, 1H). Method A (Example 17/18).
277		6-(6-methoxy-1H-imidazo[4,5-c]pyridin-1-yl)-N-[(3R)-pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, CDCl <sub>3</sub> ) $\delta$ ppm 1.940 (m, 1H), 2.250 (m, 1H), 2.923 (m, 2H), 3.086 (m, 1H), 3.245 (m, 1H), 3.957 (s, 3H), 4.390 (s, 1H), 5.232 (d, 1H), 7.266 (s, 1H), 7.811 (s, 1H), 8.044 (s, 1H), 8.393 (s, 1H), 8.664 (s, 1H). Method A (Example 17/18).
278		6-(6-methyl-1H-imidazo[4,5-c]pyridin-1-yl)-N-[(3R)-pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, MeOD) $\delta$ ppm 1.794-1.766 (m, 1H), 2.200-2.148 (m, 1H), 2.592 (s, 3H), 2.829-2.790 (m, 1H), 3.160-2.910 (m, 2H), 4.382-4.367 (m, 1H), 7.841 (s, 1H), 8.001 (s, 1H), 8.085 (s, 1H), 8.762 (s, 1H), 8.807 (s, 1H). Method A (Example 17/18).

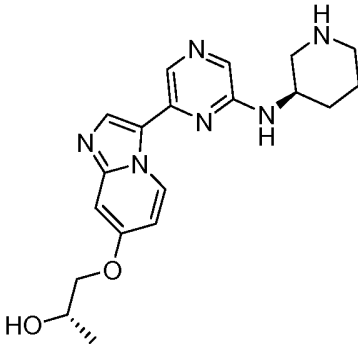
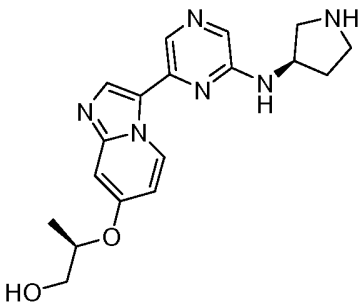
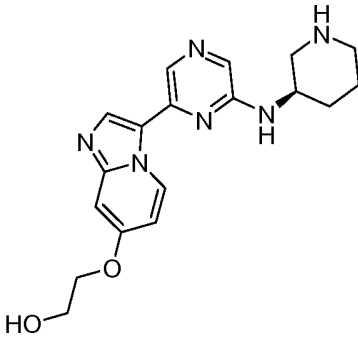


Ex.	Structure	Name, Data and Preparation Method
		17/18).
279		6-(6-methyl-3H-imidazo[4,5-c]pyridin-3-yl)-N-[(3R)-piperidin-3-yl]pyrazin-2-amine <sup>1</sup> H NMR (400 MHz, Methanol-d <sub>4</sub> ) δ ppm 1.715 (m, 2H), 1.895 (m, 1H), 2.212 (m, 1H), 2.640 (m, 2H), 2.710 (s, 3H), 3.032 (m, 1H), 3.312 (m, 1H), 4.043 (m, 1H), 7.677 (s, 1H), 7.929 (s, 1H), 8.245 (s, 1H), 9.100 (s, 1H), 9.472 (s, 1H). Method A (Example 17/18).
280		6-(6-methyl-3H-imidazo[4,5-c]pyridin-3-yl)-N-[(3R)-pyrrolidin-3-yl]pyrazin-2-amine <sup>1</sup> H NMR (400 MHz, Methanol-d <sub>4</sub> ) δ ppm 1.814 (m, 1H), 2.223 (m, 1H), 2.593 (s, 3H), 2.975 (m, 1H), 3.031 (m, 2H), 3.209 (m, 1H), 4.405 (m, 1H), 7.553 (s, 1H), 7.826 (s, 1H), 8.147 (s, 1H), 8.965 (s, 1H), 9.392 (s, 1H). Method A (Example 17/18).
281		6-(6-chloro-1H-imidazo[4,5-c]pyridin-1-yl)-N-[(3R,5S)-5-(methoxymethyl)pyrrolidin-3-yl]pyrazin-2-amine <sup>1</sup> H NMR (400 MHz, MeOD) δ ppm 1.970-1.836 (m, 2H), 2.826-2.786 (m, 1H), 3.393-3.323 (m, 1H), 3.4573.249 (m, 7H) 4.358-4.304 (m, 1H), 7.827 (s, 1H), 8.087 (s, 1H), 8.209 (s, 1H), 8.692 (s, 1H), 8.883 (s, 1H). Method A (Example 17/18).
282		6-(6-chloro-3H-imidazo[4,5-c]pyridin-3-yl)-N-[(3R,5S)-5-(methoxymethyl)pyrrolidin-3-yl]pyrazin-2-amine <sup>1</sup> H NMR (400 MHz, MeOD) δ ppm 2.072-1.988 (m, 2H), 2.922-2.882 (m, 1H), 3.542-3.400 (m, 7H), 4.502 (m, 1H), 7.834 (s, 1H), 7.952 (s, 1H), 8.264 (s, 1H), 9.142 (s, 1H), 9.413 (s, 1H). Method A (Example 17/18).

Ex.	Structure	Name, Data and Preparation Method
283		<p>6-[6-(morpholin-4-yl)-1H-imidazo[4,5-c]pyridin-1-yl]-N-[(3R)-pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, MeOD) <math>\delta</math> ppm 1.774-1.762 (m, 1H), 2.165-2.150 (m, 1H), 2.826-2.787 (m, 1H), 2.910-2.896 (m, 1H), 3.030-3.002 (m, 1H), 3.192-3.147 (m, 1H), 3.413-3.390 (t, 4H), 3.772-3.749 (t, 4H), 4.368 (m, 1H), 7.311 (s, 1H), 7.813 (s, 1H), 8.036 (s, 1H), 8.523 (s, 1H), 8.588 (s, 1H). Method A (Example 17/18).</p>
284		<p>6-(6-ethoxypyrazolo[1,5-a]pyrazin-3-yl)-N-[(3R)-piperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, METHANOL-d4) <math>\delta</math> ppm 1.46 (t, J=7.07 Hz, 3 H) 1.72 (m, 1 H) 1.88 (m, 2 H) 2.11 (m, 1 H) 2.25 (m, 1 H) 3.04 (t, J=8.59 Hz, 2 H) 3.58 (dd, J=12.00, 4.67 Hz, 1 H) 4.35 (q, J=7.07 Hz, 3 H) 7.79 (s, 1 H) 8.25 (s, 1 H) 8.28 (s, 1 H) 8.55 (s, 1 H) 9.55 (s, 1 H); LCMS: M + 1 340. Method E (Example 22).</p>
285		<p>6-(6-methylimidazo[1,2-a]pyrazin-3-yl)-N-[(2R,3R)-2-methylpiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, DMSO-d6) <math>\delta</math> ppm 1.15 - 1.25 (m, 1 H) 1.32 (d, J=6.57 Hz, 3 H) 1.67 - 1.73 (m, 1 H) 1.80 - 1.87 (m, 1 H) 1.95 - 2.01 (m, 2 H) 2.57 (s, 3 H) 2.95 - 3.03 (m, 1 H) 3.22 - 3.29 (m, 1 H) 4.33 - 4.39 (m, 1 H) 8.00 (s, 1 H) 8.18 - 8.25 (m, 1 H) 8.47 (s, 1 H) 8.63 (s, 1 H) 9.19 (br. s., 2 H) 9.46 (br. s., 1 H). Method D (Example 13).</p>
286		<p>6-(6-ethoxy-1H-benzimidazol-1-yl)-N-[(3S,4S)-4-methoxypiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, D2O): <math>\delta</math> ppm 1.425-1.391 (m, 3H), 1.832-1.701 (m, 1H), 2.595-2.498 (m, 1H), 3.139-3.046 (m, 2H), 3.615-3.409 (m, 5H), 3.708-3.698</p>

Ex.	Structure	Name, Data and Preparation Method
		(m, 1H), 4.188-4.157 (m, 2H), 4.368-4.358 (m, 1H), 7.308-7.285 (d, 1H), 7.550 (s, 1H), 7.807-7.784 (d, 1H), 8.134 (s, 1H), 8.194 (s, 1H), 9.500 (s, 1H). Method A (Example 15).
287		6-(5-ethoxy-1H-benzimidazol-1-yl)-N-[(3S,4S)-4-methoxypiperidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, D <sub>2</sub> O): $\delta$ ppm 1.425-1.391 (m, 3H), 1.813-1.785 (m, 1H), 2.530-2.484 (m, 1H), 3.182-3.041 (m, 2H), 3.525--3.414 (m, 4H), 3.656-3.615 (m, 1H), 3.740-3.684 (m, 1H), 4.218-4.166 (m, 2H), 4.352-4.316 (m, 1H), 7.279-7.251 (m, 1H), 7.366 (s, 1H), 8.019-7.996 (d, 1H), 8.110 (s, 1H), 8.191 (s, 1H), 9.493 (s, 1H). Method A (Example 15).
288		2-[5-(6-[(3R,5S)-5-(methoxymethyl)pyrrolidin-3-yl]amino)pyrazin-2-yl]imidazo[2,1-b][1,3]thiazol-2-yl]propan-2-ol 1H NMR (300 MHz, MeOD) $\delta$ ppm 1.68 (s, 6 H), 1.93 - 2.13 (m, 2 H), 2.83 - 3.01 (m, 1 H), 3.39 (s, 3 H), 3.41 - 3.62 (m, 3 H), 4.17 - 4.36 (m, 1 H), 4.38 - 4.52 (m, 1 H), 7.60 - 7.78 (m, 1 H), 7.83 (s, 1 H), 8.05 - 8.18 (m, 1 H), 8.45 (s, 1 H). Method A (Example 14).
289		2-(5-{6-[(3R)-piperidin-3-ylamino]pyrazin-2-yl}imidazo[2,1-b][1,3]thiazol-2-yl)propan-2-ol 1H NMR (300 MHz, MeOD) $\delta$ ppm 1.50 - 1.67 (m, 2 H), 1.67 (s, 6 H), 1.78 - 1.92 (m, 1 H), 2.07 - 2.29 (m, 1 H), 2.48 - 2.81 (m, 2 H), 2.91 - 3.07 (m, 1 H), 3.28 (d, J=3.20 Hz, 1 H), 3.90 - 4.03 (m, 1 H), 7.68 (s, 1 H), 7.83 (s, 1 H), 8.09 (s, 1 H), 8.48 (s, 1 H). Method A (Example 14).

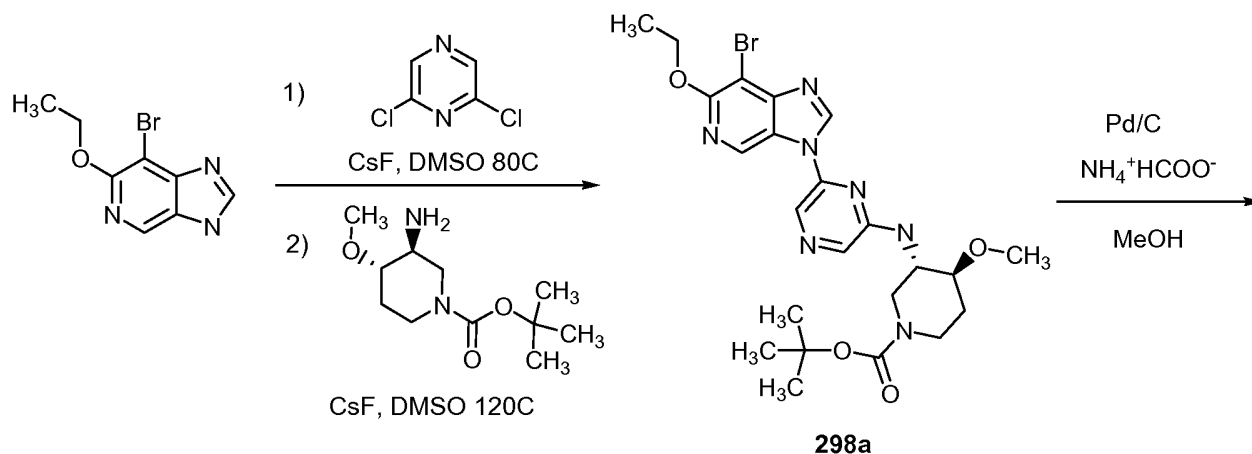
Ex.	Structure	Name, Data and Preparation Method
290		2-[(3-{6-[(3R)-pyrrolidin-3-ylamino]pyrazin-2-yl}imidazo[1,2-a]pyridin-7-yl)oxy]ethanol 1H NMR (300 MHz, MeOD) $\delta$ ppm 2.07 - 2.25 (m, 2 H) 2.35 - 2.54 (m, 1 H) 3.38 - 3.52 (m, 3 H) 3.54 - 3.66 (m, 1 H) 3.95 (t, J=4.43 Hz, 2 H) 4.19 (t, J=4.52 Hz, 2 H) 4.67 (d, J=3.20 Hz, 1 H) 6.86 (d, J=5.46 Hz, 1 H) 7.01 (s, 1 H) 7.78 (s, 1 H) 8.10 (br. s., 1 H) 8.28 (s, 1 H) 9.56 (d, J=7.72 Hz, 1 H); LCMS: M + H 341. Method A (Example 32).
291		(2S)-2-[(3-{6-[(3R)-pyrrolidin-3-ylamino]pyrazin-2-yl}imidazo[1,2-a]pyridin-7-yl)oxy]propan-1-ol 1H NMR (300 MHz, MeOD) $\delta$ ppm 1.31 (d, J=6.40 Hz, 3 H) 2.10 - 2.26 (m, 1 H) 2.36 - 2.55 (m, 1 H) 3.33 - 3.42 (m, 1 H) 3.42 - 3.55 (m, 2 H) 3.55 - 3.68 (m, 1 H) 3.89 - 4.06 (m, 2 H) 4.10 - 4.26 (m, 1 H) 4.60 - 4.74 (m, 1 H) 6.85 (dd, J=7.63, 2.54 Hz, 1 H) 6.97 (d, J=2.45 Hz, 1 H) 7.77 (s, 1 H) 8.07 (s, 1 H) 8.26 (s, 1 H) 9.51 (d, J=7.72 Hz, 1 H); LCMS: M + H 355. Method A (Example 32).
292		(2S)-2-[(3-{6-[(3R)-piperidin-3-ylamino]pyrazin-2-yl}imidazo[1,2-a]pyridin-7-yl)oxy]propan-1-ol 1H NMR (300 MHz, MeOD) $\delta$ ppm 1.37 (d, J=6.03 Hz, 3 H) 1.67 - 1.81 (m, 1 H) 1.82 - 1.93 (m, 1 H) 2.04 - 2.17 (m, 1 H) 2.19 - 2.32 (m, 1 H) 2.94 - 3.15 (m, 2 H) 3.47 - 3.61 (m, 1 H) 3.74 (d, J=5.09 Hz, 2 H) 4.14 - 4.33 (m, 1 H) 4.56 - 4.74 (m, 1 H) 4.96 (d, J=19.03 Hz, 1 H) 6.78 - 6.91 (m, 1 H) 7.04 (d, J=2.26 Hz, 1 H) 7.78 (s, 1 H) 8.09 (s, 1 H) 8.27 (s, 1 H) 9.48 (d, J=7.54 Hz, 1 H); LCMS: M + H 369. Method A (Example 32).

Ex.	Structure	Name, Data and Preparation Method
293		<p>(2S)-1-[(3-{6-[(3R)-piperidin-3-ylamino]pyrazin-2-yl}imidazo[1,2-a]pyridin-7-yl)oxy]propan-2-ol 1H NMR (300 MHz, MeOD) <math>\delta</math> ppm 1.31 (d, J=6.40 Hz, 3 H) 1.63 - 1.81 (m, 1 H) 1.80 - 1.90 (m, 1 H) 1.99 - 2.14 (m, 1 H) 2.17 - 2.31 (m, 1 H) 2.91 - 3.10 (m, 2 H) 3.27 (br. s., 1 H) 3.44 - 3.61 (m, 1 H) 3.90 - 4.08 (m, 2 H) 4.11 - 4.31 (m, 2 H) 6.88 (dd, J=7.72, 1.88 Hz, 1 H) 6.99 (s, 1 H) 7.77 (s, 1 H) 8.08 (br. s., 1 H) 8.24 (s, 1 H) 9.49 (d, J=7.54 Hz, 1 H); LCMS: M + H 369. Method A (Example 32).</p>
294		<p>(2R)-2-[(3-{6-[(3R)-pyrrolidin-3-ylamino]pyrazin-2-yl}imidazo[1,2-a]pyridin-7-yl)oxy]propan-1-ol 1H NMR (300 MHz, MeOD) <math>\delta</math> ppm 1.27 - 1.36 (m, 3 H) 3.38 (dd, J=12.90, 4.80 Hz, 1 H) 3.47 - 3.60 (m, 2 H) 3.67 (dd, J=12.06, 6.22 Hz, 1 H) 4.06 - 4.15 (m, 1 H) 4.16 - 4.27 (m, 2 H) 4.67 - 4.79 (m, 1 H) 7.31 (s, 1 H) 8.02 (s, 1 H) 8.36 (s, 1 H) 8.46 (s, 1 H) 9.65 - 9.71 (m, 1 H); LCMS: M + H 355. Method A (Example 32).</p>
295		<p>2-[(3-{6-[(3R)-piperidin-3-ylamino]pyrazin-2-yl}imidazo[1,2-a]pyridin-7-yl)oxy]ethanol 1H NMR (300 MHz, MeOD) <math>\delta</math> ppm 1.73 (t, J=10.83 Hz, 1 H) 1.79 - 1.90 (m, 1 H) 2.00 - 2.13 (m, 1 H) 2.16 - 2.29 (m, 1 H) 2.92 - 3.05 (m, 2 H) 3.23 (br. s., 1 H) 3.43 - 3.60 (m, 1 H) 3.95 (t, J=4.52 Hz, 2 H) 4.19 (t, J=4.52 Hz, 3 H) 6.88 (d, J=7.72 Hz, 1 H) 7.01 (s, 1 H) 7.77 (s, 1 H) 8.09 (s, 1 H) 8.25 (s, 1 H) 9.50 (d, J=7.54 Hz, 1 H); LCMS M + H 356. Method A (Example 32).</p>

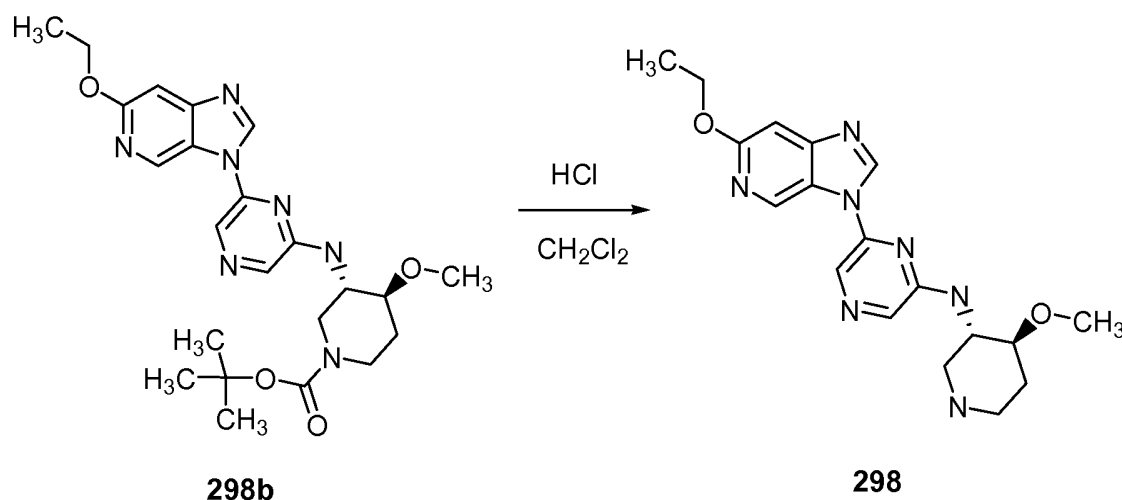
Ex.	Structure	Name, Data and Preparation Method
296		6-(imidazo[1,2-a]pyridin-3-yl)-5-methyl-N-[(3R)-pyrrolidin-3-yl]pyrazin-2-amine 1H NMR (400 MHz, MeOD) $\delta$ ppm 1.928 (m, 1H), 2.290 (m, 1H), 2.588 (s, 3H), 3.002 (m, 1H), 3.109 (m, 1H), 3.212 (m, 1H), 3.230 (m, 1H), 4.441 (m, 1H), 7.050 (t, 1H), 7.445 (t, 1H), 7.651 (s, 1H), 7.841 (s, 1H), 7.963 (s, 1H), 9.189 (d, 1H). Method A (Example 16, use 16b-1).
297		[6-(6-Ethoxy-imidazo[4,5-c]pyridin-3-yl)-pyrazin-2-yl]-((3R,5S)-5-methoxymethyl-pyrrolidin-3-yl)-amine. 1H NMR (400 MHz, MeOD) $\delta$ ppm 1.43 (t, J = 7.07 Hz, 3 H), 2.16 - 2.33 (m, 2 H), 3.26 (d, J = 4.29 Hz, 1 H), 3.46 (s, 3 H), 3.57 (d, J = 6.82 Hz, 1 H), 3.61 - 3.70 (m, 2 H), 3.97 (dd, J = 7.07, 3.28 Hz, 1 H), 4.36 (q, J = 7.07 Hz, 2 H), 4.70 (d, J = 4.29 Hz, 1 H), 7.08 (s, 1 H), 7.96 (s, 1 H), 8.31 (s, 1 H), 9.02 (s, 1 H), 9.15 (s, 1 H). LCMS: M+1 370. Method A (Example 298)

### Additional Specific Examples

**Example 298 (Method A): [6-(6-Ethoxy-imidazo[4,5-c]pyridin-3-yl)-pyrazin-2-yl]-((3S,4S)-4-methoxy-piperidin-3-yl)-amine**



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**Preparation of compound 298a: (3S,4S)-3-[6-(7-Bromo-6-ethoxy-imidazo[4,5-c]pyridin-3-yl)-pyrazin-2-ylamino]-4-methoxy-piperidine-1-carboxylic acid tert-butyl ester**

- 5 A mixture of 7-bromo-6-ethoxy-3H-imidazo[4,5-c]pyridine (100 mg, 0.413 mmol), 2,6-dichloro pyrazine (61.5 mg, 0.413 mmol) and CsF (126 mg, 0.826 mmol) in 1 mL DMSO was heated at 80°C for 6 hrs. The reaction mixture was cooled to room temperature, (3S,4S)-3-Amino-4-methoxy-piperidine-1-carboxylic acid tert-butyl ester (100 mg, 0.434 mmol) was added, continued to heat at 120°C overnight. The reaction mixture was
- 10 cooled to room temperature and poured into 15 mL H<sub>2</sub>O, solid crashed out. The solid was filtered and added 20 mL MeOH, the insoluble material was filtered and rinsed with 10 mL MeOH. The filtrate was concentrated and chromatographed on an ISCO with 100% EtOAc to give the title compound **298a** as a brown oil (90 mg, 40%).

