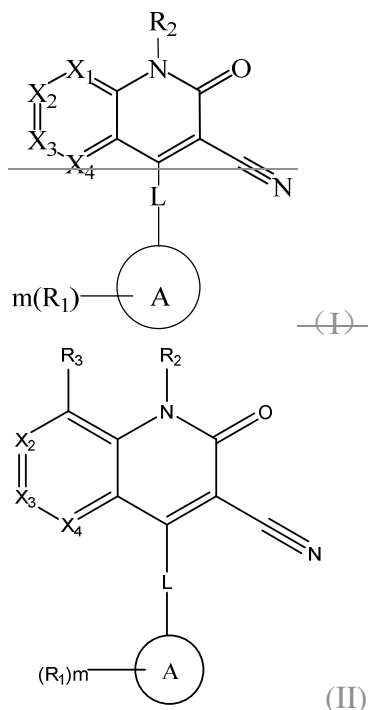


Claims

1. A compound represented by formula (III), or a pharmaceutically acceptable salt or a stereoisomer thereof,



wherein,

$\overline{X_1}$, $\overline{X_2}$, $\overline{X_3}$, and $\overline{X_4}$ are each independently CR₃ or N, and $\overline{X_1}$, $\overline{X_2}$, $\overline{X_3}$, and $\overline{X_4}$ are not simultaneously CR₃;

R₃, at each occurrence, is independently selected from the group consisting of hydrogen, hydroxy, amino, carboxyl, cyano, nitro, halogen, C₁₋₆ alkyl, C₁₋₆ alkoxy, C₁₋₆ alkylamino, (C₁₋₆ alkyl)₂ amino, halogenated C₁₋₆ alkyl, halogenated C₁₋₆ alkoxy, C₂₋₈ alkenyl, C₂₋₈ alkynyl, C₁₋₆ alkylsulfonyl, C₁₋₆ alkylthio, C₃₋₆ cycloalkyl, 4-6 membered heterocyclyl, C₁₋₆ alkylcarbonyl, aminocarbonyl, C₁₋₆ alkylaminocarbonyl, (C₁₋₆ alkyl)₂ aminocarbonyl, 4-6 membered heterocyclylcarbonyl and 5-6 membered heteroaryloxy, wherein C₁₋₆ alkyl, C₁₋₆ alkoxy, C₁₋₆ alkylamino, (C₁₋₆ alkyl)₂ amino, halogenated C₁₋₆ alkoxy, C₂₋₈ alkenyl, C₂₋₈ alkynyl, C₁₋₆ alkylsulfonyl, C₁₋₆ alkylthio, C₃₋₆ cycloalkyl, 4-6 membered heterocyclyl, C₁₋₆ alkylcarbonyl, aminocarbonyl, C₁₋₆ alkylaminocarbonyl, (C₁₋₆ alkyl)₂ aminocarbonyl, 4-6 membered heterocyclylcarbonyl and 5-6 membered heteroaryloxy are unsubstituted or optionally substituted with one or more groups independently selected from the group consisting of

hydroxy, amino, carboxyl, cyano, nitro, halogen, C₁₋₆ alkyl, C₁₋₆ alkoxy, C₁₋₆ alkoxy C₁₋₆ alkoxy, C₁₋₆ alkylamino, (C₁₋₆ alkyl)₂ amino, C₁₋₆ alkylcarbonylamino, C₁₋₆ alkylsulfonylamino, C₁₋₆ alkylcarbonyloxy, C₃₋₆ cycloalkyl, C₂₋₈ alkynyl, halogenated C₁₋₆ alkyl, C₂₋₈ alkenyl, halogenated C₁₋₆ alkoxy, 4-6 membered heterocyclyl which is unsubstituted or optionally substituted with a substituent selected from the group consisting of hydroxy, amino, carboxyl, cyano, nitro, halogen, C₁₋₆ alkyl and C₁₋₆ alkoxy, and heteroaryl which is unsubstituted or optionally substituted with a substituent selected from the group consisting of hydroxy, amino, carboxyl, cyano, nitro, halogen, C₁₋₆ alkyl and C₁₋₆ alkoxy;

L is a bond, -NH-(CH₂)_t-, and t is 0, 1, 2 or 3;

ring A is selected from the group consisting of 3-12 membered heterocyclyl, ~~aryl~~, 5-10 membered heteroaryl, 3-12 membered cycloalkyl, and 3-12 membered cycloalkenyl, wherein 3-12 membered heterocyclyl has ~~ana~~ hetero atom selected from the group consisting of O, S, N and any combination thereof, and S atom may be optionally oxidized to S(O) or S(O)₂, and wherein 5-10 membered heteroaryl has ~~ana~~ hetero atom selected from the group consisting of O, S, N and any combination thereof;

each R₁ is independently selected from the group consisting of hydrogen, hydroxy, amino, carboxyl, cyano, nitro, halogen, C₁₋₆ alkyl, C₁₋₆ alkoxy, C₁₋₆ alkylamino, (C₁₋₆ alkyl)₂ amino, halogenated C₁₋₆ alkyl, halogenated C₁₋₆ alkoxy, C₂₋₈ alkenyl, C₂₋₈ alkynyl, C₁₋₆ alkylsulfonyl, C₁₋₆ alkylthio, 3-12 membered cycloalkyl, 3-12 membered cycloalkenyl, 3-12 membered heterocyclyl, aryl and 5-10 membered heteroaryl, wherein C₁₋₆ alkyl, C₁₋₆ alkoxy, C₁₋₆ alkylamino, (C₁₋₆ alkyl)₂ amino, halogenated C₁₋₆ alkyl, halogenated C₁₋₆ alkoxy, C₂₋₈ alkenyl, C₂₋₈ alkynyl, C₁₋₆ alkylsulfonyl, C₁₋₆ alkylthio, 3-12 membered cycloalkyl, 3-12 membered cycloalkenyl, 3-12 membered heterocyclyl, aryl and 5-10 membered heteroaryl are unsubstituted or optionally substituted with a group selected from the group consisting of hydroxy, amino, carboxyl, cyano, nitro, halogen, C₁₋₆ alkyl, C₁₋₆ alkoxy, C₁₋₆ alkoxy C₁₋₆ alkoxy, C₁₋₆ alkylamino, (C₁₋₆ alkyl)₂ amino, C₁₋₆ alkylcarbonylamino, and C₁₋₆ alkylsulfonylamino;

m is 0, 1, 2 or 3; and

R₂ is selected from the group consisting of hydrogen, C₁₋₆ alkyl, C₂₋₈ alkenyl, C₂₋₈ alkynyl, and halogenated C₁₋₆ alkyl.

2. _____ The compound or a pharmaceutically acceptable salt or a stereoisomer thereof according to claim 1,

wherein,

X_1 , X_2 , X_3 , and X_4 are each independently CR_3 or N, and X_1 , X_2 , X_3 , and X_4 are not simultaneously CR_3 ;

R_3 , at each occurrence, is independently selected from the group consisting of hydrogen, hydroxy, amino, carboxyl, cyano, nitro, halogen, C_{1-6} alkyl, C_{1-6} alkoxy, C_{1-6} alkylamino, $(C_{1-6} \text{ alkyl})_2$ amino, halogenated C_{1-6} alkyl, halogenated C_{1-6} alkoxy, C_{2-8} alkenyl, C_{2-8} alkynyl, C_{1-6} alkylsulfonyl, C_{1-6} alkylthio, C_{3-6} cycloalkyl, 4-6 membered heterocyclyl, C_{1-6} alkylcarbonyl, C_{1-6} alkylaminocarbonyl, $(C_{1-6} \text{ alkyl})_2$ aminocarbonyl, and aminocarbonyl, wherein C_{1-6} alkyl, C_{1-6} alkoxy, C_{1-6} alkylamino, $(C_{1-6} \text{ alkyl})_2$ amino, halogenated C_{1-6} alkoxy, C_{2-8} alkenyl, C_{2-8} alkynyl, C_{1-6} alkylsulfonyl, C_{1-6} alkylthio, C_{3-6} cycloalkyl, 4-6 membered heterocyclyl, C_{1-6} alkylcarbonyl, C_{1-6} alkylaminocarbonyl, $(C_{1-6} \text{ alkyl})_2$ aminocarbonyl and aminocarbonyl are unsubstituted or optionally substituted with one or more groups independently selected from the group consisting of hydroxy, amino, carboxyl, cyano, nitro, halogen, C_{1-6} alkyl, C_{1-6} alkoxy, C_{1-6} alkoxy C_{1-6} alkoxy, C_{1-6} alkylamino, $(C_{1-6} \text{ alkyl})_2$ amino, C_{3-6} cycloalkyl, C_{1-6} alkylcarbonylamino, C_{1-6} alkylsulfonylamino, C_{1-6} alkylcarbonyloxy and unsubstituted or C_{1-6} alkyl-substituted 4-6 membered heterocyclyl;