**Preparation of compound 298b: (3S,4S)-3-[6-(6-Ethoxy-imidazo[4,5-c]pyridin-3-yl)-pyrazin-2-ylamino]-4-methoxy-piperidine-1-carboxylic acid tert-butyl ester**

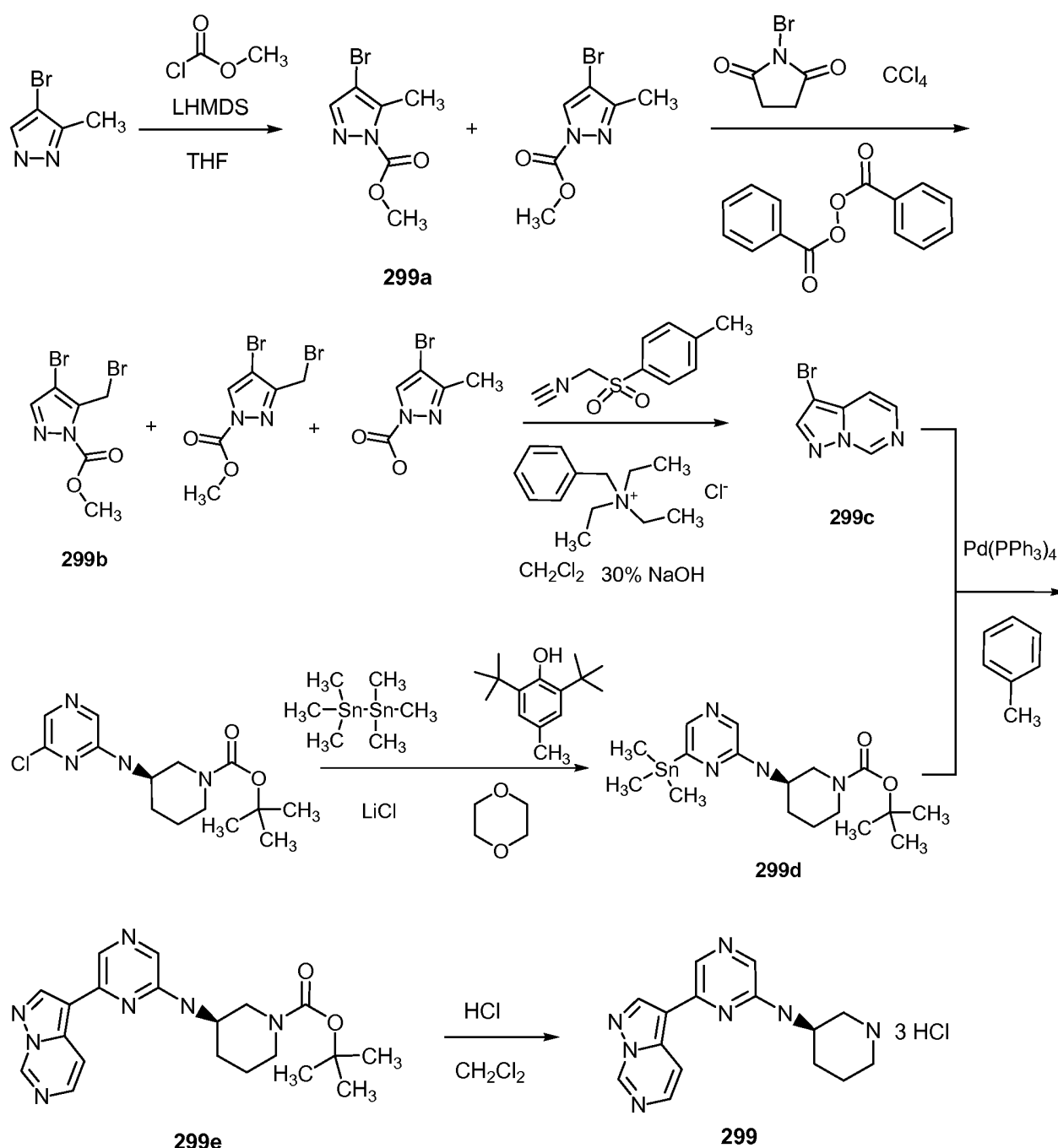
- 15 A mixture of **298a** (89 mg, 0.16 mmol), 10% Pd/C wet (41 mg, 0.39 mmol) and ammonium formate (89 mg, 1.3 mmol) was heated to reflux for 1.5hrs. The reaction was filtered, the solvent was evaporated and the crude product was chromatographed on an ISCO with 100% EtOAc to give the title compound **298b** as an oil (46 mg, 60%).
- 20 **298b** (46 mg, 0.098 mmol) was dissolved in 1 mL CH<sub>2</sub>Cl<sub>2</sub> anhydrous, 0.5 mL 4M HCl in dioxane was added, the reaction mixture was stirred at room temperature for 1hr. The solvent was evaporated; the residue was dried over vacuum. The residue was dissolved in 15 mL 5% MeOH/CH<sub>2</sub>Cl<sub>2</sub>, 10mL H<sub>2</sub>O and 1 mL std NaHCO<sub>3</sub> was added, the aqueous layer was extracted with 5% MeOH/CH<sub>2</sub>Cl<sub>2</sub>, the organic layers were combined and dried
- 25 over vacuum to give the title compound **298** as a grey solid (32 mg, 88%). <sup>1</sup>H NMR (400

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MHz, MeOD)  $\delta$  ppm 1.43 (t,  $J = 7.07$  Hz, 3 H), 1.83 (q,  $J = 9.68$  Hz, 1 H), 2.42 (br. s., 1 H), 3.02-3.13 (m, 1 H), 3.07 (d,  $J = 9.09$  Hz, 1 H), 3.39 (d,  $J = 13.89$  Hz, 1 H), 3.47 (s, 3 H), 3.58 (ddd,  $J = 8.21, 4.04, 3.92$  Hz, 2 H), 4.34 (q,  $J = 7.07$  Hz, 2 H), 4.29 (dt,  $J = 8.15, 4.14$  Hz, 1 H), 7.06 (s, 1 H), 8.01 (s, 1 H), 8.27 (s, 1 H), 9.01 (s, 1 H), 9.09 (br. s., 1 H).

5 LCMS:  $M+1$  370.

**Example 299 (Method H): (R)-Piperidin-3-yl-(6-pyrazolo[1,5-c]pyrimidin-3-yl-pyrazin-2-yl)-amine**



10



**Preparation of compound 299a: 4-Bromo-5-methyl-pyrazole-1-carboxylic acid methyl ester**

Lithium bis(trimethylsilyl)amide in hexane (0.7 mL, 0.7 mmol, 1M) was added to a solution of 4-bromo-3-methyl-1H-pyrazole (100 mg, 0.62 mmol) under the N<sub>2</sub> at -78°C, and the mixture was allowed to warm to room temperature for a period of 2 hrs. The mixture was cooled again to -78°C, methyl chloroformate (0.7 mmol, 0.054 mL) was added drop wise, stirring was continued at -78°C, and the reaction was allowed to warm to room temperature and stirred for overnight. The reaction mixture was treated with NH<sub>4</sub>Cl, extracted with ethyl acetate, and the combined organic layers were washed with brine and dried over Na<sub>2</sub>SO<sub>4</sub>. The solvent was evaporated and the crude product was chromatographed on an ISCO with 10% EtOAc/Heptane, got 128 mg white solid as a 1 : 1 mixture of the title compound **299a** and 4-bromo-3-methyl-pyrazole-1-carboxylic acid methyl ester.

**Preparation of compound 299b: 4-Bromo-5-bromomethyl-pyrazole-1-carboxylic acid methyl ester**

Bromo-N-succinimide (105 mg, 0.59 mmol) and benzoyl peroxide (2 mg, 0.008 mmol) were added to a solution of the 1 : 1 mixture of **299a** and 4-bromo-3-methyl-pyrazole-1-carboxylic acid methyl ester (128 mg, 0.58 mmol) in CCl<sub>4</sub> (6 mL), and the mixture was stirred and heated to reflux for 6 hrs. The succinimide formed was filtered off, and the solvent was evaporated under reduced pressure. The residue was chromatographed on an ISCO with 10% EtOAc/Heptane, got 110 mg white solid as a mixture of 1 : 0.4 : 0.6 title compound **299b** : 4-bromo-3-bromomethyl-pyrazole-1-carboxylic acid methyl ester : 4-bromo-3-methyl-pyrazole-1-carboxylic acid methyl ester. The mixture was used for next step without further separation.

**Preparation of compound 299c: 3-Bromo-pyrazolo[1,5-c]pyrimidine**

To a mixture of 30 mg above **299b**, (p-tolylsulfonyl)methyl isocyanide (20 mg, 0.1 mmol) and benzyl triethylammonium chloride (4.8 mg, 0.02 mmol) at -10°C was added 1 mL 1:1 CH<sub>2</sub>Cl<sub>2</sub> : 30% aqueous NaOH solution. After stirred for 20 min, the reaction mixture was poured into water and extracted with CH<sub>2</sub>Cl<sub>2</sub>. The organic phase was washed with brine, dried over Na<sub>2</sub>SO<sub>4</sub>, concentrated under reduced pressure to give a crude product, which was chromatographed on an ISCO with 20% EtOAc/Heptane to give 3 mg title compound **299c** as white solid. <sup>1</sup>H NMR (400 MHz, CHLOROFORM-d) δ ppm 7.43 (d, J

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= 6.32 Hz, 1 H), 7.90 (d,  $J$  = 6.32 Hz, 1 H), 8.06 (s, 1H), 9.20 (s, 1 H). LCMS:  $M+1$  198, 200.

**Preparation of compound 299d: (R)-3-(6-Trimethylstannanyl-pyrazin-2-ylamino)-piperidine-1-carboxylic acid tert-butyl ester**

5 A mixture of (R)-3-(6-Chloro-pyrazin-2-ylamino)-piperidine-1-carboxylic acid tert-butyl ester (200 mg, 0.64 mmol), hexamethyldistannane (419 mg, 1.28 mmol), 2,6-bis(1,1-dimethylethyl)-4-methylphenol (7.1 mg, 0.032 mmol), lithium chloride (81.3 mg, 1.92 mmol) and tetrakis(triphenylphosphine)palladium(0) (74 mg, 0.064 mmol) in 5 mL 1, 4-dioxane was degassed and purged with nitrogen and heated to reflux overnight. The  
10 reaction was filtered and the solvent was removed under reduced pressure. The crude product was chromatographed on an ISCO with 50% EtOAc/Heptane to give 180 mg oil as a 1 : 1 mixture of the title compound **299d** and (R)-3-(6-Chloro-pyrazin-2-ylamino)-piperidine-1-carboxylic acid tert-butyl ester which was used for next step without further separation.

15 **Preparation of compound 299e: (R)-3-(6-Pyrazolo[1,5-c]pyrimidin-3-yl-pyrazin-2-ylamino)-piperidine-1-carboxylic acid tert-butyl ester**

A mixture of **299c** (25 mg, 0.13 mmol), 167 mg **299d** and tetrakis(triphenylphosphine)palladium(0) (15 mg, 0.013 mmol) in 4 mL toluene was heated in a microwave at 160°C for 10 min. The reaction was filtered and the solvent  
20 was removed under reduced pressure. The crude product was loaded into prep TLC plate (60% EtOAc/Heptane) which gave a mixture of the title compound **299e** and the dimer of pyrazine. The title compound **299e** was further purified by a mass triggered prep HPLC as an oil (13.7 mg, 28%).  $^1\text{H}$  NMR (400 MHz, CHLOROFORM- $d$ )  $\delta$  ppm 1.42 (br. s., 9 H), 1.64 (br. s., 2 H), 1.71 (br. s., 1 H), 1.80 (br. s., 1 H), 2.06 (dd,  $J$  =  
25 11.49, 7.45 Hz, 1 H), 3.31 (br. s., 1 H), 3.60 (br. s., 1 H), 4.01 (d,  $J$  = 3.54 Hz, 1 H), 4.76 (d,  $J$  = 6.57 Hz, 1 H), 7.76 (br. s., 1 H), 7.97 (d,  $J$  = 6.32 Hz, 1 H), 8.22 (br. s., 2 H), 8.52 (s, 1 H), 9.29 (s, 1 H). LCMS:  $M+1$  396.

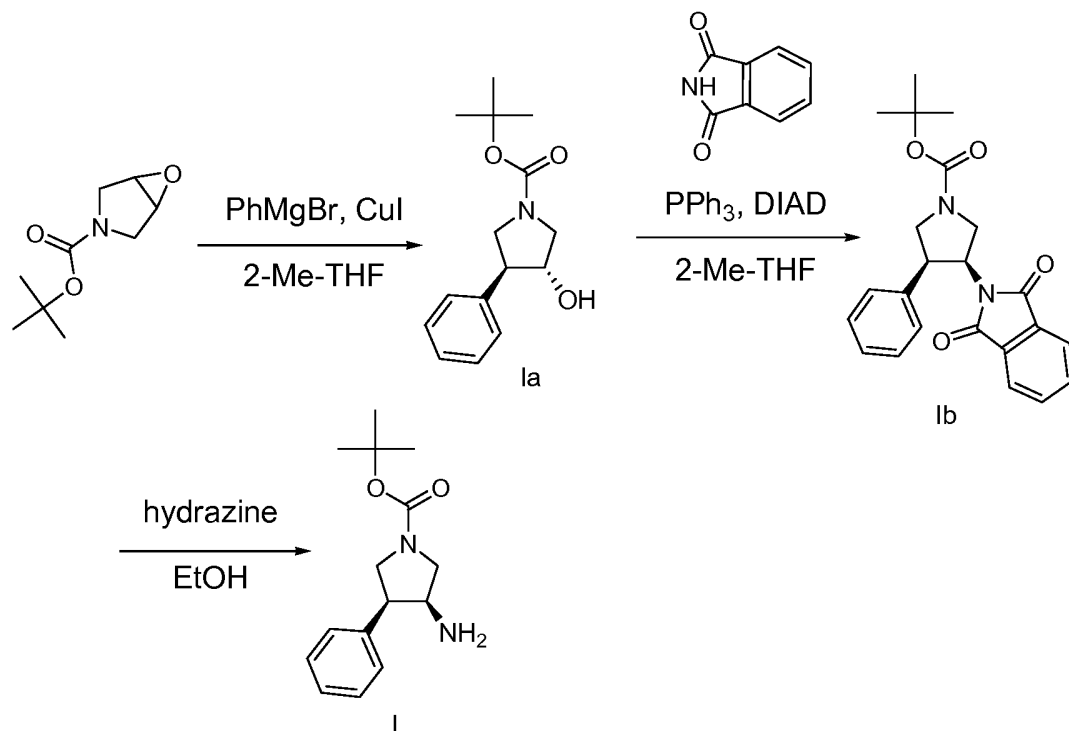
**299e** (13.7 mg, 0.035 mmol) was dissolved in 1 mL  $\text{CH}_2\text{Cl}_2$  anhydrous, 1 mL 4M HCl in dioxane was added, the reaction mixture was stirred at room temperature for 1hr. 6 mL  
30  $\text{CH}_2\text{Cl}_2$  anhydrous was added, the mixture was sonicated. The solid was filtered and rinsed with 6 mL  $\text{CH}_2\text{Cl}_2$ , dried over vacuum to give the title compound **299** as a yellow solid (10.7 mg, 75%).  $^1\text{H}$  NMR (400 MHz, MeOD)  $\delta$  ppm 1.83 (br. s., 1 H), 2.00 (br. s., 1 H), 2.14 (br. s., 1 H), 2.25 (br. s., 1 H), 3.09 - 3.21 (m, 2 H), 3.36 (br. s., 2 H), 3.67 (d,  $J$

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= 4.29 Hz, 1 H), 4.52 (br. s., 1 H), 7.87 (br. s., 1 H), 8.18 (d,  $J$  = 5.81 Hz, 1 H), 8.34 (d,  $J$  = 6.06 Hz, 1 H), 8.41 (br. s., 1 H), 8.87 (s, 1 H), 9.56 (s, 1 H). LCMS:  $M+1$  296.

### Synthesis of commercial unavailable Amines

#### 5 Example I: **cis-(racemic)-3-Amino-4-phenyl-pyrrolidine-1-carboxylic acid tert-butyl ester**



#### Preparation of compound **1a**: trans-(racemic)-3-hydroxy-4-phenyl-pyrrolidine-1-carboxylic acid tert-butyl ester

- 10 Oxa-3-aza-bicyclo[3.1.0]hexane-3-carboxylic acid tert-butyl ester (3 g, 16 mmol), was dissolved in 2-methyl-tetrahydrofuran (5 mL) and added dropwise to a solution of phenylmagnesium bromide (1.5 eq, 24.3 mL of a 1.0 M solution) and copper iodide (0.05 eq) at 0 °C. The reaction was allowed to warm to room temperature and stir for 18 h. Reaction was cooled to 0 °C and quenched with sat.  $\text{NH}_4\text{Cl}$  solution and extracted with EtOAc. Organic was washed with  $\text{NaHCO}_3$  and brine and dried over  $\text{Na}_2\text{SO}_4$  and the solvent removed. Residue was purified by column chromatography on  $\text{SiO}_2$  (15-40% EtOAc/HEptane) which gave the title compound **1a** as a yellow oil (3.59 g).

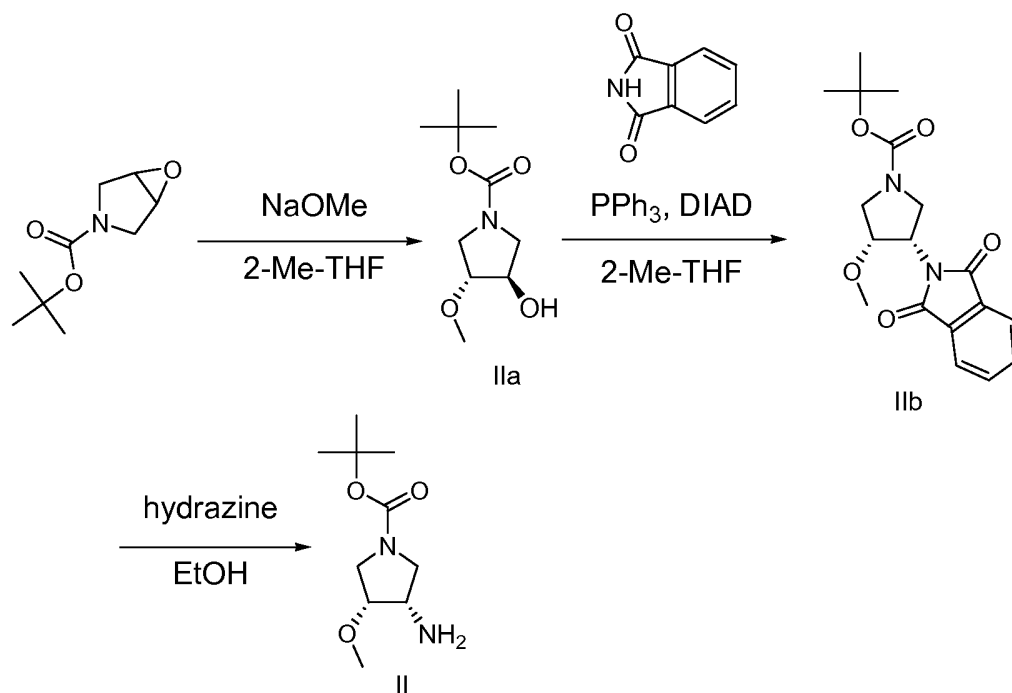
#### Preparation of compound **1b**: cis-(racemic)-3-(1,3-dioxo-1,3-dihydro-indol-2-yl)-4-phenyl-pyrrolidine-1-carboxylic acid tert-butyl ester

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**la** (3.59 g) was dissolved in 2-Me-THF and Phthalimide (2.35 g, 1.2 eq) and  $\text{PPh}_3$  (4.23 g, 1.2 eq) were added and stirred for 1 h. The reaction was cooled to 0 °C, and DIAD (3.4 g, 1.2 eq) was added slowly and the reaction was allowed to warm to RT and stir overnight. Reaction was concentrated and dissolved in EtOAc, washed with 2M NaOH, brine and dried over  $\text{Na}_2\text{SO}_4$ . Solvent was removed and residue purified by column chromatography on  $\text{SiO}_2$  (25% EtOAc/heptane) which gave the title compound **lb** as a white solid (3.8 g).

**lb** (800 mg) was dissolved in ethanol (20 mL) and treated with hydrazine (10 eq) at room temperature for 24 h. The reaction was filtered to remove solids and the filtrate concentrated from ethanol (3 x 10 mL) which gave the title compound **I** as a clear oil (440 mg, 50%).  $^1\text{H}$  NMR (400 MHz,  $\text{DMSO}-d_6$ )  $\delta$  ppm 1.43 (s, 9 H) 3.11 (s, 1 H) 3.35 (s, 1 H) 3.44 (dd,  $J=7.05, 4.78$  Hz, 4 H) 4.32 (s, 1 H) 4.77 (s, 1 H) 7.24 (d,  $J=1.76$  Hz, 3 H) 7.33 (d,  $J=7.30$  Hz, 2 H).

**Example II: Cis-(racemic)-3-Amino-4-methoxy-pyrrolidine-1-carboxylic acid tert-butyl ester**



**Preparation of compound IIa: trans-(racemic)- 3-Hydroxy-4-methoxy-pyrrolidine-1-carboxylic acid tert-butyl ester**

6-Oxa-3-aza-bicyclo[3.1.0]hexane-3-carboxylic acid tert-butyl ester (3 g, 16 mmol) was dissolved in 2-Me-THF (10mL) and a solution of sodium methoxide in methanol (10 mL of a 25% solution) was added and the reaction stirred at rt overnight. Reaction was

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quenched with sat.  $\text{NH}_4\text{Cl}$  and concentrated, then after extraction with EtOAc, residue was purified by column chromatography on  $\text{SiO}_2$  (35% EtOAc/heptane) which gave the title compound **Ila** as a clear oil (1.05 g).

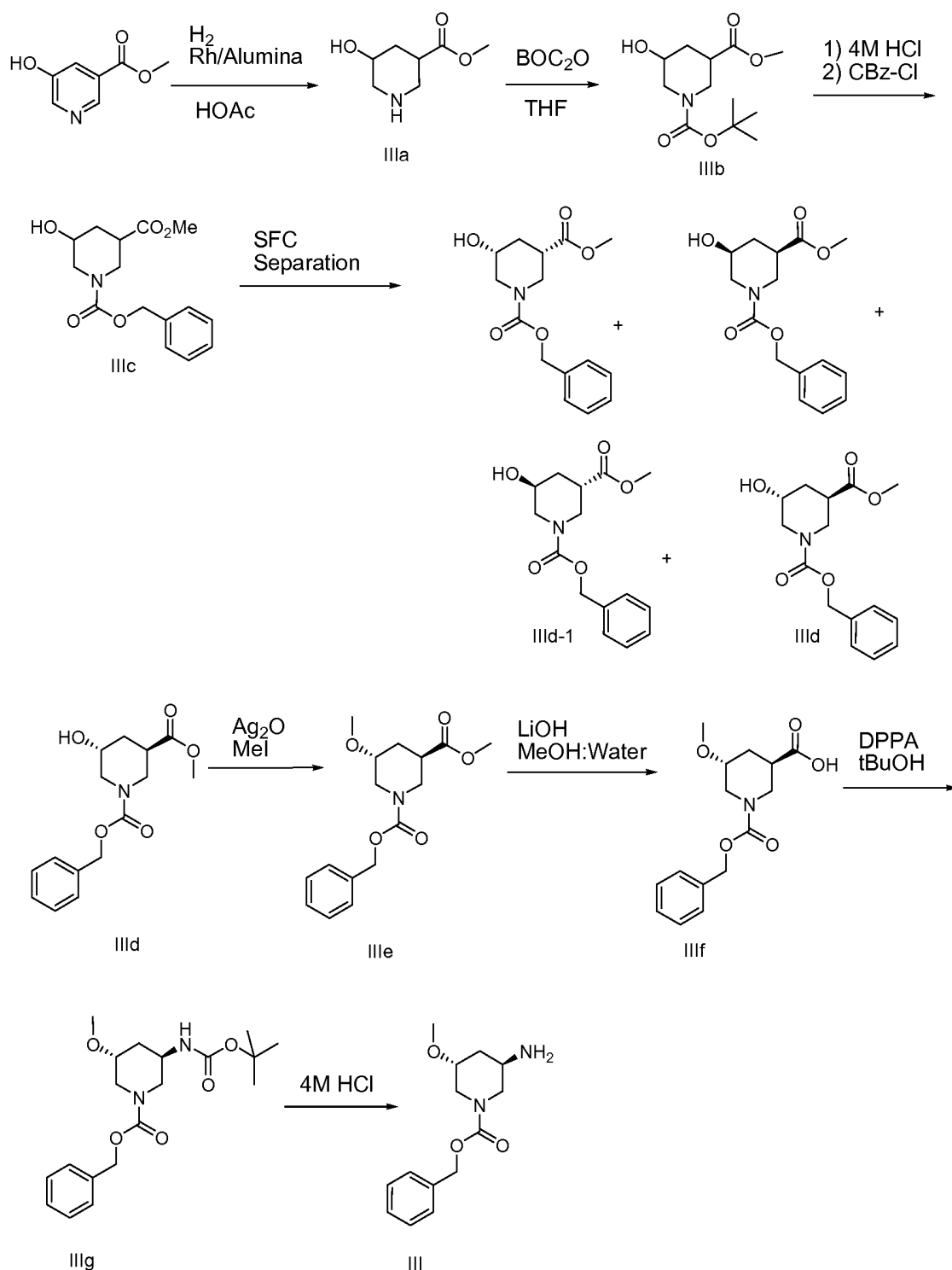
**Preparation of compound IIb: cis-(racemic)-3-(1,3-Dioxo-1,3-dihydro-isoindol-2-yl)-4-methoxy-pyrrolidine-1-carboxylic acid tert-butyl ester**

**Ila** (1.05 g) was dissolved in 2-Me-THF and Phthalimide (853 mg, 1.2 eq) and  $\text{PPh}_3$  (1.54 g, 1.2 eq) were added and stirred for 1 h. The reaction was cooled to 0 °C, and DIAD (1.24 g, 1.2 eq) was added slowly and the reaction was allowed to warm to RT and stir overnight. Reaction was concentrated and dissolved in EtOAc, washed with 2M NaOH, brine and dried over  $\text{Na}_2\text{SO}_4$ . Solvent was removed and residue purified by column chromatography on  $\text{SiO}_2$  (30% EtOAc/heptane) which gave the title compound **IIb** as a clear oil (1.886g).

**IIb** (1.886 g) was dissolved in ethanol (20mL) and treated with hydrazine (10 eq) at room temperature for 24 h. The reaction was filtered to remove solids and the filtrate concentrated from ethanol (3 x 10 mL) which gave the title compound **II** as a clear oil (570 mg, 25%).  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  ppm 1.45 (s, 10 H) 3.06 (s, 1 H) 3.39 (s, 6 H) 3.56 (s, 2 H) 3.65 (s, 1 H).

**Example III: (3R,5R)-3-Amino-5-methoxy-piperidine-1-carboxylic acid benzyl ester**

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### Preparation of compound IIIa: 5-Hydroxy-piperidine-3-carboxylic acid methyl ester (racemic)

Methyl 5-hydroxypyridine-3-carboxylate (22 g, 140 mmol), acetic acid (250 mL) and rhodium on alumina (2.2 g, 21 mmol) were added to a 1 L reactor. The mixture was hydrogenated at 200 psi and 50 °C for 18 h. The reaction was allowed to cool, then filtered through a microfiber filter paper, and concentrated *in vacuo* which afforded a

viscous colorless residue. The residue was azeotroped with toluene and dried which gave the title compound **IIIa** (25.4 g, 78%).

**Preparation of compound IIIb: 5-Hydroxy-piperidine-1,3-dicarboxylic acid 1-tert-butyl ester 3-methyl ester (racemic)**

- 5 **IIIa** (25.4 g) was dissolved in THF (250 mL). Sat. aqueous sodium bicarbonate was added followed by dropwise addition of Boc anhydride (28.5 g, 130.6 mmol). The mixture was stirred for 24 h. Ethyl acetate was added and the organic layer extracted, washed with brine, and dried over sodium sulfate. The residue was concentrated and purified by column chromatography (20% ethyl acetate in heptanes to 50%). Collected
- 10 KMnO<sub>4</sub>/PMA active spot which gave the title compound **IIIb** as a colorless oil (19.7g).

**Preparation of compound IIIc: 5-Hydroxy-piperidine-1,3-dicarboxylic acid 1-benzyl ester 3-methyl ester (racemic)**

- IIIb** (19.7 g) was dissolved in ethyl acetate (250 mL), and 4M HCl in dioxane (125 mL) was added. The mixture was stirred overnight. The mixture was concentrated and the
- 15 residue dissolved in THF (250 mL), the mixture cooled to 0°C, then dilute with saturated sodium bicarbonate. Benzyl chloroformate (15 g, 84 mmol) was added in a dropwise manner. The mixture was stirred overnight. The organic layers were separated and the aqueous layer extracted with ethyl acetate. The organic layer was washed with brine, dried over sodium sulfate, and concentrated. The residue was purified by column
- 20 chromatography (20% to 50% ethyl acetate in heptanes). The major PMA/uv active spot was collected which gave the title compound **IIIc** as a colorless oil (14.1 g).

**Preparation of compound IIId: (3R,5R)-5-Hydroxy-piperidine-1,3-dicarboxylic acid 1-benzyl ester 3-methyl ester**

- Separated 14.1 g of mixture of diastereomers using chiral SFC methods which gave the
- 25 title compound **IIId**. <sup>1</sup>H NMR (400 MHz, DMSO-*d*<sub>6</sub>) δ ppm 1.78 - 1.87 (m, 1 H) 2.76 - 2.89 (m, 1 H) 3.07 - 3.22 (m, 1 H) 3.28 - 3.45 (m, 2 H) 3.56 (br. s., 3 H) 3.73 - 3.81 (m, 1 H) 3.83 - 4.04 (m, 1 H) 4.83 - 4.96 (m, 1 H) 4.99 - 5.13 (m, 2 H) 7.26 - 7.44 (m, 5 H).

**Preparation of compound IIle: (3R,5R)-5-Methoxy-piperidine-1,3-dicarboxylic acid 1-benzyl ester 3-methyl ester**

- 30 To a sealed vessel was added **IIId** (300 mg, 1.02 mmol), silver (II) oxide (237 mg, 1.02 mmol), and iodomethane (2.05 mL, 0.5M). The mixture was refluxed 16 h. The reaction was filtered and concentrated *in vacuo*. The crude material was purified by silica gel column chromatography (0-100% EtOAc/Heptanes) which gave the title compound **IIle**

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as a clear oil (186 mg, 59%). <sup>1</sup>H NMR (400 MHz, CHLOROFORM-*d*) ppm 1.57 (s, 3 H) 1.70 - 1.90 (m, 1 H) 2.10 - 2.26 (m, 1 H) 2.80 - 2.95 (m, 1 H) 2.98 - 3.09 (m, 1 H) 3.25 - 3.32 (m, 1 H) 3.37 - 3.41 (m, 1 H) 3.41 - 3.54 (m, 1 H) 3.64 - 3.69 (m, 2 H) 4.10 - 4.17 (m, 1 H) 4.20 - 4.35 (m, 1 H) 5.13 (d, 2 H) 7.29 - 7.44 (m, 5 H). LCMS *m/z* 308 (M+1).

5 **Preparation of compound III<sub>f</sub>: (3R,5R)-5-Methoxy-piperidine-1,3-dicarboxylic acid 1-benzyl ester**

In a flask was added III<sub>e</sub> (182 mg, 0.592 mmol), LiOH (28 mg, 1.18 mmol), and 3:1 MeOH:water (6 mL). The mixture was stirred at room temperature for 16 h. The mixture was concentrated and neutralized to pH 5 with 1 N HCl. The compound was  
10 purified by prep HPLC which gave the title compound III<sub>f</sub> as a clear oil (140 mg, 80% yield). LCMS *m/z* 294 (M+1)

**Preparation of compound III<sub>g</sub>: (3R,5R)-3-tert-Butoxycarbonylamino-5-methoxy-piperidine-1-carboxylic acid benzyl ester**

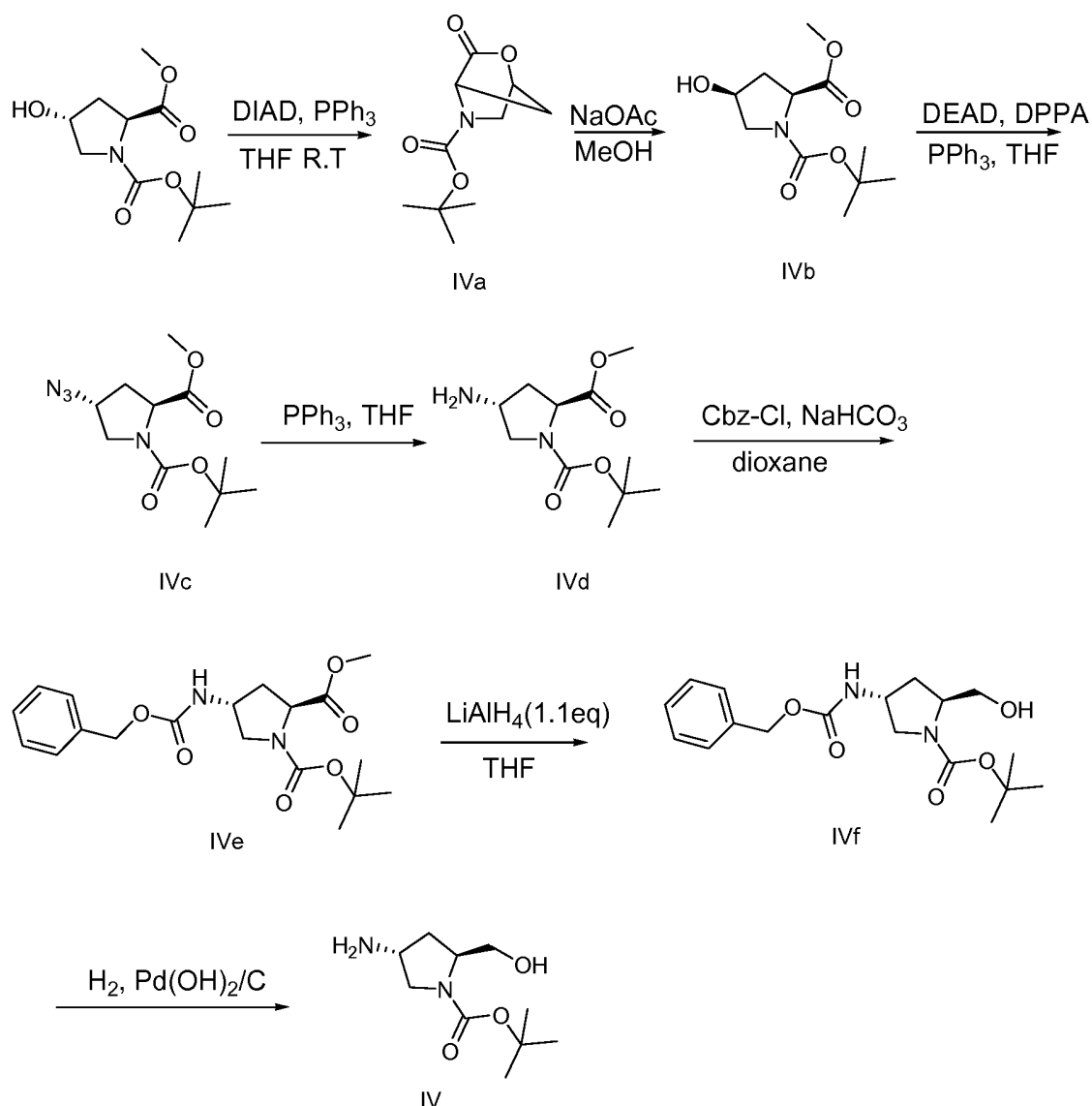
III<sub>f</sub> (140 mg) was dissolved in tBuOH (2.5 mL, 0.2M) and treated with TEA (93  $\mu$ L, 0.67  
15 mmol). The mixture was then treated with DPPA (0.124 mL, 0.572 mmol) and heated at 90 °C for 16 h. Dilute with water and EtOAc. Extract aqueous with EtOAc 5 x 20 mL. Dry over Na<sub>2</sub>SO<sub>4</sub>, filter and concentrate. Purify by biotage 0-100% EtOAc/Heptanes which gave the title compound III<sub>g</sub> as a clear oil (100 mg, 58%). <sup>1</sup>H NMR (400 MHz, CHLOROFORM-*d*) ppm 1.21 - 1.33 (m, 1 H) 1.35 - 1.53 (m, 9 H) 1.84 - 1.92 (m, 1 H)  
20 2.90 - 3.16 (m, 1 H) 3.28 - 3.50 (m, 5 H) 3.50 - 3.71 (m, 1 H) 3.74 - 4.27 (m, 2 H) 5.08 - 5.27 (m, 2 H) 7.28 - 7.40 (m, 5 H). LCMS *m/z* 365 (M+1).

A solution of the III<sub>g</sub> (100 mg, 0.274 mmol) in dichloromethane (5 mL) was added 4M HCl in dioxane (0.137 mL, 0.548 mol) and stirred at room temperature for 16 hours. The reaction was concentrated in vacuo which gave the title compound III as a tan gum (44  
25 mg, 61 %). LCMS *m/z* 265 (M+1)

**Example IV: tert-Butyl (2S,4R)-4-amino-2-(hydroxymethyl)pyrrolidine-1-carboxylate**



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#### Preparation of compound **IVa**: *tert*-Butyl 3-oxo-2-oxa-5-azabicyclo[2.2.1]heptane-5-carboxylate

To a solution of 1-*tert*-butyl 2-methyl (2*S*,4*R*)-4-hydroxypyrrolidine-1,2-dicarboxylate (170.0 g, 0.736 mol) and PPh<sub>3</sub> (237.0 g, 0.88 mol) in dry THF (1.5 L) was added dropwise DIAD (178.35 g, 0.88 mol) at 0 °C under N<sub>2</sub> gas. After addition, the resulting reaction mixture was stirred at room temperature overnight. TLC (petroleum ether/EtOAc 3:1) indicated the complete consumption of compound 1A. The solvent was removed in vacuo. The residue was purified by column chromatography (silica gel, petroleum ether/EtOAc 6:1) which gave the title compound **IVa** as a white solid (110.0 g, yield: 72.0%).

#### Preparation of compound **IVb**: 1-*tert*-Butyl 2-methyl (2*S*,4*S*)-4-hydroxypyrrolidine-1,2-dicarboxylate

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A solution of **IVa** (47.0 g, 0.22mol) and NaOAc (36.0 g, 0.44 mol) in dry MeOH (1.0 L) was stirred at 40 °C under N<sub>2</sub> gas overnight. The solvent was removed in vacuo. The residue was partitioned between water (1.0 L) and EtOAc (1.0 L). The organic layer was separated. The aqueous layer was extracted with EtOAc (500 mL×2). The combined  
5 EtOAc layers were washed with brine (600 mL), dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated in vacuo which gave the title compound **IVb** as a white solid (53.0 g, yield: 98.0%).

**Preparation of compound IVc: 1-tert-Butyl 2-methyl (2S,4R)-4-azidopyrrolidine-1,2-dicarboxylate**

To a solution of **IVb** (70.0 g, 0.286 mol) in dry THF (700 mL) were added PPh<sub>3</sub> (75.0 g, 0.286 mol) and DEAD (59.5 g, 0.342 mol) at 0 °C. After stirring at this temperature for  
10 0.5 hour, to the reaction mixture was added dropwise DPPA (93.89 g, 0.342 mol) at 0 °C. The resulting mixture was stirred at room temperature for 5 days. The solution of **IVc** was used for next step without any purification.

**Preparation of compound IVd: 1-tert-Butyl 2-methyl (2S,4R)-4-aminopyrrolidine-1,2-dicarboxylate**

To a stirred solution of **IVc** (77.3 g, 0.286 mol) in THF (0.7 L) was added PPh<sub>3</sub> (80.0 g, 0.684 mol) in portions, followed by addition of water (12.87 mL, 0.75 mol). The reaction  
mixture was stirred at 65 °C overnight. The reaction mixture was concentrated in vacuo. The residue was diluted with dichloromethane (1.0 L). The dichloromethane layer was  
20 acidified with 10% aqueous citric acid to pH 4~5, and then extracted with dichloromethane (500 mL×2) to removed impurity. The aqueous layer was basified with saturated aqueous Na<sub>2</sub>CO<sub>3</sub> to pH 8~9 and then extracted with CH<sub>2</sub>Cl<sub>2</sub> (500 mL×3). The combined organic layers were washed with brine, dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated in vacuo which gave the title compound as yellow oil (37.0 g, yield: 53%).

**Preparation of compound IVe: 1-tert-Butyl 2-methyl (2S,4R)-4-[[[(benzyloxy)carbonyl]amino}pyrrolidine-1,2-dicarboxylate**

To a solution of **IVd** (37.0 g, 0.15 mol) and Cbz-Cl (30.7g, 0.18 mol) in dioxane (370 mL) was added aqueous NaOH (10%, 370 mL). The mixture was stirred at room  
temperature overnight. The reaction mixture was concentrated in vacuo. The residue  
30 was partitioned between water (1.0 L) and EtOAc (1.0 L). The aqueous layer was extracted with EtOAc (1.0 L×3). The combined organic layers were washed with brine (500 mL), dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated in vacuo to give crude product, which was purified by column chromatography (silica gel, petroleum ether/EtOAc from 3:1)

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which gave the title compound **IVe** as a colorless syrup (45.0 g, yield: 79.2%). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) 7.38-7.32 (m, 5H), 5.10 (s, 2H), 4.95-4.86 (m, 1H), 4.37-4.26 (m, 2H), 3.79-3.73 (m, 4H), 3.39-3.28 (m, 1H), 2.31-2.19 (m, 2H), 1.45-1.40 (d, 9H).