L is a bond, $-NH-(CH_2)_t-$, and t is 0, 1, 2 or 3;

ring A is selected from the group consisting of 3-12 membered heterocyclyl, ~~aryl~~, 5-10 membered heteroaryl, 3-12 membered cycloalkyl, and 3-12 membered cycloalkenyl, wherein 3-12 membered heterocyclyl has ~~ana~~ hetero atom selected from the group consisting of O, S, N and any combination thereof, and S atom may be optionally oxidized to S(O) or S(O)₂, and wherein 5-10 membered heteroaryl has ~~ana~~ hetero atom selected from the group consisting of O, S, N, and any combination thereof;

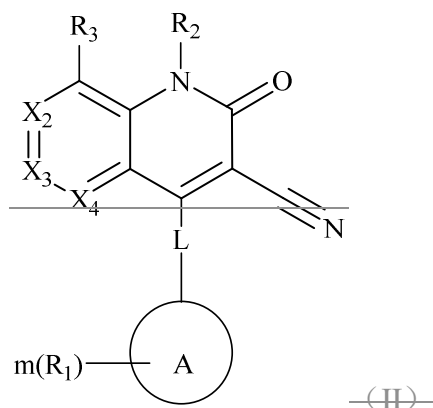
each R_1 is independently selected from the group consisting of hydrogen, hydroxy, amino, carboxyl, cyano, nitro, halogen, C_{1-6} alkyl, C_{1-6} alkoxy, C_{1-6} alkylamino, $(C_{1-6} \text{ alkyl})_2$ amino, halogenated C_{1-6} alkyl, halogenated C_{1-6} alkoxy, C_{2-8} alkenyl, C_{2-8} alkynyl, C_{1-6} alkylsulfonyl, C_{1-6} alkylthio, 3-12 membered cycloalkyl, 3-12 membered cycloalkenyl, 3-12 membered heterocyclyl, aryl and 5-10 membered heteroaryl, wherein C_{1-6} alkyl, C_{1-6} alkoxy, C_{1-6} alkylamino, $(C_{1-6} \text{ alkyl})_2$ amino, halogenated C_{1-6} alkyl, halogenated C_{1-6} alkoxy,

C₂₋₈ alkenyl, C₂₋₈ alkynyl, C₁₋₆ alkylsulfonyl, C₁₋₆ alkylthio, 3-12 membered cycloalkyl, 3-12 membered cycloalkenyl, 3-12 membered heterocyclyl, aryl and 5-10 membered heteroaryl are unsubstituted or optionally substituted with a group selected from the group consisting of hydroxy, amino, carboxyl, cyano, nitro, halogen, C₁₋₆ alkyl, C₁₋₆ alkoxy, C₁₋₆ alkoxy C₁₋₆ alkoxy, C₁₋₆ alkylamino, (C₁₋₆ alkyl)₂ amino, C₁₋₆ alkylcarbonylamino, and C₁₋₆ alkylsulfonylamino;

m is 0, 1, 2 or 3; and

R₂ is selected from the group consisting of hydrogen, C₁₋₆ alkyl, C₂₋₈ alkenyl, C₂₋₈ alkynyl, and halogenated C₁₋₆ alkyl.

~~3. The compound or a pharmaceutically acceptable salt or a stereoisomer thereof according to claim 2, wherein the compound has a structure represented by formula (II):~~



~~wherein,~~

~~X₂, X₃, X₄, R₁, R₂, R₃, ring A, L and m are as defined in claim 2, and X₂, X₃ and X₄ are not simultaneously CR₃~~

~~43. The compound or a pharmaceutically acceptable salt or a stereoisomer thereof according to claim 32,~~

~~wherein,~~

~~X₂, X₃, and X₄ are each independently CR₃ or N, and X₂, X₃, and X₄ are not simultaneously CR₃;~~

R₃, at each occurrence, is independently selected from the group consisting of hydrogen, amino, carboxyl, cyano, halogen, C₁₋₆ alkyl, C₁₋₆ alkoxy, C₁₋₆ alkylamino, (C₁₋₆ alkyl)₂ amino, C₂₋₈ alkenyl, C₂₋₈ alkynyl, C₁₋₆ alkylsulfonyl, C₁₋₆ alkylthio, C₃₋₆ cycloalkyl, 4-6 membered nitrogen-containing heterocyclyl, C₁₋₆ alkylcarbonyl, C₁₋₆ alkylaminocarbonyl, (C₁₋₆ alkyl)₂ aminocarbonyl, and aminocarbonyl, wherein C₁₋₆ alkyl, C₁₋₆ alkoxy, C₁₋₆