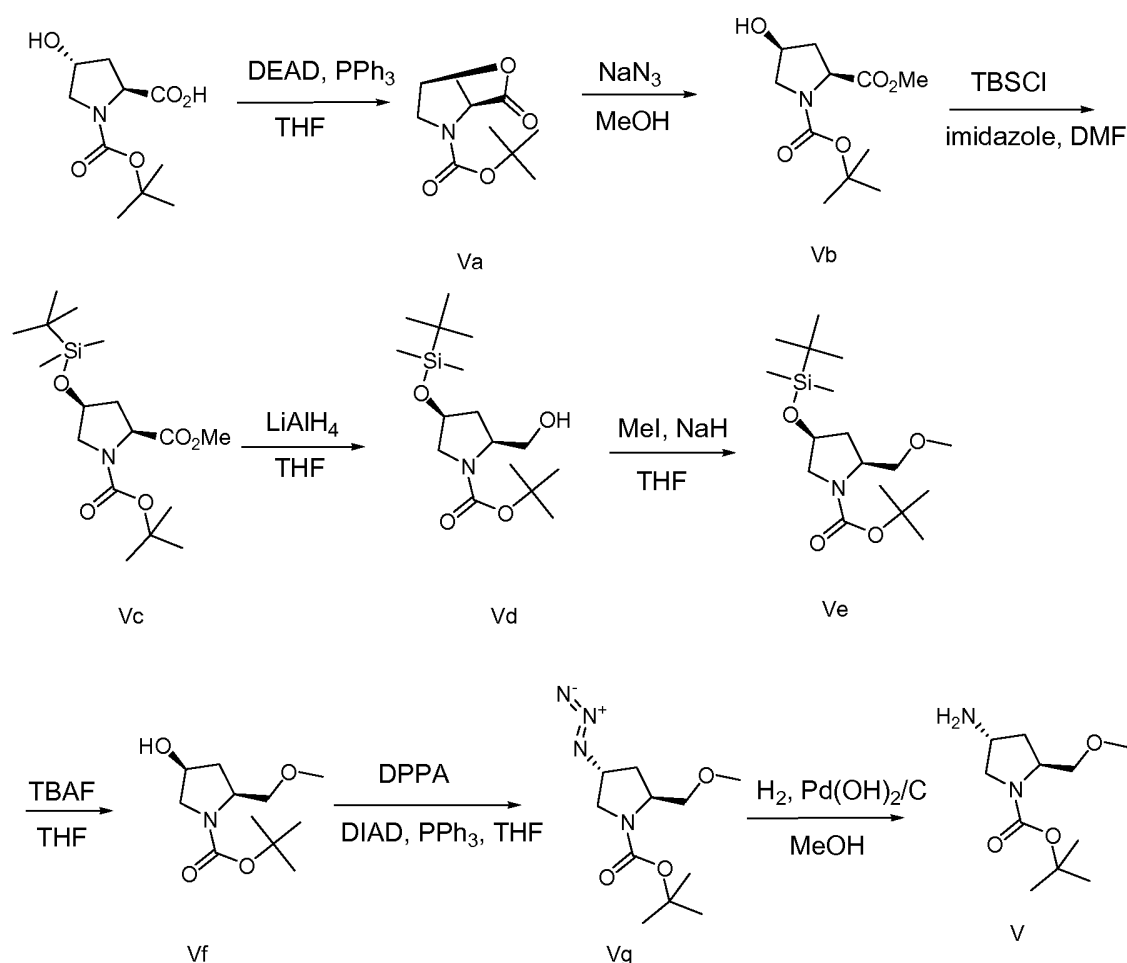
**Preparation of compound IVf: *tert*-Butyl (2*S*,4*R*)-4-[[*(benzyloxy)*carbonyl]amino}-2-(hydroxymethyl)pyrrolidine-1-carboxylate**

To a stirred suspension of LiAlH<sub>4</sub> (1.2 g, 31.73 mmol) in dry THF (100 mL) was added dropwise a solution of **IVe** (8.0 g, 21.15 mmol) in dry THF (20 mL) at 0 °C. The resulting mixture was stirred at room temperature for three hours. The reaction mixture was quenched with 10% aqueous NaOH (10 mL) at 0 °C and then diluted with EtOAc (500 mL). The resulting mixture was filtered and washed with EtOAc (300 mL). The organic layer was washed with brine (200 mL), dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated in vacuo to yield crude product, which was purified by column chromatography (silica gel, petroleum ether/EtOAc from 4:1 to 2:1) which gave the title compound **IVf** as a colorless syrup (3.0 g, 41%). <sup>1</sup>H NMR (400 MHz, DMSO): 7.51-7.47 (m, 1H), 7.36-7.33 (m, 5H), 5.05 (s, 2H), 4.79-4.71 (m, 1H), 4.15-4.08 (m, 1H), 3.76-3.56 (m, 1H), 3.42-3.33 (m, 3H), 3.11-3.06 (m, 1H), 2.12-1.99 (m, 1H), 1.83-1.70 (m, 1H), 1.37 (s, 9H).

**IVf** (800 mg, 2.3 mmol) was dissolved in EtOAc (30 mL) and MeOH (10 mL) and the resultant clear solution was treated w/ 20% Pd(OH)<sub>2</sub> on carbon (80 mg) and hydrogen (1 atm). After 18 hours, the reaction mixture was filtered and the filtrate was concentrated under reduced pressure which gave the title compound **IV** as a white solid (490 mg, 99% yield) <sup>1</sup>H NMR (400 MHz, DMSO-d<sub>6</sub>) 4.66 (br. s., 1 H), 3.63 - 3.77 (m, 1 H), 3.40 - 3.51 (m, 2 H), 3.15 - 3.36 (m, 3 H), 2.82 - 2.96 (m, 1 H), 1.89 - 2.04 (m, 1 H), 1.78 (br. s., 1 H), 1.51 - 1.64 (m, 1 H), 1.39 (s, 9 H). LCMS m/z 117 (M-BOC+1).

**Example V: *tert*-Butyl (2*S*,4*R*)-4-amino-2-(methoxymethyl)pyrrolidine-1-carboxylate**

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**Preparation of compound Va: *tert*-Butyl (1*S*,4*S*)-3-oxo-2-oxa-5-azabicyclo[2.2.1]heptane-5-carboxylate**

To a solution of (4*R*)-1-(*tert*-butoxycarbonyl)-4-hydroxy-L-proline (100 g, 0.443 mol) and PPh<sub>3</sub> (227 g, 0.866 mol) in dry THF (1 L) was added dropwise DEAD (151 g, 0.866 mol) at 0 °C under nitrogen. After the addition, the reaction was allowed to warm up to room temperature and stirred overnight. The reaction was concentrated in vacuo and the residue was purified by column chromatography (petroleum ether: ethyl acetate = 20:1~5:1) which gave the title compound **Va** as a yellow solid (106.5 g).

**Preparation of compound Vb: 1-*tert*-Butyl 2-methyl (2*S*,4*S*)-4-hydroxypyrrolidine-1,2-dicarboxylate**

To a solution of **Va** (135 g, 0.634 mol) in dry MeOH (1000 mL) was added NaN<sub>3</sub> (41.5 g, 0.634 mol) at room temperature. The reaction mixture was heated to 40 °C and stirred for 18 h. The reaction was concentrated in vacuo to remove most of the solvent below 30 °C. The residue was poured into 500 mL of water and extracted with CH<sub>2</sub>Cl<sub>2</sub> (200 mL x 4). The combined organics were washed with brine (100 mL), dried over sodium

sulfate, filtered and concentrated in vacuo which gave the title compound **Vb** as a white solid (140.5 g, 90.5%).

**Preparation of compound Vc: 1-tert-Butyl 2-methyl (2S,4S)-4-[[tert-butyl(dimethyl)silyl]oxy]pyrrolidine-1,2-dicarboxylate:**

- 5 To a solution of **Vb** (90 g, 0.36 mol) and imidazole (50 g, 0.734 mol) in dry DMF (1 L) was added TBSCl (82.7 g, 0.551 mol) in portions at 0 °C. After the addition, the reaction was allowed to warm up to room temperature and stirred overnight. The reaction was poured into 1 L of water and extracted with ethyl acetate (300 mL x 5). The combined organics was washed with brine (200 mL), dried over sodium sulfate, filtered and  
10 concentrated in vacuo which gave the title compound **Vc** as colorless oil which was used in next step without further purification (125.5 g).

**Preparation of compound Vd: tert-Butyl (2S,4S)-4-[[tert-butyl(dimethyl)silyl]oxy]-2-(hydroxymethyl)pyrrolidine-1-carboxylate**

- To a suspension of LiAlH<sub>4</sub> (38 g, 1.0 mol) in dry THF (1 L) was added dropwise a  
15 solution of **Vc** (180 g, 0.5 mol) in dry THF (1 L) at -20 °C under nitrogen. After the addition, the reaction was kept at -20 °C and stirred for 3 h. The reaction was quenched by added dropwise 10 % of NaOH aqueous. The precipitate solid was filtered off and the filtrate was concentrated in vacuo which gave the title compound **Vd** as light yellow oil (86.5 g, 52.2%).

- 20 **Preparation of compound Ve: tert-Butyl (2S,4S)-4-[[tert-butyl(dimethyl)silyl]oxy]-2-(methoxymethyl)pyrrolidine-1-carboxylate**

- To a solution of **Vd** (35 g, 0.106 mol) in dry THF (500 mL) was added NaH (6.4 g, 0.159 mol) in portions at 0 °C under nitrogen. The mixture was stirred at this temperature for 1 h. MeI was added dropwise to this mixture at 0 °C. The reaction mixture was allowed to  
25 warm up to room temperature and stirred overnight. The reaction was poured into ice/water with stirring and extracted with ethyl acetate (200 mL x 4). The combined organics was washed with brine (150 mL), dried over sodium sulfate, filtered and concentrated in vacuo. The residue was purified by column chromatography (petroleum ether: ethyl acetate = 50:1~10:1) which gave the title compound **Ve** as light yellow oil  
30 (20 g, 54.8%).

**Preparation of compound Vf: tert-Butyl (2S,4S)-4-hydroxy-2-(methoxymethyl)pyrrolidine-1-carboxylate**

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A solution of **Ve** (31 g, 89.72 mmol) and TBAF (47 g, 0.179 mol) in THF (400 mL) was heated to reflux for 24 h. The reaction was concentrated in vacuo and the residue was purified by flash column chromatography (petroleum ether: ethyl acetate = 30:1~10:1) which gave the title compound **Vf** (20.2 g, 97.35%) as light yellow oil.

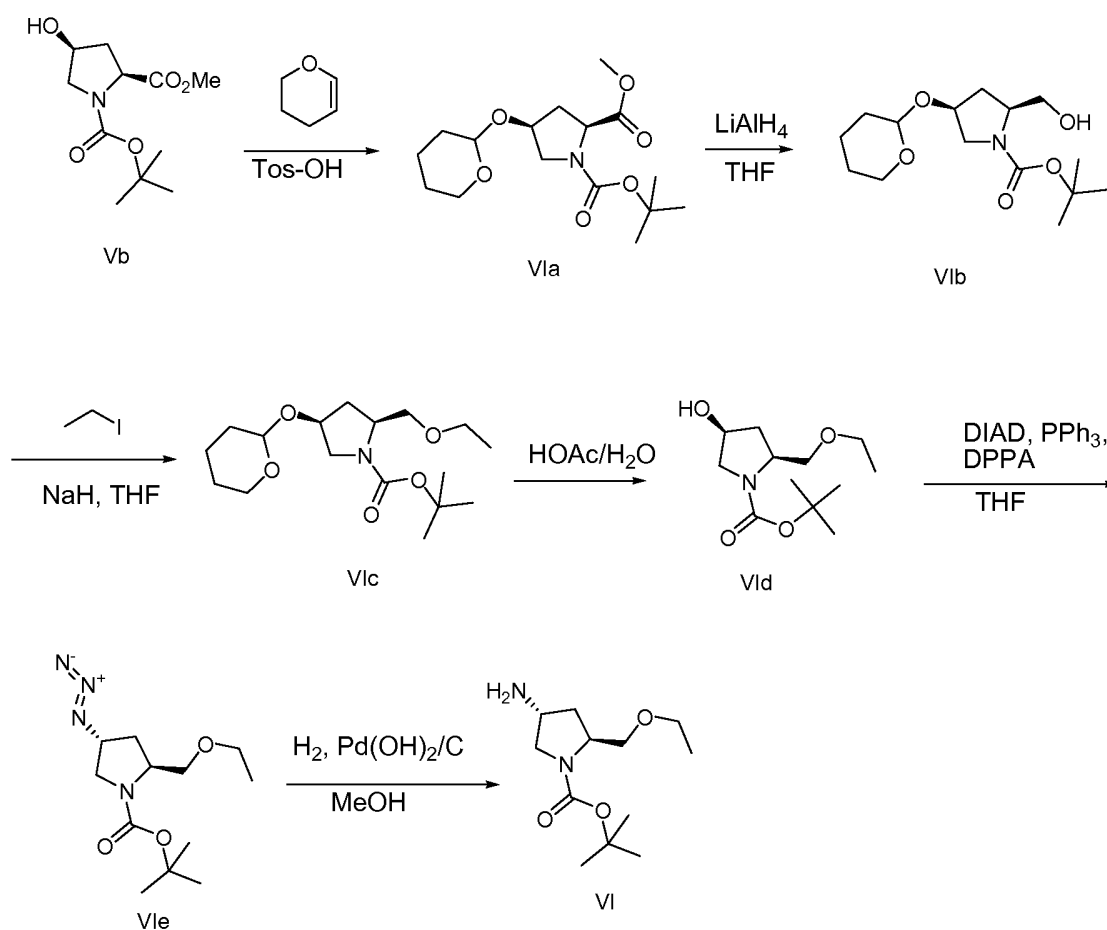
5 **Preparation of compound Vg: *tert*-Butyl (2*S*,4*R*)-4-azido-2-(methoxymethyl)pyrrolidine-1-carboxylate**

To a solution of **Vf** (20 g, 86.47 mmol) and PPh<sub>3</sub> (27.2 g, 0.104 mol) in dry THF (200 mL) was added dropwise DIAD (21 g, 0.104 mol) at 0 °C under nitrogen. Then DPPA (28.6 g, 0.104 mol) was added dropwise. After the addition, the reaction was allowed to  
10 warm up to room temperature and stirred overnight. TLC (petroleum ether: ethyl acetate = 4:1) showed the reaction was complete. The reaction was concentrated in vacuo below 30 °C. The residue was purified by column chromatography (petroleum ether: ethyl acetate = 100:1~20:1) which gave the title compound **Vg** (15.1 g, 67.7%) as light yellow oil.

15 A mixture of **Vg** (15 g, 58.6 mmol) and Pd(OH)<sub>2</sub>/C (2.0 g) in MeOH (200 mL) was hydrogenated under H<sub>2</sub> (25 psi, room temperature) for 48 h. The mixture was filtered through a Celite pad. The filtrate was concentrated in vacuo and the residue was purified by column chromatography (CH<sub>2</sub>Cl<sub>2</sub>: MeOH = 100:1~15:1) which gave the title compound **V** (9.8 g, 72.8%) as brown oil.

20 **Example VI: *tert*-Butyl (2*S*,4*R*)-4-amino-2-(ethoxymethyl)pyrrolidine-1-carboxylate**

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**Preparation of compound VIa: 1-*tert*-Butyl 2-methyl (2*S*,4*S*)-4-(tetrahydro-2*H*-pyran-2-yloxy)pyrrolidine-1,2-dicarboxylate**

A solution of **Vb** (170 g, 0.694 mol), 3,4-dihydro-2*H*-pyran (174.9 g, 2.082 mol) and Tos-OH (4.0 g) in dry ether (2 L) was stirred at room temperature for 3 h. The reaction was concentrated in vacuo which gave the title compound **VIa** (239.5 g) as yellow oil which was used in next step without further purification.

**Preparation of compound VIb: *tert*-Butyl (2*S*,4*S*)-2-(hydroxymethyl)-4-(tetrahydro-2*H*-pyran-2-yloxy)pyrrolidine-1-carboxylate**

To a suspension of LiAlH<sub>4</sub> (34.9 g, 0.917 mol) in dry THF (1000 mL) was added dropwise a solution of **VIa** (150 g, 0.459 mol) in dry THF (1000 mL) at -20 °C under nitrogen. After the addition, the reaction was kept at -20 °C and stirred for 3 h. The reaction was quenched by added dropwise 10 % of NaOH aqueous. The precipitate solid was filtered off and the filtrate was concentrated in vacuo. The residue was purified by flash column chromatography (petroleum ether: ethyl acetate = 50:1~5:1) which gave the title compound **VIb** (105 g, 76.5%) as light yellow oil.

**Preparation of compound Vlc: *tert*-Butyl (2*S*,4*S*)-2-(ethoxymethyl)-4-(tetrahydro-2*H*-pyran-2-yloxy)pyrrolidine-1-carboxylate:**

To a solution of **Vlb** (50 g, 0.166 mol) in dry THF (600 mL) was added NaH (13.3 g, 0.332 mol) in portions at 0 °C under nitrogen. The mixture was stirred at this  
5 temperature for 1 h. Iodo-ethane (77.2 g, 0.498 mol) was added dropwise to this mixture at 0 °C. The reaction mixture was allowed to warm up to room temperature and stirred overnight. The reaction was poured into ice/water with stirring and extracted with ethyl acetate (200 mL x 5). The combined organics was washed with brine (100 mL), dried over sodium sulfate, filtered and concentrated in vacuo which gave the title  
10 compound **Vlc** (51.5 g) as brown oil, which was used in next step without further purification.

**Preparation of compound Vld: *tert*-Butyl (2*S*,4*S*)-2-(ethoxymethyl)-4-hydroxypyrrolidine-1-carboxylate**

A solution of **Vld** (51.0 g, 0.155 mol) in HOAc/H<sub>2</sub>O (1:1, 500 mL) was heated to 40 °C  
15 and stirred overnight. The reaction was basified with solid NaHCO<sub>3</sub> to pH~8 and extracted with ethyl acetate (200 mL x 5). The combined organics was washed with brine (100 mL) and dried over sodium sulfate, filtered and concentrated in vacuo. The residue was purified by column chromatography (petroleum ether: ethyl acetate = 30:1~10:1) which gave the title compound **Vld** (20.6 g, 54.2%) as brown oil.

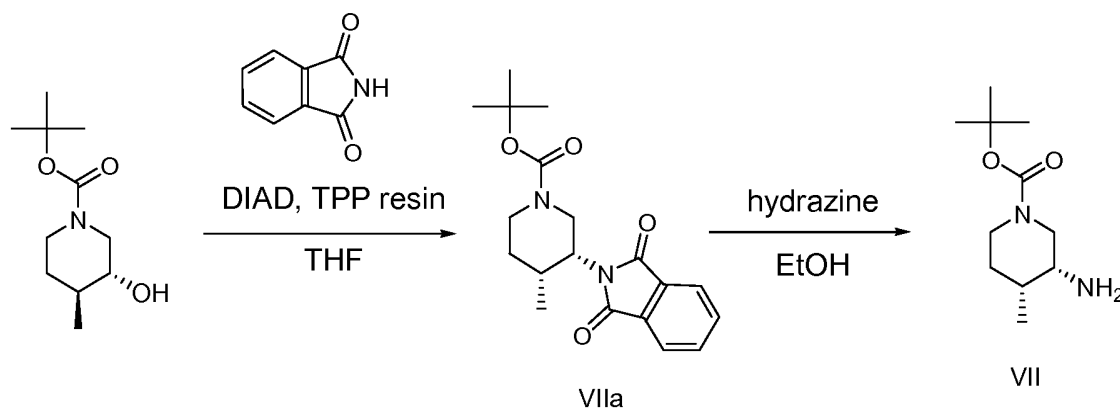
**20 Preparation of compound Vle: *tert*-Butyl (2*S*,4*R*)-4-azido-2-(ethoxymethyl)pyrrolidine-1-carboxylate**

To a solution of **Vld** (22 g, 89.8 mmol) and PPh<sub>3</sub> (28.2 g, 108 mmol) in dry THF (400 mL) was added dropwise DIAD (21.8 g, 108 mmol) at 0 °C under nitrogen. Then DPPA (29.6 g, 108 mmol) was added dropwise. After the addition, the reaction was allowed to  
25 warm up to room temperature and stirred overnight. The reaction was concentrated in vacuo below 30 °C. The residue was purified by column chromatography (petroleum ether: ethyl acetate = 100:1~10:1) which gave the title compound **Vle** (15.4 g, 63.6%) as colorless oil.

A mixture of **Vle** (15 g, 55.6 mmol) and Pd(OH)<sub>2</sub>/C (2.0 g) in MeOH (200 mL) was  
30 hydrogenated under H<sub>2</sub> (25 psi, room temperature) for 5 h. The mixture was filtered through a celite pad. The filtrate was concentrated in vacuo and the residue was purified by column chromatography (CH<sub>2</sub>Cl<sub>2</sub>: MeOH = 100:1~20:1) which gave the title compound **VI** (11.05 g, 81.5%) as brown oil.



**Example VII: (3R,4R)-3-Amino-4-methyl-piperidine-1-carboxylic acid tert-butyl ester**



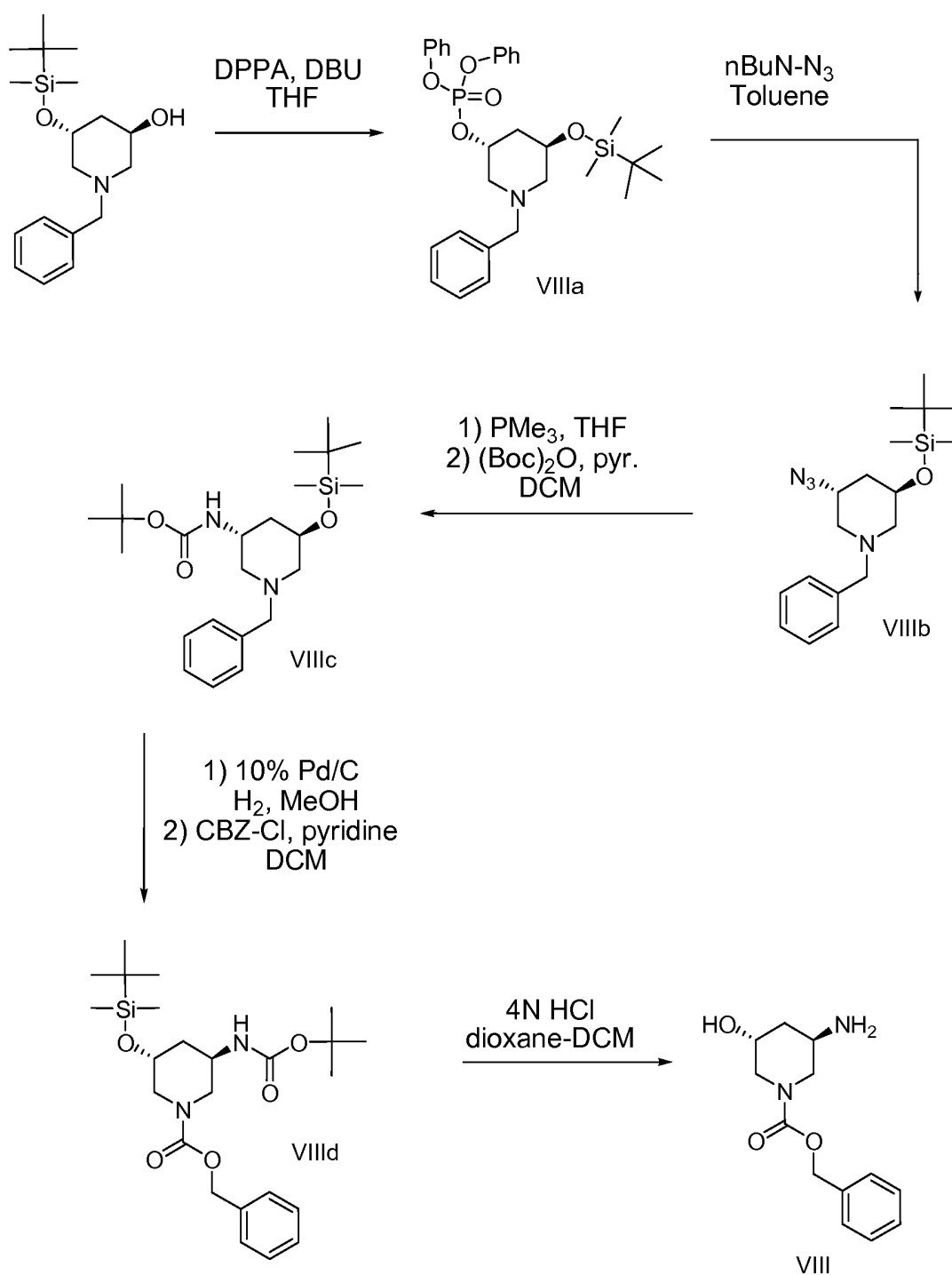
**Preparation of compound VIIa: (3R,4R)-3-(1,3-Dioxo-1,3-dihydro-isoindol-2-yl)-4-methyl-piperidine-1-carboxylic acid tert-butyl ester**

To a solution of trans-3-Hydroxy-4-methyl-piperidine-1-carboxylic acid tert-butyl ester (1.78 g, 8.28 mmol) (WO 01/87838), phthalimide (1.46 g, 9.94 mmol) and TPP-resin (4.14 g) in anhydrous THF (30 ml) at 23 °C was added DIAD (2.4 ml, 12.4 mmol). The reaction mixture was stirred at 23 °C for 48 h. then the resin was filtered off and the filtrate was concentrated under reduced pressure to give an oil. The crude oil was purified by flash chromatography using silica gel (0-50% EtOAc-Heptane) which gave the title compound **VIIa** (1.6 g, 47% yield).

A solution of the **VIIa** (1.6 g) in EtOH (15 ml) was treated with hydrazine hydrate (2.3 ml, 46 mmol) and the resulting mixture was heated to 80 °C for 12 h. The reaction mixture was then concentrated under reduced pressure to an oil and purified by flash chromatography using silica gel, eluting with 30-100% EtOAc in heptane which gave the title compound **VII** as a colorless oil. <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) 0.95 (d, J=6.82 Hz, 3 H) 1.16 - 1.34 (m, 2 H) 1.45 (s, 9 H) 1.71 (d, J=3.54 Hz, 1 H) 2.84 (br. s., 2 H) 2.99 (d, J=12.88 Hz, 1 H) 3.76 - 3.86 (m, 1 H) 3.85 - 4.01 (m, 1 H). LCMS: M+1=215.

**Example VIII: (3R,5R)-3-Amino-5-hydroxy-piperidine-1-carboxylic acid benzyl ester**

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**Preparation of compound VIIIa: Phosphoric acid (3R,5R)-1-benzyl-5-(tert-butyl-dimethyl-silanyloxy)-piperidin-3-yl ester diphenyl ester**

To a solution of (3R,5R)-1-Benzyl-5-(tert-butyl-dimethyl-silanyloxy)-piperidin-3-ol (322 mg, 1 mmol) in THF (3.3 ml) cooled to 0 C was added DBU (164  $\mu\text{l}$ , 1.1 mmol) followed by diphenyl phosphoryl azide (237  $\mu\text{l}$ , 1.1 mmol). The reaction was allowed to stir at 23 C for 18 hours. The reaction mixture was quenched with saturated sodium bicarbonate (1 ml) then extracted with EtOAc (10 ml). The EtOAc phase was washed with brine then

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dried with Na<sub>2</sub>SO<sub>4</sub> and concentrated under reduced pressure. The crude product was purified by flash chromatography on silica gel (0-60% EtOAc-heptane) which gave the title compound **VIIIa** as a clear oil (2.8g, 81%). <sup>1</sup>H NMR (400 MHz, CHLOROFORM-d) - 0.01 (d, J=4.29 Hz, 6 H) 0.85 (s, 9 H) 1.54 - 1.74 (m, 1 H) 1.96 - 2.18 (m, 2 H) 2.41 (d, J=12.13 Hz, 1 H) 2.64 - 2.91 (m, 2 H) 3.40 - 3.74 (m, 2 H) 4.07 (ddd, J=8.21, 4.29, 4.17 Hz, 1 H) 4.95 (d, J=2.78 Hz, 1 H) 7.12 - 7.46 (m, 15 H). LCMS: M+1=554

**Preparation of compound VIIIb: (3R,5R)-3-Azido-1-benzyl-5-(tert-butyl-dimethyl-silanyloxy)-piperidine**

A solution of **VIIIa** (1.1 g, 2.0 mmol) in toluene (6.7 ml) was treated with tetrabutylammonium azide (1.14g, 4 mmol) at 100 C for 18 hours.. The crude reaction mixture was concentrated under reduced pressure to an oil and purified by flash chromatography on silica gel (0-40% EtOAc-heptane) which gave the title compound **VIIIb** as a clear oil (466 mg, 67% yield). <sup>1</sup>H NMR (400 MHz, CHLOROFORM-d) 0.05 (d, J=8.59 Hz, 6 H) 0.89 (s, 9 H) 1.53 - 1.71 (m, 1 H) 1.88 (d, J=11.12 Hz, 1 H) 2.11 - 2.25 (m, 1 H) 2.43 (d, J=11.12 Hz, 1 H) 2.54 - 2.77 (m, 2 H) 3.46 - 3.71 (m, 2H) 3.82 (br. s., 1 H) 4.05 (dt, J=7.77, 3.82 Hz, 1 H) 7.33 (d, J=4.04 Hz, 5 H). LCMS: M+H=347.

**Preparation of compound VIIIc: [(3R,5R)-1-Benzyl-5-(tert-butyl-dimethyl-silanyloxy)-piperidin-3-yl]-carbamic acid tert-butyl ester**

A solution of **VIIIb** (430 mg, 1.24 mmol) in THF (6.2 ml) was treated with H<sub>2</sub>O (3 drops) and a 1M solution of trimethyl phosphine in toluene (3.72 ml, 3.72 mmol). The reaction mixture was stirred at 23 C for 18 hours then concentrated to an oil under reduced pressure. The crude oil was dissolved in DCM (5 ml), cooled to 0 C, then treated with pyridine (125 ul) and Boc<sub>2</sub>O (297 mg) for 5 hours. The reaction mixture was diluted with water (5 ml) and DCM (5 ml). The DCM layer was washed with brine then dried with Na<sub>2</sub>SO<sub>4</sub> and concentrated under reduced pressure to an oil. The crude oil was purified by flash chromatography on silica gel (0-60% EtOAc-heptane) to give the title compound **VIIIc** as a clear oil (394 mg, 75% yield). LCMS: M+H= 421.

**Preparation of compound VIId: (3R,5R)-3-tert-Butoxycarbonylamino-5-(tert-butyl-dimethyl-silanyloxy)-piperidine-1-carboxylic acid benzyl ester**

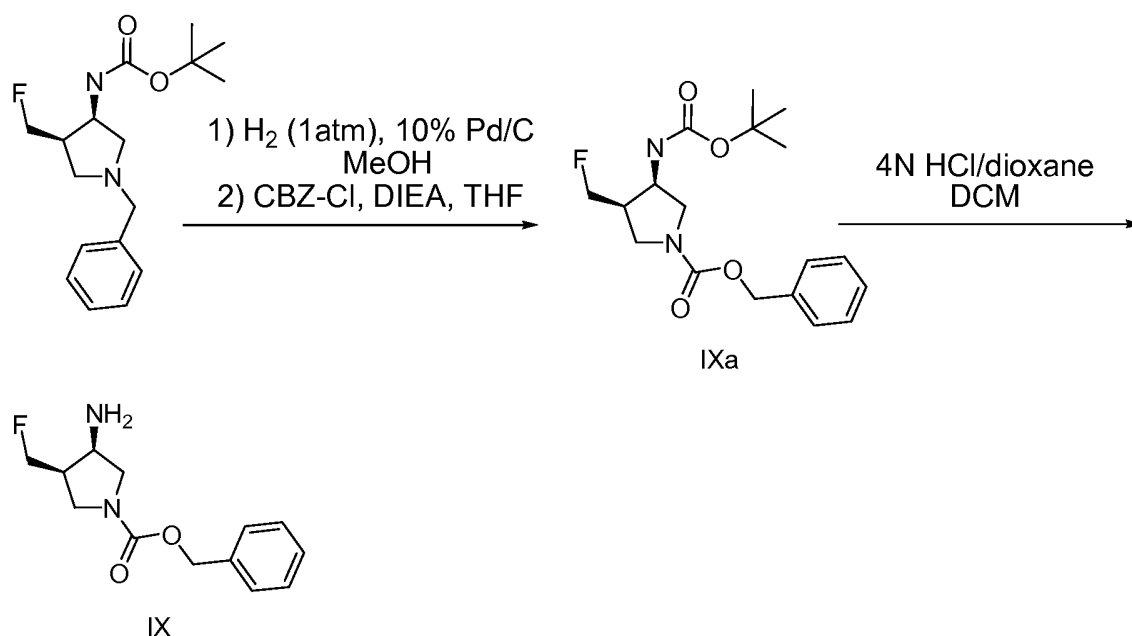
A mixture of **VIIIc** (394 mg, 0.937 mol) and 10% Pd/C (40 mg) in EtOH (10 ml) was hydrogenated at 1 atm. and 23 C using a balloon. After 18 hours the reaction mixture was filtered through celite then concentrated under reduced pressure to an oil. The

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crude oil was dissolved in DCM (5 ml), then cooled to 0 C. Pyridine (103 ul) was added, followed by CBZ-Cl (144 ul). After 5 hours the reaction mixture was quenched with saturated NaHCO<sub>3</sub> then partitioned between dichloromethane and water. The organic phase was washed with brine, dried with Na<sub>2</sub>SO<sub>4</sub> then concentrated under reduced pressure to an oil. The crude oil was purified by flash chromatography using silica gel (0-50% EtOAc-Heptane) to give the title compound **VIIId** as a colorless oil. (304 mg, 70 % yield). LCMS: M+1-Boc=365.

A solution of **VIIId** (101 mg, 0.217 mmol) in DCM (1 ml) was treated with 4N HCl in dioxane (0.5 ml, 2 mmol). The resulting mixture was stirred at 23 C for 6 hours then concentrated under reduced pressure to an oil. The crude oil was partitioned between ethyl acetate (10 ml) and water (3 ml). The aqueous phase was neutralized with saturated sodium bicarbonate (1 ml). The phases were separated and the organic was washed with brine (3 ml) then dried with Na<sub>2</sub>SO<sub>4</sub> and concentrated under reduced pressure to give the title compound **VIII** as a colorless oil. (56 mg, 92% yield). LCMS: M+H=251

**Example IX: (3R,4R)-3-Amino-4-fluoromethyl-pyrrolidine-1-carboxylic acid benzyl ester**



**Preparation of compound IXa: (3R,4R)-3-tert-Butoxycarbonylamino-4-fluoromethyl-pyrrolidine-1-carboxylic acid benzyl ester**

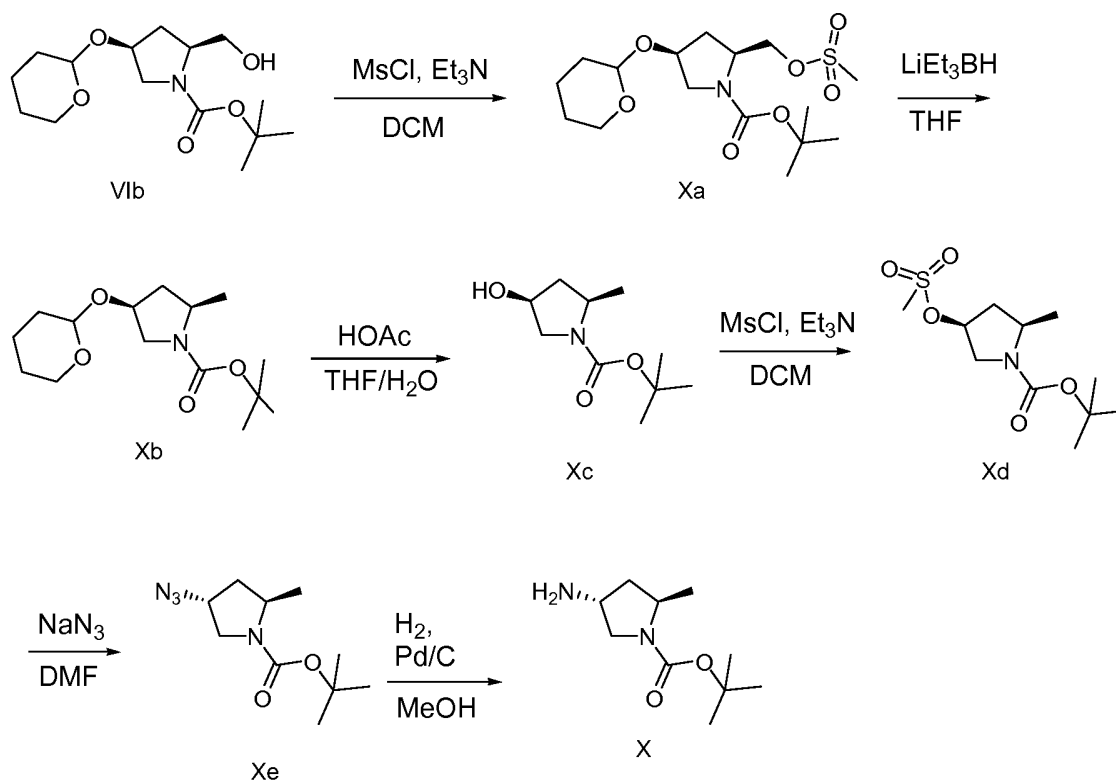
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A solution of ((3R,4R)-1-Benzyl-4-fluoromethyl-pyrrolidin-3-yl)-carbamic acid tert-butyl ester (1g, 3.24 mmol) in methanol (20 mL) was hydrogenated at 1 atm with 10% palladium on carbon (100 mg) for 24 hours. The crude reaction mixture was filtered through celite then concentrated to an oil. The crude amine was dissolved in dichloromethane (8 ml) then cooled to 0 °C and diisopropylethylamine (619 µl, 3.57 mmol) was added followed by benzyl chloroformate (507 µl, 3.57 mmol, 1.1 equiv.). The crude reaction was concentrated to an oil then purified by silica gel chromatography eluting with 0-20% EtOAc in Heptane which gave the title compound **IXa** as a colorless oil (811 mg). <sup>1</sup>H NMR (400 MHz, CHLOROFORM-d) 1.45 (s, 9 H) 2.67 (br. s., 1 H) 3.24 - 3.49 (m, 2 H) 3.63 - 3.80 (m, 2 H) 4.27 - 4.53 (m, 2 H) 4.53 - 4.66 (m, 1 H) 4.70 (dd, J=9.73, 4.93 Hz, 1 H) 5.14 (br. s., 2 H) 7.37 (br. s., 5 H); LCMS: M+1-Boc=253.

To a solution of **IXa** (811 mg, 2.30 mmol) in dichloromethane (7.6 ml) at 23 °C was added 4N HCl in dioxane (2.88 ml, 11.5 mmol). The resulting mixture was stirred for 3 hours. The crude reaction mixture was concentrated to an oil then partitioned between saturated sodium bicarbonate and ethyl acetate. The ethyl acetate layer was washed with brine, dried with sodium sulfate and concentrated to give the title compound **IX** as a clear oil (526 mg). <sup>1</sup>H NMR (400 MHz, CHLOROFORM-d) 2.46 - 2.65 (m, 1 H) 3.22 - 3.41 (m, 2 H) 3.55 - 3.66 (m, 2 H) 3.66 - 3.73 (m, 1 H) 4.45 - 4.76 (m, 2 H) 5.05 - 5.22 (m, 2 H) 7.37 (d, J=4.55 Hz, 5 H); LCMS: M+1=253.

**Example X: tert-butyl (2R,4R)-4-amino-2-methylpyrrolidine-1-carboxylate**

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**Preparation of compound Xa: *tert*-butyl (2*S*,4*S*)-2-[[[(methylsulfonyl)oxy]methyl]-4-(tetrahydro-2*H*-pyran-2-yloxy)pyrrolidine-1-carboxylate**

To a solution of **VIb** (70.0 g, 0.232 mol) and Et<sub>3</sub>N (47.0 g, 0.465 mol) in dry DCM (170 mL) was added dropwise MsCl (40.0 g, 0.349 mol) at 0 °C under N<sub>2</sub> gas. After the addition, the reaction mixture was stirred at room temperature for 1 hour. The reaction mixture was diluted with EtOAc (500 mL) and then washed with 5% aqueous citric acid (300 mL×3), 5% aqueous Na<sub>2</sub>CO<sub>3</sub> (300 mL×3) and brine (300 mL×3) in sequence. The organic layer was dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated in vacuum which gave the title compound **Xa** (90.0 g, 80 %) as a yellow oil.

**Preparation of compound Xb: *tert*-butyl (2*R*,4*S*)-2-methyl-4-(tetrahydro-2*H*-pyran-2-yloxy)pyrrolidine-1-carboxylate**

A solution of **Xa** (32.0 g, 0.084 mol) in THF (60 mL) was added dropwise LiEt<sub>3</sub>BH/THF (1.0 M, 370 mL) at 0 °C over 1 hours. After addition, the reaction was stirred at room temperature for 4 hours. The reaction mixture was quenched with ice-water, then extracted with EtOAc (300 mL×3). The combined organic layers were washed with 5% citric acid aqueous solution (500 mL×3), saturated aqueous Na<sub>2</sub>CO<sub>3</sub> (500 mL×3) and brine (500 mL×3) in sequences, dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated in vacuum to give a residue, which was purified by column chromatography (silica gel, petroleum ether/EtOAc 10:1) which gave the title compound **Xb** (15.0 g, 66%) as colorless oil.

**Preparation of compound Xc: *tert*-butyl (2*R*,4*S*)-4-hydroxy-2-methylpyrrolidine-1-carboxylate**

A solution of **Xb** (15.0 g, 0.053 mol) in HOAc/THF/H<sub>2</sub>O (1:1:1, 300 mL) was refluxed for 2 hours. The reaction mixture was neutralized with solid NaHCO<sub>3</sub> to pH ~7 and then  
5 extracted with EtOAc (100 mL×3). The combined organic layers were washed with brine (100 mL×3), dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated in vacuum to yield residue, which was purified by column chromatography (silica gel, petroleum ether/EtOAc 10:1) which gave the title compound **Xc** (8.2 g, 77%) as a white solid.

**Preparation of compound Xd: *tert*-butyl (2*R*,4*S*)-2-methyl-4-  
10 [(methylsulfonyl)oxy]pyrrolidine-1-carboxylate**

To a solution of **Xc** (9.5 g, 0.047 mol) and Et<sub>3</sub>N (9.5 g, 0.095 mol) in dry DCM (60 mL) was added dropwise MsCl (8.1 g, 0.071 mol) at 0 °C under N<sub>2</sub> gas. After the addition, the reaction mixture was stirred at room temperature overnight. The reaction mixture was diluted with EtOAc (500 mL) and then filtered. The filtrate was washed with 5% aqueous  
15 citric acid (200 mL×3), 5% aqueous Na<sub>2</sub>CO<sub>3</sub> (200 mL×3) and brine (200 mL×3) in sequence, then dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated in vacuum which gave the title compound **Xd** (12.6 g, 94 %) as an orange oil.

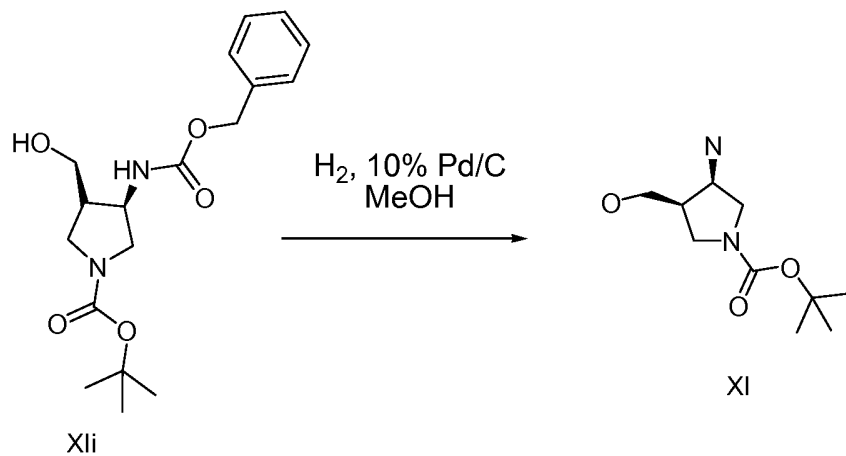
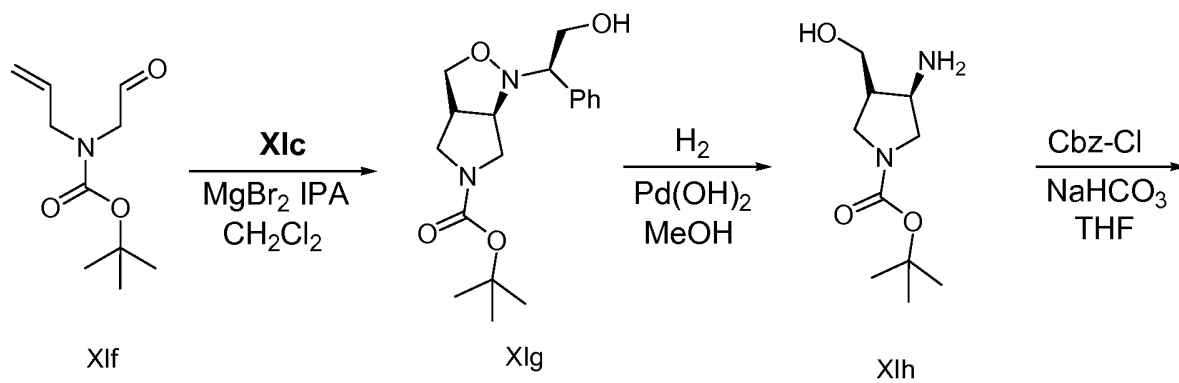
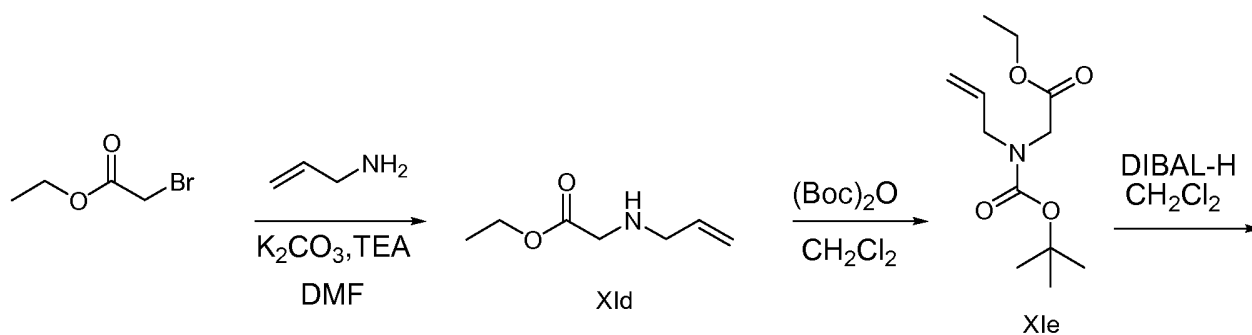
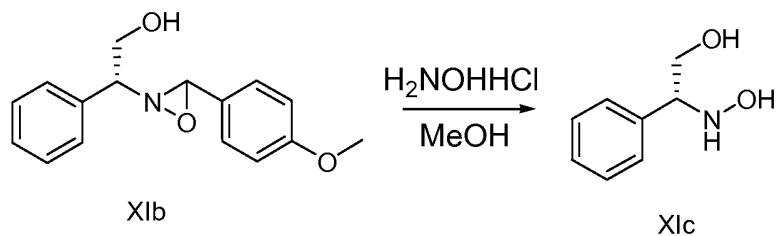
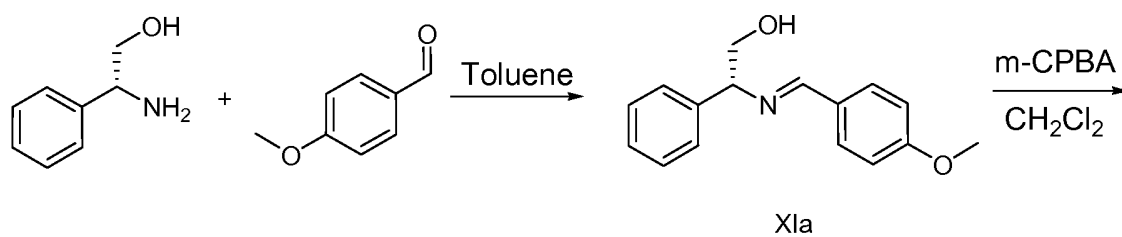
**Preparation of compound Xe: *tert*-butyl (2*R*,4*R*)-4-azido-2-methylpyrrolidine-1-carboxylate**

A solution of **Xd** (13.2 g, 0.047 mol) and NaN<sub>3</sub> (6.1 g, 0.095 mol) in DMF (200 mL) was stirred at 80 °C under N<sub>2</sub> gas for two hours. The reaction mixture was poured into 5% aqueous NaHCO<sub>3</sub> (400 mL). The mixture was extracted with ether (200 mL×3). The combined organic layers were washed with brine (150 mL×3), dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated in vacuum. Et<sub>2</sub>O was displaced with methanol (150 mL×3) which gave a  
25 solution of the title compound **Xe** in methanol (~100 mL), which was used for next step without further purification.

A mixture of **Xe** and 10% Pd/C (1.5 g) in methanol (100 mL) was hydrogenated under H<sub>2</sub> (50 psi) at room temperature for two hours. The reaction mixture was filtered and the filtrate was concentrated in vacuum which gave the title compound **X** (7.8 g, 90 %) as  
30 yellow oil. <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>): 3.99-3.81 (m, 1H), 3.53-3.47 (m, 2H), 3.09-2.90 (m, 1H), 1.79-1.68 (m, 2H), 1.39 (s, 9H), 1.18-1.09 (d, 2H); LCMS: M+H=201.

**Example XI: (3*R*,4*R*)-3-Amino-4-hydroxymethyl-pyrrolidine-1-carboxylic acid *tert*-butyl ester**

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**Preparation of compound XIa: (2R)-2-[(E)-(4-methoxyphenyl)methylidene]amino}-2-phenylethanol**

A solution of (2R)-2-amino-2-phenylethanol (148 g, 1.08 mol) and 4-methoxybenzaldehyde (147 g, 1.08 mol) in toluene (2 L) was heated at reflux to remove  
5 water by Dean-Stark trap for 3 hr. The mixture was concentrated and the residue was dried which gave the title compound **XIa** (265 g, 96%) as a white solid, which was used for next reaction without further purification.

**Preparation of compound XIb: (2R)-2-[3-(4-methoxyphenyl)oxaziridin-2-yl]-2-phenylethanol**

10 A solution of **XIa** (265 g, 1.03 mol) in CH<sub>2</sub>Cl<sub>2</sub> (2 L) was cooled to 0 °C and stirred using a machine stirrer. To the cold mixture was added m-CPBA (267 g, 1.55 mol) in portions over about 0.5 hr. After the addition, the resulting mixture was stirred at 0 °C for an additional 0.5 hr. The solids were then removed by vacuum filtration and the solids were rinsed with CH<sub>2</sub>Cl<sub>2</sub>. The filtrate was washed with 10% aq. K<sub>2</sub>CO<sub>3</sub>, dried over MgSO<sub>4</sub>,  
15 filtered and concentrated which gave the title compound **XIb** (279.4 g, 100%) as a yellow oil, which was used for next reaction without further purification.

**Preparation of compound XIc: (2R)-2-(hydroxyamino)-2-phenylethanol**

**XIb** (279.4 g, 1.03 mol) was dissolved in MeOH (2 L), and hydroxylamine hydrochloride (143.2 g, 2.06 mol) was added in one portion. After the addition, the mixture was stirred  
20 at room temperature overnight. Conc. HCl (175 mL) was added dropwise to the reaction mixture and concentrated. The residue was diluted with water (210 mL) and extracted with EtOAc (6 x 2 L) until no more organic material could be extracted. The aqueous layer was based to pH = 9 by careful addition of solid Na<sub>2</sub>CO<sub>3</sub>. The aqueous solution was extracted with CHCl<sub>3</sub> (3 x 1 L), the combined organic extracts were dried over  
25 MgSO<sub>4</sub>, filtered and concentrated. The residue was re-crystallized from EtOAc/Hexane (1:1, 200 mL) which gave the title compound **XIc** (37 g, 23.4%) as a pale white solid.

**Preparation of compound XId: ethyl N-prop-2-en-1-ylglycinate**

To an ice cold solution of K<sub>2</sub>CO<sub>3</sub> (331.7 g, 2.4 mol), NaI (360 g, 2.4 mol), DMF (1 L), triethylamine (484.8 g, 4.8 mol) and prop-2-en-1-amine (82 g, 1.44 mol) was slowly  
30 added a solution of ethyl bromoacetate (200 g, 1.2 mol) in DMF (100 mL) via addition funnel over 0.5 hr. The ice bath was removed upon completion of addition, and the mixture was stirred at room temperature overnight. The mixture was filtered and rinsed with Et<sub>2</sub>O. Cold saturated NaCl aq. (2 L) was added to filtrate and the mixture was

extracted with Et<sub>2</sub>O (1 L \* 3). The combined organic extracts were dried over Na<sub>2</sub>SO<sub>4</sub>, filtered and concentrated which gave the title compound **XId** (150 g, 87.3%) as a yellow oil, which was directly utilized for next reaction without further purification.

**Preparation of compound Xle: ethyl *N*-(*tert*-butoxycarbonyl)-*N*-prop-2-en-1-ylglycinate**

To a solution of **XId** (150 g, 1.05 mol) in MeOH (2 L) was added triethylamine (106 g, 1.05 mol), the solution was cooled to 0 °C and Boc<sub>2</sub>O (229 g, 1.05 mol) was added dropwise over about 0.5 h. After the addition, the mixture was stirred at room temperature overnight. The mixture was concentrated and the residue was diluted with EtOAc (1 L). The mixture was washed sequentially with water and sat. aq. NaCl, dried over Na<sub>2</sub>SO<sub>4</sub> and concentrated. The residue was purified by distillation under reduced pressure (b.p. ~100 °C/0.5 mm Hg) which gave the title compound **Xle** (180 g, 70%) as a clear colorless oil.

**Preparation of compound Xlf: *tert*-butyl (2-oxoethyl)prop-2-en-1-ylcarbamate**

To a solution of **Xle** (87 g, 0.358 mol) in CH<sub>2</sub>Cl<sub>2</sub> (1 L) was added dropwise a solution of DIBAL-H (715 mL of 1.0 M in CH<sub>2</sub>Cl<sub>2</sub>, 0.715 mol) over 1 hr at -78 °C. After the addition, the mixture was further stirred at -78 °C for 2 hours and quenched by addition of sat. aq. NH<sub>4</sub>Cl (100 mL) and 2 N HCl (350 mL). The mixture was extracted with CH<sub>2</sub>Cl<sub>2</sub> (1 L X 2). The combined organic extracts were washed with sat. aq. NaCl, dried over Na<sub>2</sub>SO<sub>4</sub>, filtered and concentrated. The residue was purified by distillation under reduced pressure (b.p. ~90 °C/0.5 mm Hg) which gave the title compound **Xlf** (45 g, 63.1%) as a light yellow oil.

**Preparation of compound Xlg: *tert*-butyl (3*aR*,6*aR*)-1-[(1*R*)-2-hydroxy-1-phenylethyl]tetrahydro-1*H*-pyrrolo[3,4-*c*]isoxazole-5(3*H*)-carboxylate**

To a solution of **Xlc** (26 g, 0.17 mol) in CH<sub>2</sub>Cl<sub>2</sub> (560 mL) was added MgBr<sub>2</sub> (45 g, 0.17 mol). The resulting mixture was stirred at room temperature for 30 min and isopropanol (10.2 g, 0.17 mol) was added. The mixture was stirred at room temperature for 10 min, a solution of **Xlf** (34.7 g, 0.17 mol) in CH<sub>2</sub>Cl<sub>2</sub> (140 mL) was added dropwise. The resulting mixture was heated at 35 °C overnight. The reaction was poured into a solution of ice/sat. aq. NaHCO<sub>3</sub> (1 L) and subsequently diluted with CH<sub>2</sub>Cl<sub>2</sub> (1 L). The phases were separated, and the organic extract was washed with sat. aq. NaCl, dried over Na<sub>2</sub>SO<sub>4</sub>, filtered and concentrated. The crude product was purified by column

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chromatography (petroleum ether: EtOAc = 2:1) which gave the title compound **Xlg** (30 g, 52.9%) as a light yellow oil.

**Preparation of compound Xlh: *tert*-butyl (3*R*,4*R*)-3-amino-4-(hydroxymethyl)pyrrolidine-1-carboxylate**

- 5 A Parr reaction vessel was charged with **Xlg** (30 g, 90 mmol), acetic acid (30 mL), MeOH (360 mL), water (150 mL) and 20% Pd(OH)<sub>2</sub>/C (8.4 g, 12.5 mol%). The reaction vessel was purged with N<sub>2</sub>, then hydrogenated under H<sub>2</sub> (50 Psi) for 48 h. The mixture was filtered through Celite and the filter cake was rinsed with MeOH. The filtrate was concentrated and the residue was dried in vacuo which gave the title compound **Xlh** (19  
10 g, 100%) as an oil, which was used for next reaction without further purification.

**Preparation of compound Xli: (3*R*,4*R*)-3-Benzoyloxycarbonylamino-4-hydroxymethyl-pyrrolidine-1-carboxylic acid *tert*-butyl ester**

- Xlh (19 g, 0.09 mol) was dissolved in THF-H<sub>2</sub>O (V/V 2:1, 750 mL). The mixture was cooled to 0 °C and solid NaHCO<sub>3</sub> (30.2 g, 0.36 mol) was added, followed by benzyl  
15 chloroformate (18.4 g, 0.108 mol). The resulting mixture was stirred at room temperature for 2 hours, then poured into 1 N HCl/ice (1 L). The mixture was extracted with EtOAc (3 x 1 L). The combined organic extracts were washed with water, sat. aq. NaCl, dried over Na<sub>2</sub>SO<sub>4</sub>, filtered and concentrated. The residue was purified by column chromatography (petroleum ether: EtOAc = 2:1) which gave the title compound  
20 **Xli** (12 g, 38%) as a white solid.

A mixture of **Xli** (701 mg, 2 mmol) and 10% palladium on carbon (70 mg) in methanol (5 ml) was hydrogenated at 1 atm and 23 °C. TLC (1:1) EtOAc-Heptanes indicated that the reaction was complete. The crude reaction mixture was filtered through celite then concentrated to give the title compound **XI** (220 mg) as a white solid.

25

Biological testing, K<sub>i</sub> data and cellular assay data

**K<sub>i</sub> Determination**

- K<sub>i</sub> determination, spectrophotometric based assay:* CHK1 inhibitors were serially diluted in DMSO and an aliquot of these dilutions was added to a solution  
30 containing 1 nM of CHK1 (kinase domain) in a 50 mM Tris.HCl buffer, pH 7.5 containing 25 mM MgCl<sub>2</sub>, 400 mM NaCl, 80 ug/mL pyruvate kinase, 40 ug/mL lactate dehydrogenase, 4 mM phosphoenolpyruvate, 200 uM NADH and 2.5% DMSO (upon inhibitor addition). After 15 min pre-incubation, the enzymatic reaction was initiated

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by the simultaneous addition of Syntide 2 peptide (125  $\mu$ M, final concentration) and ATP (150  $\mu$ M, final concentration). The kinase-catalyzed production of ADP from ATP that accompanied phosphoryl transfer to the substrate Syntide 2 was coupled to the oxidation of NADH through the activities of pyruvate kinase and lactate dehydrogenase. NADH conversion to  $\text{NAD}^+$  was monitored by the decrease in absorbance at 340 nm ( $\epsilon = 6.22 \text{ cm}^{-1}\text{mM}^{-1}$ ) using a microplate reader from Molecular Devices Spectromax Plus (Sunnyvale, CA) or BMG LABTECH Inc (Offenburg, Germany).

The inhibition of CHK1 was analyzed by fitting the data to the following equation to determine  $K_{iapp}$ :

$$V_i = V_o \left( 1 - \left( \frac{[E]_o + [I]_o + K_i(1 + S_o / K_m) - \sqrt{([E]_o + [I]_o + K_i(1 + S_o / K_m))^2 - 4.[E]_o.[I]_o}}{2.[E]_o} \right) \right)$$

where  $[E]_o$  and  $[I]_o$  are the active enzyme and inhibitor concentration, respectively;  $K_i$  is the inhibition binding constant and  $K_m$  the Michaelis-Menten constant for ATP;  $V_i$  and  $V_o$  are the rates of substrate oxidation in the presence of and in the absence of inhibitor, respectively.

#### EC50 determination (Cellular assay):

The Histone H3 phosphorylation ELISA assay detects cells entering mitosis and represents the primary *in vitro* cell-based assay used to measure the cellular potency of compounds in abrogating the  $G_2$  check point induced by DNA damage in HeLa cells or MiaPaCa cells. The candidate substances were assayed for potency in their ability to inhibit camptothecin-induced  $G_2$  arrest, as measured by an increase in Histone H3 phosphorylation on Ser10, a marker of entry into mitosis.

The PathScan Phospho-Histone H3 (Ser10) Sandwich ELISA kit was used (Cell Signaling, #7155) and the assay was performed according to manufacturer recommendations. Tissue culture plates were seeded with HeLa cells or MiaPaCa Cells and allowed to attach overnight. The cells were then treated with camptothecin to induce DNA damage for 8hrs. Candidate substances or diluent were then added in the presence of nocodazole for 16 hours. Cells were then lysed with buffer from Assay Designs (#80-1114) supplemented with protease inhibitors and frozen overnight. The fresh whole cell lysates were then thawed and added to the ELISA plate with shaking for 3 hours. Between all subsequent steps plates were washed 4 times with PBST. Biotinylated phospho Histone H3 (ser10) detection antibody was

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added for 1 hour, followed by addition of horseradish peroxidase-linked streptavidin secondary antibody for 1 hour. Color development of the antibody was performed with addition of TMB substrate and incubation for 2 minutes on a plate shaker. Stop solution was added and plates were read with absorbance at 450nm on a spectrophotometer. EC50 values were calculated by sigmoid curve fitting using a four-parameter analysis.

CHK-1 Kinase Domain Ki data and CHK-1 cellular assay EC50 data of the compounds of Examples 1-299 are shown below. Under the "Ki" column, data entries in the format of "%" are percent inhibition data where no Ki data is available. Data entry under the "EC50" column with an \* are data obtained using Mia Paca-2 cells rather than HeLa cells. Data is not available where noted as n/a.

Table 3 Ki and EC50 value of the compounds.

Example No.	Ki (uM)	EC50 (uM)
1	0.0132	0.0703
2	0.00324	0.0343
3	0%	0.486
4	0.00774	0.0928*
5	0.00249	0.0183*
6	0.00254	0.0318
7	0.00165	0.0167*
8	16.7%	n/a
9	0.131	10
10	0.0236	0.244
11	101%	0.0621
12	0.0275	0.0684
13	0.0128	0.513*
14	0.0336	4.21*
15	43.5%	10
16	0.0194	0.0811*
17	0.00641	0.0595*
18	0.00123	0.0191*
19	0.167	10*
20	0.93	10*

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21	0.00602	0.0688*
22	n/a	n/a
23	36.1%	10
24	0.00638	0.178*
25	0.0702	10
26	63.9	n/a
27	0.0539	5.58
28	0.00477	0.205
29	0.00551	0.0868*
30	0.147	0.634
31	0.0273	0.183
32	n/a	n/a
33	0.00100	0.00727*
34	0.00338	0.0290
35	0.00388	0.0409
36	n/a	n/a
37	0.00203	0.0210*
38	0.0080	0.0400
39	0.0170	0.677
40	0.00443	0.104
41	0.007	0.0258
42	0.007	0.0293
43	0.00669	0.0646
44	0.00251	0.0210
45	0.585	n/a
46	29.7%	7.97
47	0.0246	0.0522
48	0.165	0.600
49	0.0117	0.142
50	0.0174	0.148
51	0.00960	0.0956
52	0.00955	0.0729
53	0.037	0.459

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54	0.118	1.11
55	0.023	0.229
56	0.0112	0.126
57	0.00609	0.373
58	0%	n/a
59	0.00300	0.00909
60	1.00	8.32
61	0.0379	0.119
62	0.0735	0.694
63	35.5%	n/a
64	1.11	10
65	0.0330	0.501
66	0.0127	0.344
67	0.0800	0.507
68	0%	n/a
69	0.60%	n/a
70	0%	n/a
71	0%	n/a
72	1.4%	n/a
73	0%	n/a
74	5.8%	n/a
75	6.7%	n/a
76	1.6%	n/a
77	0%	n/a
78	0.0371	3.56
79	0.00568	0.184
80	1.00	n/a
81	1.00	n/a
82	1.00	n/a
83	1.00	n/a
84	1.00	n/a
85	0.0131	0.795
86	0.00168	0.295*

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87	0.00863	0.127*
88	0.0907	10
89	0.261	10
90	0.0705	10
91	0.0187	0.497
92	0.0875	10
93	0.0890	3.33
94	0.0206	0.370
95	0.0375	10
96	0.00270	0.0243
97	0.00862	0.151
98	1.00	10
99	0.0284	10
100	0.0146	3.53
101	0.0554	10
102	0.00310	10
103	0.0265	0.0696
104	0.0364	10
105	0.0206	10
106	0.0218	0.271
107	0.00285	0.0316
108	0.0102	0.0470
109	0.0284	0.190
110	0.0173	0.589*
111	0.00363	0.0224
112	0.0127	1.11
113	95.5%	0.103
114	0.0123	0.230
115	0.00330	0.169
116	0.00197	0.0203
117	0.000802	0.0329
118	0.00527	1.11
119	0.00538	0.0267



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120	0.0343	0.686*
121	16.5%	10
122	0.0110	1.06
123	0.00322	0.0229*
124	0.00229	10
125	0.000663	0.0350
126	0.00588	0.140
127	0.00891	1.06
128	0.00179	0.172
129	0.000929	0.0108*
130	0.00486	0.139*
131	0%	10
132	18.3%	10
133	0.0214	10
134	0%	10
135	0.0126	0.208*
136	0.0520	0.966
137	0.00240	0.256*
138	0.142	0.188
139	0.00970	10
140	0.00107	0.0192
141	0.0100	0.0778
142	0.00149	0.125*
143	0.00111	0.119
144	0.00318	0.167*
145	0.0081	0.389
146	0.0190	0.493
147	0.0129	0.295
148	104%	10
149	0.00677	10
150	0.00591	0.284
151	0.00107	0.0787
152	0.00147	0.00560

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153	2.2%	n/a
154	0.00390	0.602*
155	0.00100	0.0461*
156	0.0284	0.314
157	0.0217	0.0733*
158	0.0498	0.129*
159	0.0208	0.166
160	0.00107	0.0257*
161	0.00147	0.00566*
162	30	0.321*
163	0.0140	0.248*
164	0.0184	10
165	0.00109	0.123
166	0.00479	0.123
167	0.101	10
168	0.0227	10
169	45.9%	1.85
170	0.0111	0.414
171	21.7%	10
172	0.178	10
173	0.0237	10
174	0.0169	10
175	0.0137	0.197
176	0.00954	0.0112
177	49.1%	10
178	0.00201	0.0312
179	29.1%	0.294
180	0.00150	10
181	0.00720	0.0261*
182	98.9%	n/a
183	0.00540	0.0530
184	109%	0.0664
185	0.00540	0.0664

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186	0.0240	0.664
187	n/a	n/a
188	0.0578	0.663*
189	0.0179	0.626*
190	0.156	1.32
191	0.00470	5.07
192	0.0292	0.187*
193	0.0265	0.102
194	0.0136	0.00776
195	0.0734	0.0785
196	0.0320	0.0168
197	0.00305	0.00482*
198	0.00109	0.0234
199	0.00782	0.106*
200	26.1%	0.127*
201	0.00488	0.0489
202	0.0184	0.0194
203	0.00409	0.134*
204	0.0545	0.0749*
205	0.0383	0.0552*
206	0.0482	0.240*
207	21%	n/a
208	0.195	n/a
209	0.00130	0.123
210	0.00285	n/a
211	0.00254	0.00459*
212	n/a	n/a
213	0.00358	10
214	0.000935	0.0122*
215	0.00678	0.0358
216	0.0155	0.0358
217	0.00699	0.0364*
218	0.00512	10

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219	48.4%	0.979
220	17.9%	n/a
221	0.00334	0.370
222	42.5%	10
223	0.0681	0.329
224	0.00239	0.0303
225	0.0179	0.0649*
226	0.00460	0.00717*
227	0.0920	1.00*
228	0.00650	0.0245*
229	0.00440	0.00975*
230	0.00920	0.0768*
231	0.0286	20*
232	0.00260	0.100*
233	0.00340	0.0755*
234	0.00250	0.0899*
235	0.00680	0.0679*
236	0.0876	0.479*
237	0.00298	0.0467*
238	0.00490	0.0871*
239	0.0722	0.201*
240	0.0616	0.171*
241	0.0450	0.201*
242	0.0280	0.129*
243	0.0248	0.172*
244	0.0159	0.0603*
245	0.00472	0.0859*
246	0.0353	0.229
247	0.192	1.11*
248	0.0453	10
249	0.00450	0.0322
250	0.0488	1.62*
251	0.0100	0.255*

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252	0.0693	1.11*
253	0.0856	1.03*
254	0.0283	0.542*
255	0.0345	0.597*
256	0.00126	0.0537*
257	0.0126	0.166*
258	0.00438	0.0984*
259	0.00382	0.0388*
260	0.233	0.549*
261	0.0149	0.0370*
262	0.0564	0.303
263	0.374	n/a
264	n/a	n/a
265	0.00537	0.244*
266	0.0787	0.548*
267	27.0	10*
268	0.0658	1.48*
269	0.00976	0.0730*
270	n/a	n/a
271	0.118	4.77*
272	0.0408	2.01*
273	n/a	n/a
274	n/a	n/a
275	n/a	n/a
276	n/a	n/a
277	n/a	n/a
278	n/a	n/a
279	n/a	n/a
280	n/a	n/a
281	n/a	n/a
282	n/a	n/a
283	n/a	n/a
284	n/a	n/a

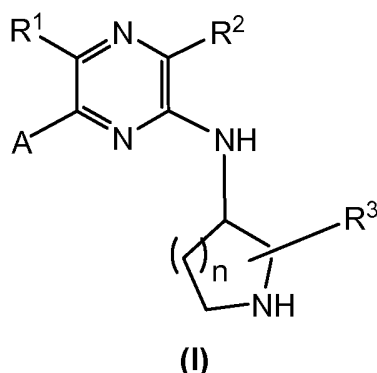
- 265 -

285	0.0213	0.0910*
286	n/a	n/a
287	n/a	n/a
288	n/a	n/a
289	n/a	n/a
290	n/a	n/a
291	n/a	n/a
292	n/a	n/a
293	n/a	n/a
294	n/a	n/a
295	n/a	n/a
296	0.334	4.08
297	0.105	n/a
298	0.00527	n/a
299	0.00411	n/a

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## Claims

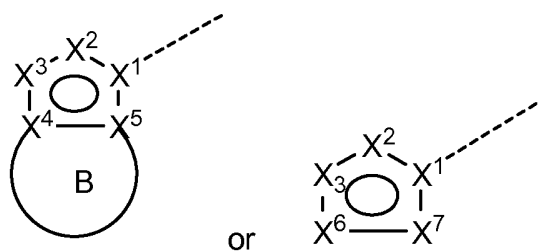
1. A compound of formula (I),



5 wherein,

n is 0, 1 or 2;

A is of the structure



and A is optionally further substituted with 1-6  $R^4$ ;

10  $X^1$ ,  $X^2$ ,  $X^3$ ,  $X^4$  and  $X^5$  form a 5 member heteroaryl having 1-4 nitrogen ring atoms;

$X^1$ ,  $X^2$ ,  $X^3$ ,  $X^6$  and  $X^7$  form a 5 member heteroaryl having 1-4 nitrogen ring atoms;

15  $X^1$  is N or C;  $X^2$  is N, NH or CH;  $X^3$  is N; each of  $X^4$  and  $X^5$  is independently N or C; each of  $X^6$  and  $X^7$  is independently N, NH or CH;

B together with  $X^4$  and  $X^5$  form a ring selected from phenyl, 5-6 member heteroaryl, 5-6 member heterocyclyl,  $C_5$ - $C_6$  cycloalkyl and  $C_5$ - $C_6$  cycloalkenyl, each of the said 5-6 member heteroaryl and 5-6 member heterocyclyl has 1-3 ring heteroatoms selected from N, O and S;

20 each of  $R^1$  and  $R^2$  is independently selected from hydrogen, fluorine, chlorine, -CN,  $-OR^b$ ,  $-N(R^b)_2$ , and  $C_1$ - $C_3$  alkyl optionally substituted with 1-6 groups selected from fluorine, chlorine and -CN;

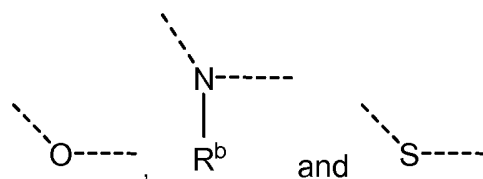
$R^3$  represents 1-6 optional substituents independently selected from the group consisting of -oxo- and  $R^0$ ;

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two  $R^3$  attached to the same ring atom, together with the ring atom attached to, may form a ring selected from  $C_3$ - $C_6$  cycloalkyl,  $C_5$ - $C_6$  cycloalkenyl and 3-6 member heterocyclyl; each of the said  $C_3$ - $C_6$  cycloalkyl,  $C_5$ - $C_6$  cycloalkenyl and 3-6 member heterocyclyl is optionally further substituted with 1-5 groups selected from -oxo- and  $R^w$ ;

two  $R^3$  attached to two adjacent ring atoms, together with the ring atoms attached to, may form a fused ring selected from  $C_3$ - $C_6$  cycloalkyl,  $C_5$ - $C_6$  cycloalkenyl, 3-6 member heterocyclyl, phenyl and 5-6 member heteroaryl; the said  $C_3$ - $C_6$  cycloalkyl,  $C_5$ - $C_6$  cycloalkenyl, 3-6 member heterocyclyl, phenyl and 5-6 member heteroaryl is optionally further substituted with 1-5 groups selected from oxo and  $R^w$ ;

two  $R^3$  attached to, two different ring atoms with at least one ring atom in between, may form a  $C_1$ - $C_4$  alkylene, a 2-4 member heteroalkylene, or a diradical selected from the group consisting of:



such  $C_1$ - $C_4$  alkylene, 2-4 member heteroalkylene and diradical together with the azetidiny (when  $n$  is 0), pyrrolidiny (when  $n$  is 1) or the piperidiny (when  $n$  is 2) form a bicyclic bridged ring system, the said bicyclic bridged ring system having a total of 6-9 ring atoms with 1-3 of the ring atoms selected from O, N and S; the  $C_1$ - $C_4$  alkylene or a 1-4 member heteroalkylene is optionally further substituted with 1-5 groups selected from -oxo- and  $R^w$ ;

each  $R^4$  is independently  $R^0$ ;

each  $R^0$  is independently selected from the group consisting of **(a)** fluorine, chlorine and -CN; **(b)**  $C_1$ - $C_6$  alkyl,  $C_2$ - $C_6$  alkenyl and  $C_2$ - $C_6$  alkynyl, each of which is optionally further substituted with 1-6 groups selected from fluorine, chlorine and CN; **(c)**  $C_3$ - $C_6$  cycloalkyl, -L-( $C_3$ - $C_6$  cycloalkyl), 4-6 member heterocyclyl, -L-(4-6 member heterocyclyl), phenyl, -L-phenyl, 5-6 member heteroaryl, -L-(5-6 member heteroaryl),  $C_5$ - $C_6$  cycloalkenyl, -L-( $C_5$ - $C_6$  cycloalkenyl), wherein each  $C_3$ - $C_6$  cycloalkyl, phenyl, 5-6 member heteroaryl, 4-6 member heterocyclyl and  $C_5$ - $C_6$  cycloalkenyl is independently optionally further substituted with 1-6  $R^x$ ; **(d)**  $-N(R^a)_2$ , -L- $N(R^a)_2$ ; **(e)** -OR<sup>a</sup>, -L-OR<sup>a</sup>; **(f)** -O-L- $N(R^a)_2$ , -N( $R^b$ )-L-OR<sup>a</sup>, -L-O-L- $N(R^a)_2$ , -L-N( $R^b$ )-L-OR<sup>a</sup>; **(g)** -C(O) $R^a$ , -C(O)OR<sup>a</sup>, -C(O) $N(R^a)_2$ , -L-C(O) $R^a$ , -L-C(O)OR<sup>a</sup>, -L-C(O) $N(R^a)_2$ ; **(h)** -N( $R^b$ )-



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$(L)_p-C(O)R^a$ ,  $-N(R^b)-(L)_p-C(O)OR^a$ ,  $-N(R^b)-(L)_p-C(O)N(R^a)_2$ ,  $-L-N(R^b)-(L)_p-C(O)R^a$ ,  $-L-N(R^b)-(L)_p-C(O)OR^a$ ,  $-L-N(R^b)-(L)_p-C(O)N(R^a)_2$ ; **(i)**  $-O-(L)_p-C(O)R^a$ ,  $-O-(L)_p-C(O)N(R^a)_2$ ,  $-O-(L)_p-C(O)O-R^a$ ,  $-L-O-(L)_p-C(O)R^a$ ,  $-L-O-(L)_p-C(O)N(R^a)_2$ ,  $-L-O-(L)_p-C(O)O-R^a$ ; **(j)**  $-S(O)_2R^a$ ,  $-S(O)_2OR^a$ ,  $-S(O)_2N(R^a)_2$ ,  $-L-S(O)_2R^a$ ,  $-L-S(O)_2OR^a$ ,  $-L-S(O)_2N(R^a)_2$ ; **(k)**  $-O-(L)_p-S(O)_2R^a$ ,  $-O-(L)_p-S(O)_2O-R^a$ ,  $-O-(L)_p-S(O)_2N(R^a)_2$ ,  $-L-O-(L)_p-S(O)_2R^a$ ,  $-L-O-(L)_p-S(O)_2O-R^a$ ,  $-L-O-(L)_p-S(O)_2N(R^a)_2$ ; **(l)**  $-N(R^b)-(L)_p-S(O)_2R^a$ ,  $-N(R^b)-(L)_p-S(O)_2O-R^a$ ,  $-N(R^b)-(L)_p-S(O)_2N(R^a)_2$ ,  $-L-N(R^b)-(L)_p-S(O)_2R^a$ ,  $-L-N(R^b)-(L)_p-S(O)_2O-R^a$ ,  $-L-N(R^b)-(L)_p-S(O)_2N(R^a)_2$ ; and **(m)**  $-C(R^a)=N-CN$ ,  $-L-C(R^a)=N-CN$ ;

each  $R^a$  is independently selected from the group consisting of **(a)** hydrogen,  $C_1-C_6$  alkyl and  $C_1-C_6$  perfluoroalkyl; **(b)**  $C_1-C_6$  alkyl further substituted by 1-2 groups selected from fluorine, chlorine,  $-CN$ ,  $-OR^b$  and  $-N(R^b)_2$ ; **(c)**  $C_2-C_6$  alkenyl and  $C_2-C_6$  alkynyl, each of which is optionally further substituted by 1-3 groups selected from fluorine, chlorine,  $-CN$ ,  $-OR^b$  and  $-N(R^b)_2$ ; **(d)**  $-(C_1-C_6 \text{ alkylene})_p-(C_3-C_6 \text{ cycloalkyl})$ ,  $-(C_1-C_6 \text{ alkylene})_p\text{-phenyl}$ ,  $-(C_1-C_6 \text{ alkylene})_p\text{-(5-6 member heteroaryl)}$ ,  $-(C_1-C_6 \text{ alkylene})_p\text{-(4-6 member heterocyclyl)}$ ,  $-(C_1-C_6 \text{ alkylene})_p\text{-(}C_5\text{-}C_6 \text{ cycloalkenyl)}$ , wherein each  $C_1-C_6$  alkylene is optionally further substituted with 1-3 groups selected from fluorine, chlorine and  $-CN$ , wherein each of the said  $C_3-C_6$  cycloalkyl, phenyl, 5-6 member heteroaryl, 4-6 member heterocyclyl and  $C_5-C_6$  cycloalkenyl is independently optionally further substituted with 1-3  $R^y$ ;

or two  $R^a$  connected to the same nitrogen form a 3-10 member heterocyclyl or 5-10 member heteroaryl, the said 3-10 member heterocyclyl and the said 5-10 member heteroaryl is optionally further substituted with 1-3  $R^z$ ;

each  $L$  is independently  $C_1-C_6$  alkylene,  $C_2-C_6$  alkenylene or  $C_2-C_6$  alkynylene, and each  $L$  is optionally further substituted with 1-3 groups selected from fluorine, chlorine,  $OH$  and  $-CN$ ;

each  $R^w$ ,  $R^x$ ,  $R^y$  and  $R^z$  is independently selected from the group consisting of

**(i)** fluorine, chlorine,  $-CN$ ,  $-OR^b$ ,  $C_1-C_6$  alkyl,  $C_1-C_3$  perfluoroalkyl,  $C_2-C_6$  alkenyl,  $C_2-C_6$  alkynyl and  $-N(R^b)_2$ ; **(ii)**  $C_1-C_6$  alkyl further substituted with 1-2 groups selected from fluorine, chlorine,  $-CN$ ,  $-OR^b$  and  $-N(R^b)_2$ ; **(iii)**  $-C(O)-R^b$ ,  $-C(O)OR^b$ ,  $-C(O)-N(R^b)_2$ ; **(iv)**  $-N(R^b)-C(O)-R^b$ ,  $-N(R^b)-C(O)OR^b$ ,  $-N(R^b)-C(O)-N(R^b)_2$ ; **(v)**  $-O-C(O)-R^b$ ,  $-O-C(O)OR^b$ ,  $-O-C(O)-N(R^b)_2$ ; **(vi)**  $-S(O)_2-R^b$ ,  $-S(O)_2O-R^b$ ,  $-S(O)_2N(R^b)_2$ ; **(vii)**  $-N(R^b)-S(O)_2-R^b$ ,  $-N(R^b)-S(O)_2O-R^b$ ,  $-N(R^b)-S(O)_2N(R^b)_2$ ; and **(viii)**  $-O-S(O)_2-R^b$ ,  $-O-S(O)_2O-R^b$ ,  $-O-S(O)_2N(R^b)_2$ ;

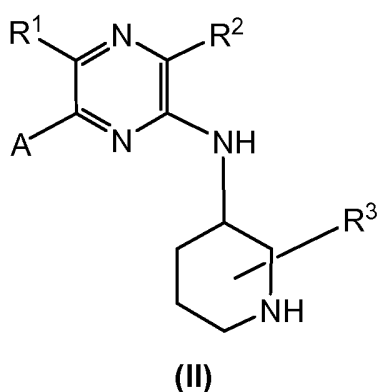
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each  $R^b$  is independently selected from the group consisting of hydrogen,  $C_1$ - $C_3$  alkyl,  $C_1$ - $C_3$  perfluoroalkyl and  $C_1$ - $C_3$  alkyl further substituted by 1-2 groups selected from fluorine, chlorine and CN;

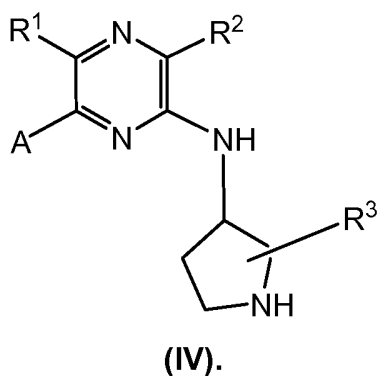
each  $p$  is independently 0 or 1;

5 or a pharmaceutically acceptable salt thereof.

2. The compound or salt of claim 1, wherein the compound is of formula II

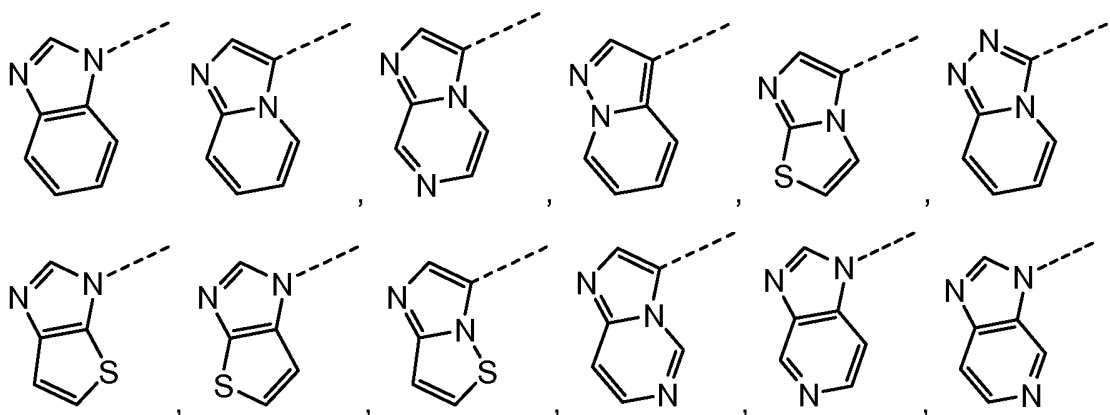


10 3. The compound or salt of claim 1, wherein  $n$  is 1 and the compound is of formula IV,

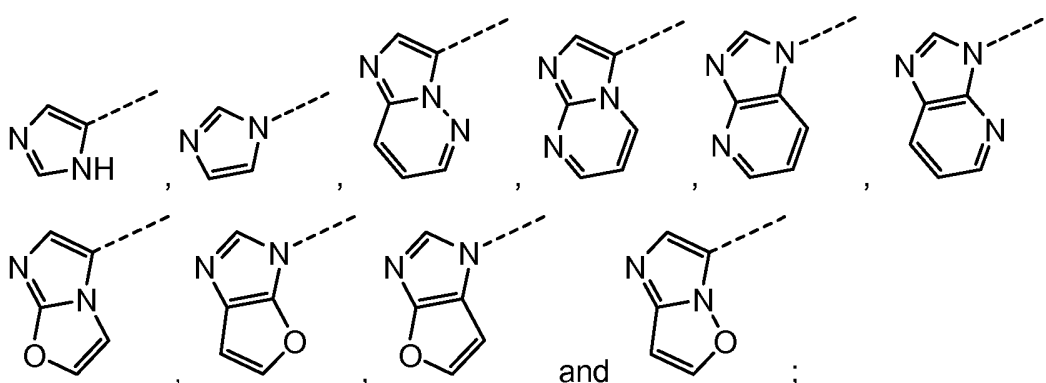


4. The compound or salt of any of claims 1-3, wherein

15 A is a heteroaryl selected from the group consisting of



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and A is optionally further substituted with 1-5 R<sup>4</sup>;

each of R<sup>1</sup> and R<sup>2</sup> is independently selected from hydrogen, fluorine, chlorine, -CN, -OR<sup>b</sup>, -N(R<sup>b</sup>)<sub>2</sub>, and C<sub>1</sub>-C<sub>3</sub> alkyl optionally substituted with 1-6 groups selected from fluorine, chlorine and -CN;

R<sup>3</sup> represents 1-6 optional substituents independently selected from the group consisting of -oxo- and R<sup>0</sup>;

each  $R^4$  is independently  $R^0$ ;

each R<sup>0</sup> is independently selected from the group consisting of **(a)** fluorine, chlorine and -CN; **(b)** C<sub>1</sub>-C<sub>6</sub> alkyl, optionally further substituted with 1-6 groups selected from fluorine, chlorine and CN; **(c)** C<sub>3</sub>-C<sub>6</sub> cycloalkyl, -L-(C<sub>3</sub>-C<sub>6</sub> cycloalkyl), 4-6 member heterocyclyl, -L-(4-6 member heterocyclyl), wherein each C<sub>3</sub>-C<sub>6</sub> cycloalkyl and 4-6 member heterocyclyl is independently optionally further substituted with 1-6 R<sup>x</sup>; **(d)** -N(R<sup>a</sup>)<sub>2</sub>, -L-N(R<sup>a</sup>)<sub>2</sub>; **(e)** -OR<sup>a</sup>, -L-OR<sup>a</sup>; and **(g)** -C(O)R<sup>a</sup>, -C(O)OR<sup>a</sup>, -C(O)N(R<sup>a</sup>)<sub>2</sub>, -L-C(O)R<sup>a</sup>, -L-C(O)OR<sup>a</sup>, -L-C(O)N(R<sup>a</sup>)<sub>2</sub>;

each R<sup>a</sup> is independently selected from the group consisting of **(a)** hydrogen, C<sub>1</sub>-C<sub>6</sub> alkyl and C<sub>1</sub>-C<sub>6</sub> perfluoroalkyl; **(b)** C<sub>1</sub>-C<sub>6</sub> alkyl further substituted by 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub>; **(d)** -(C<sub>1</sub>-C<sub>6</sub> alkylene)<sub>p</sub>-(C<sub>3</sub>-C<sub>6</sub> cycloalkyl), -(C<sub>1</sub>-C<sub>6</sub> alkylene)<sub>p</sub>-(4-6 member heterocyclyl), wherein each C<sub>1</sub>-C<sub>6</sub> alkylene is optionally further substituted with 1-3 groups selected from fluorine, chlorine and -CN, wherein each of the said C<sub>3</sub>-C<sub>6</sub> cycloalkyl and 4-6 member heterocyclyl is independently optionally further substituted with 1-3 R<sup>y</sup>;

or two R<sup>a</sup> connected to the same nitrogen form a 3-10 member heterocyclyl or  
25 5-10 member heteroaryl, the said 3-10 member heterocyclyl and the said 5-10  
member heteroaryl is optionally further substituted with 1-3 R<sup>z</sup>;

each L is independently C<sub>1</sub>-C<sub>6</sub> alkylene optionally further substituted with 1-3 groups selected from fluorine, chlorine, OH and -CN;

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each  $R^w$ ,  $R^x$ ,  $R^y$  and  $R^z$  is independently selected from the group consisting of  
 (i) fluorine, chlorine,  $-\text{CN}$ ,  $-\text{OR}^b$ ,  $\text{C}_1\text{-C}_6$  alkyl,  $\text{C}_1\text{-C}_3$  perfluoroalkyl,  $\text{C}_2\text{-C}_6$  alkenyl,  $\text{C}_2\text{-C}_6$  alkynyl and  $-\text{N}(\text{R}^b)_2$ ; (ii)  $\text{C}_1\text{-C}_6$  alkyl further substituted with 1-2 groups selected from fluorine, chlorine,  $-\text{CN}$ ,  $-\text{OR}^b$  and  $-\text{N}(\text{R}^b)_2$ ; (iii)  $-\text{C}(\text{O})\text{-R}^b$ ,  $-\text{C}(\text{O})\text{OR}^b$ ,  $-\text{C}(\text{O})\text{-N}(\text{R}^b)_2$ ; and

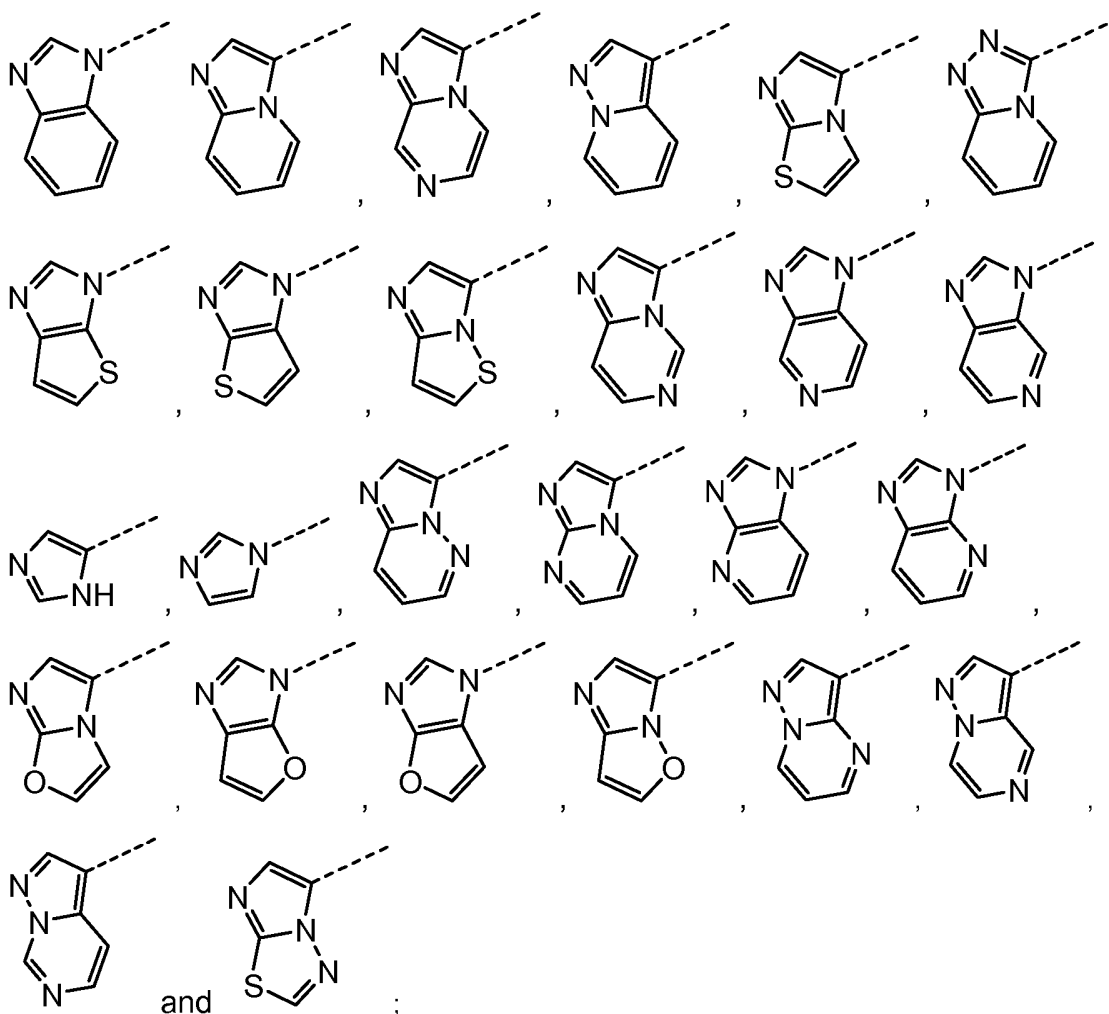
each  $\text{R}^b$  is independently selected from the group consisting of hydrogen,  $\text{C}_1\text{-C}_3$  alkyl,  $\text{C}_1\text{-C}_3$  perfluoroalkyl and  $\text{C}_1\text{-C}_3$  alkyl further substituted by 1-2 groups selected from fluorine, chlorine and CN.

5. The compound or salt of any of claims 1-4, wherein  $\text{R}^1$  is hydrogen.

6. The compound or salt of claim 1,  
 wherein,

$n$  is 1 or 2;

A is a heteroaryl selected from the group consisting of



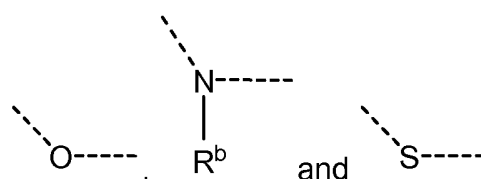
A is optionally further substituted with 1-5  $\text{R}^4$ ;

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$R^1$  is hydrogen;

$R^2$  is selected from hydrogen, fluorine, chlorine,  $-\text{CN}$ ,  $-\text{OR}^b$  and  $\text{C}_1\text{-C}_3$  alkyl;

$R^3$  represents 1-6 optional substituents independently selected from the group consisting of  $-\text{oxo}-$  and  $R^0$ ; further more, when  $n$  is 2, two  $R^3$  attached to, two  
 5 different ring atoms with at least one ring atom in between, may form a  $\text{C}_1\text{-C}_4$  alkylene, a 2-4 member heteroalkylene, or a diradical selected from the group consisting of:



such  $\text{C}_1\text{-C}_4$  alkylene, 2-4 member heteroalkylene and diradical together with the  
 10 piperidinyl (when  $n$  is 2) form a bicyclic bridged ring system, the said bicyclic bridged ring system having a total of 6-9 ring atoms with 1-3 of the ring atoms selected from N, O and S; the  $\text{C}_1\text{-C}_4$  alkylene or a 1-4 member heteroalkylene is optionally further substituted with 1-5 groups selected from  $-\text{oxo}-$  and  $R^w$ ;

each  $R^4$  is independently  $R^0$ ;

15 each  $R^0$  is independently selected from the group consisting of **(a)** fluorine, chlorine and  $-\text{CN}$ ; **(b)**  $\text{C}_1\text{-C}_6$  alkyl,  $\text{C}_2\text{-C}_6$  alkenyl and  $\text{C}_2\text{-C}_6$  alkynyl, each of which is optionally further substituted with 1-6 groups selected from fluorine, chlorine and CN; **(c)**  $\text{C}_3\text{-C}_6$  cycloalkyl,  $-\text{L}-(\text{C}_3\text{-C}_6 \text{ cycloalkyl})$ , 4-6 member heterocyclyl,  $-\text{L}-(4\text{-}6 \text{ member heterocyclyl})$ , wherein each  $\text{C}_3\text{-C}_6$  cycloalkyl and 4-6 member heterocyclyl is  
 20 optionally further substituted with 1-6  $R^x$ ; **(d)**  $-\text{N}(\text{R}^a)_2$ ,  $-\text{L}-\text{N}(\text{R}^a)_2$ ; **(e)**  $-\text{OR}^a$ ,  $-\text{L}-\text{OR}^a$ ; and **(f)**  $-\text{C}(\text{O})\text{R}^a$ ,  $-\text{C}(\text{O})\text{OR}^a$ ,  $-\text{C}(\text{O})\text{N}(\text{R}^a)_2$ ,  $-\text{L}-\text{C}(\text{O})\text{R}^a$ ,  $-\text{L}-\text{C}(\text{O})\text{OR}^a$ ,  $-\text{L}-\text{C}(\text{O})\text{N}(\text{R}^a)_2$ ;

each  $R^a$  is independently selected from the group consisting of **(a)** hydrogen,  $\text{C}_1\text{-C}_6$  alkyl and  $\text{C}_1\text{-C}_6$  perfluoroalkyl; and **(b)**  $\text{C}_1\text{-C}_6$  alkyl further substituted by 1-2 groups selected from fluorine, chlorine,  $-\text{CN}$ ,  $-\text{OR}^b$  and  $-\text{N}(\text{R}^b)_2$ ; **(c)**  $-(\text{C}_1\text{-C}_6 \text{ alkylene})_p-(\text{C}_3\text{-C}_6 \text{ cycloalkyl})$ ,  $-(\text{C}_1\text{-C}_6 \text{ alkylene})_p-(4\text{-}6 \text{ member heterocyclyl})$ , wherein  
 25 each  $\text{C}_1\text{-C}_6$  alkylene is optionally further substituted with 1-3 groups selected from fluorine, chlorine and  $-\text{CN}$ , wherein each of the said  $\text{C}_3\text{-C}_6$  cycloalkyl, 4-6 member heterocyclyl is independently optionally further substituted with 1-3  $R^y$ ;

or two  $R^a$  connected to the same nitrogen form a 3-10 member heterocyclyl or  
 30 5-10 member heteroaryl, the said 3-10 member heterocyclyl and the said 5-10 member heteroaryl is optionally further substituted with 1-3  $R^z$ ;

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each L is independently C<sub>1</sub>-C<sub>6</sub> alkylene and each L is optionally further substituted with 1-3 groups selected from fluorine, chlorine, OH and -CN;

each R<sup>w</sup>, R<sup>x</sup>, R<sup>y</sup> and R<sup>z</sup> is independently selected from the group consisting of

(i) fluorine, chlorine, -CN, -OR<sup>b</sup>, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl and -N(R<sup>b</sup>)<sub>2</sub>; (ii)

5 C<sub>1</sub>-C<sub>6</sub> alkyl further substituted with 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub>;

each R<sup>b</sup> is independently selected from the group consisting of hydrogen, C<sub>1</sub>-C<sub>3</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> perfluoroalkyl and C<sub>1</sub>-C<sub>3</sub> alkyl further substituted by 1-2 groups selected from fluorine, chlorine and CN; and

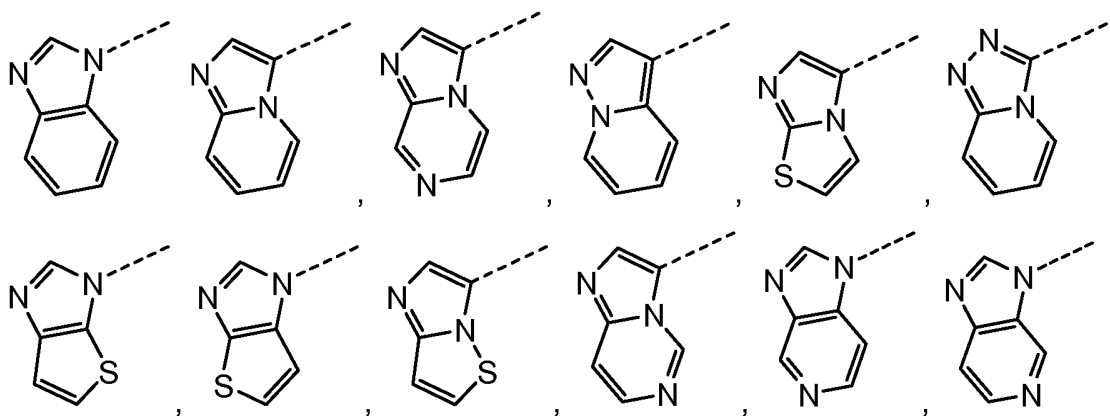
10 each p is independently 0 or 1.

7. The compound or salt of claim 1,

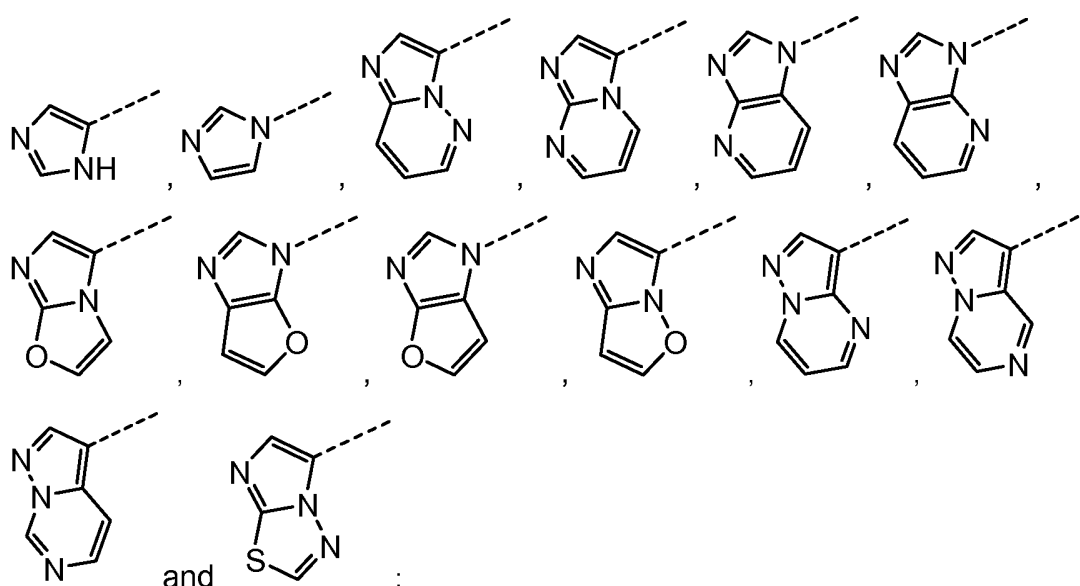
wherein,

n is 1 or 2.

15 A is a heteroaryl selected from the group consisting of



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A is optionally further substituted with 1-5 R<sup>4</sup>;

- 5           R<sup>1</sup> is hydrogen;  
           R<sup>2</sup> is selected from hydrogen, fluorine, chlorine, -CN, -OR<sup>b</sup> and C<sub>1</sub>-C<sub>3</sub> alkyl;  
           R<sup>3</sup> represents 1-6 optional substituents independently selected from the group  
 consisting of -oxo- and R<sup>0</sup>;  
           each R<sup>4</sup> is independently R<sup>0</sup>;  
 10          each R<sup>0</sup> is independently selected from the group consisting of **(a)** fluorine,  
           chlorine and -CN; **(b)** C<sub>1</sub>-C<sub>6</sub> alkyl optionally further substituted with 1-6 groups  
           selected from fluorine, chlorine and CN; **(c)** C<sub>3</sub>-C<sub>6</sub> cycloalkyl, -L-(C<sub>3</sub>-C<sub>6</sub> cycloalkyl), 4-  
           6 member heterocyclyl, -L-(4-6 member heterocyclyl), wherein each C<sub>3</sub>-C<sub>6</sub> cycloalkyl  
           and 4-6 member heterocyclyl is optionally further substituted with 1-6 R<sup>x</sup>; **(d)** -OR<sup>a</sup>, -  
 15          L-OR<sup>a</sup>; and **(e)** -C(O)N(R<sup>a</sup>)<sub>2</sub>, -L-C(O)N(R<sup>a</sup>)<sub>2</sub>;

each R<sup>a</sup> is independently selected from the group consisting of **(a)** hydrogen, C<sub>1</sub>-C<sub>6</sub> alkyl and C<sub>1</sub>-C<sub>6</sub> perfluoroalkyl; and **(b)** C<sub>1</sub>-C<sub>6</sub> alkyl further substituted by 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub>; **(c)** -(C<sub>1</sub>-C<sub>6</sub> alkylene)<sub>p</sub>-(C<sub>3</sub>-C<sub>6</sub> cycloalkyl), -(C<sub>1</sub>-C<sub>6</sub> alkylene)<sub>p</sub>-(4-6 member heterocyclyl), wherein each C<sub>1</sub>-C<sub>6</sub> alkylene is optionally further substituted with 1-3 groups selected from fluorine, chlorine and -CN, wherein each of the said C<sub>3</sub>-C<sub>6</sub> cycloalkyl, 4-6 member heterocyclyl is independently optionally further substituted with 1-3 R<sup>y</sup>;

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or two R<sup>a</sup> connected to the same nitrogen form a 3-10 member heterocyclyl or 5-10 member heteroaryl, the said 3-10 member heterocyclyl and the said 5-10 member heteroaryl is optionally further substituted with 1-3 R<sup>z</sup>;

each L is independently C<sub>1</sub>-C<sub>6</sub> alkylene and each L is optionally further substituted with 1-3 groups selected from fluorine, chlorine, OH and -CN;

each R<sup>w</sup>, R<sup>x</sup>, R<sup>y</sup> and R<sup>z</sup> is independently selected from the group consisting of (i) fluorine, chlorine, -CN, -OR<sup>b</sup> and C<sub>1</sub>-C<sub>6</sub> alkyl; (ii) C<sub>1</sub>-C<sub>6</sub> alkyl further substituted with 1-2 groups selected from fluorine, chlorine and -CN;

each R<sup>b</sup> is independently selected from the group consisting of hydrogen and C<sub>1</sub>-C<sub>3</sub> alkyl; and

each p is independently 0 or 1.

8. The compound or salt of any of claims 1-7, wherein R<sup>1</sup> is hydrogen and R<sup>2</sup> is hydrogen.

9. The compound or salt of any of claims 1-7, wherein A is further substituted with 1-3 R<sup>4</sup> selected from the group consisting of

(a) fluorine, chlorine and -CN; and

(b) C<sub>1</sub>-C<sub>6</sub> alkyl, optionally further substituted with 1-6 groups selected from fluorine, chlorine and CN.

10. The compound or salt of any of claims 1-9, wherein each R<sup>a</sup> is independently selected from the group consisting of hydrogen, C<sub>1</sub>-C<sub>6</sub> alkyl, C<sub>1</sub>-C<sub>6</sub> perfluoroalkyl and C<sub>1</sub>-C<sub>6</sub> alkyl further substituted by 1-2 groups selected from fluorine, chlorine, -CN, -OR<sup>b</sup> and -N(R<sup>b</sup>)<sub>2</sub>.

11. The compound or salt of any of claims 1-5, wherein each L is -C<sub>1</sub>-C<sub>6</sub> alkylene, and L is optionally further substituted.

12. The compound or salt of any of claims 1-11, wherein each R<sup>w</sup>, R<sup>x</sup>, R<sup>y</sup> and R<sup>z</sup> is independently selected from the group consisting of fluorine, chlorine, -CN and C<sub>1</sub>-C<sub>6</sub> alkyl.

13. The compound or salt of any of claims 1-12, wherein each R<sup>b</sup> is independently selected from the group consisting of hydrogen and C<sub>1</sub>-C<sub>3</sub> alkyl.

14. The compound or salt of any of claims 1-13, wherein each R<sup>3</sup> is independently selected from the group consisting of -oxo-, fluorine, chlorine, C<sub>1</sub>-C<sub>3</sub> alkyl, C<sub>1</sub>-C<sub>3</sub> alkoxy, and CF<sub>3</sub>.



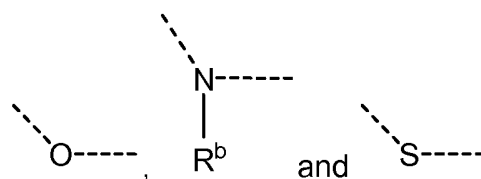
- 276 -

15. The compound or salt of any of claims 1-14, wherein each  $R^3$  is independently selected from the group consisting of -oxo- and

(a) fluorine, chlorine and -CN;

(b)  $C_1-C_6$  alkyl,  $C_2-C_6$  alkenyl and  $C_2-C_6$  alkynyl, each of which is optionally further substituted with 1-6 groups selected from fluorine, chlorine and CN;

further more, two  $R^3$  attached to, two different ring atoms with at least one ring atom in between, may form a  $C_1-C_4$  alkylene, a 2-4 member heteroalkylene, or a diradical selected from the group consisting of:



such  $C_1-C_4$  alkylene, 2-4 member heteroalkylene and diradical together with the azetidiny (when n is 0), pyrrolidiny (when n is 1) or the piperidiny (when n is 2) form a bicyclic bridged ring system, the said bicyclic bridged ring system having a total of 6-9 ring atoms with 1-3 of the ring atoms selected from O, N and S; the  $C_1-C_4$  alkylene or a 1-4 member heteroalkylene is optionally further substituted with 1-5 groups selected from -oxo- and  $R^w$ .

16. The compound or salt of any of claims 1-15, wherein each p is 0.

17. The compound or salt of any of claims 1-15, wherein each p is 1.

18. A pharmaceutical composition comprising the compound or salt of claim 1, and a pharmaceutically acceptable carrier.

19. The use of the compound or salt of claim 1, for the preparation of a medicament for the treatment of cancer.

# INTERNATIONAL SEARCH REPORT

International application No  
PCT/IB2009/053389

## A. CLASSIFICATION OF SUBJECT MATTER

INV. C07D401/14 C07D403/14 C07D471/04 C07D487/04 C07D513/04  
C07D519/00 A61K31/437 A61P35/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

C07D A61K A61P

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, BEILSTEIN Data, CHEM ABS Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P, A	WO 2009/054941 A (MERCK & CO INC [US]; GUERIN DAVID J [US]; JUNG JOON [US]; STANTON ELIZ) 30 April 2009 (2009-04-30) Abstract; claims; examples.	1-19
A	WO 2008/024974 A (SERENEX INC [US]; HUANG KENNETH HE [US]; SMITH EMILIE D [US]; VEAL JAM) 28 February 2008 (2008-02-28) Abstract; claims; examples, e.g. page 129, number 970.	1-19



Further documents are listed in the continuation of Box C.



See patent family annex.

\* Special categories of cited documents:

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \*Z\* document member of the same patent family

Date of the actual completion of the international search

23 October 2009

Date of mailing of the international search report

04/11/2009

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# INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2009/053389

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	TAO, LIN: "Chk1 inhibitors for novel cancer treatment" ANTI-CANCER AGENTS IN MEDICINAL CHEMISTRY, BENTHAM SCIENCE PUBLISHERS LTD, NL, vol. 6, no. 4, 1 July 2006 (2006-07-01), pages 377-388, XP009115323 ISSN: 1871-5206 the whole document -----	1-19
A	WO 03/093297 A (EXELIXIS INC [US]; BUHR CHRIS A [US]; BAIK TAE-GON) 13 November 2003 (2003-11-13) Abstract; claims; examples. -----	1-19

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2009/053389

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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WO 03093297 A	13-11-2003	AU 2003234464 A1	17-11-2003
		CA 2484209 A1	13-11-2003
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		JP 2005530760 T	13-10-2005