alkylamino, (C₁₋₆ alkyl)₂ amino, C₂₋₈ alkenyl, C₂₋₈ alkynyl, C₁₋₆ alkylsulfonyl, C₁₋₆ alkylthio, C₃₋₆ cycloalkyl, 4-6 membered nitrogen-containing heterocyclyl, C₁₋₆ alkylcarbonyl, C₁₋₆ alkylaminocarbonyl, (C₁₋₆ alkyl)₂ aminocarbonyl and aminocarbonyl are unsubstituted or optionally substituted with one or more groups independently selected from the group consisting of hydroxy, amino, cyano, halogen, C₁₋₆ alkyl, C₁₋₆ alkoxy, C₁₋₆ alkylamino, (C₁₋₆ alkyl)₂ amino, C₁₋₆ alkylcarbonyloxy, C₃₋₆ cycloalkyl and unsubstituted or C₁₋₆ alkyl-substituted 4-6 membered heterocyclyl;

L is a bond;

ring A is 3-12 membered heterocyclyl, wherein 3-12 membered heterocyclyl has ~~an~~ hetero atom selected from the group consisting of O, S, N and any combination thereof, and S atom may be optionally oxidized to S(O) or S(O)₂;

each R₁ is independently selected from the group consisting of hydrogen, hydroxy, cyano, halogen, C₁₋₆ alkyl, C₁₋₆ alkoxy and 5-6 membered heteroaryl, wherein C₁₋₆ alkyl, C₁₋₆ alkoxy and 5-6 membered heteroaryl are unsubstituted or substituted with hydroxy;

m is 0, 1, or 2; and

R₂ is hydrogen or C₁₋₆ alkyl.

~~4.5.~~ The compound or a pharmaceutically acceptable salt or a stereoisomer thereof according to claim 34,

wherein,

X₂ is N, and X₃ and X₄ are each independently CR₃ or N;

R₃, at each occurrence, is independently selected from the group consisting of hydrogen, amino, cyano, halogen, carboxyl, C₁₋₄ alkyl, C₁₋₄ alkoxy, C₁₋₄ alkylamino, (C₁₋₄ alkyl)₂ amino, C₂₋₆ alkenyl, C₂₋₆ alkynyl, C₁₋₄ alkylcarbonyl, C₁₋₄ alkylaminocarbonyl, (C₁₋₆ alkyl)₂ aminocarbonyl, C₁₋₄ alkylsulfonyl, C₁₋₄ alkylthio, aminocarbonyl, cyclopropyl, azetidiny, morpholinyl and piperazinyl, wherein C₁₋₄ alkyl, C₁₋₄ alkoxy, C₁₋₄ alkylamino, (C₁₋₄ alkyl)₂ amino, C₂₋₆ alkenyl, C₂₋₆ alkynyl, C₁₋₄ alkylcarbonyl, C₁₋₄ alkylaminocarbonyl, (C₁₋₆ alkyl)₂ aminocarbonyl, C₁₋₄ alkylsulfonyl, C₁₋₄ alkylthio, aminocarbonyl, cyclopropyl, azetidiny, morpholinyl and piperazinyl are unsubstituted or optionally substituted with one or more groups independently selected from the group consisting of hydroxy, amino, cyano, halogen, C₁₋₄ alkyl, C₁₋₄ alkoxy, C₁₋₄ alkylamino, (C₁₋₄ alkyl)₂ amino, cyclopropyl, C₁₋₄ alkylcarbonyloxy, and unsubstituted or C₁₋₄ alkyl-substituted 4-6 membered heterocyclyl;

L is a bond;

ring A is 4-12 membered heterocyclyl, wherein 4-12 membered heterocyclyl has one or two hetero atoms selected from the group consisting of O, S, and N, and contains at least one N, ring A is connected to L through N atom, and S atom can be optionally oxidized to S(O)₂;

each R₁ is independently selected from the group consisting of hydrogen, hydroxy, cyano, halogen, C₁₋₄ alkyl, C₁₋₄ alkoxy, pyrazolyl, thiazolyl and triazolyl, wherein C₁₋₄ alkyl, C₁₋₄ alkoxy, pyrazolyl, thiazolyl and triazolyl are unsubstituted or substituted with hydroxy; and

m is 0, 1 or 2.

~~6.5.~~ The compound or a pharmaceutically acceptable salt or a stereoisomer thereof according to claim ~~34 or 5~~,

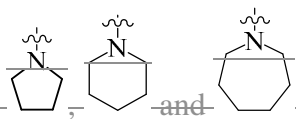
wherein,

X₂ is N, X₃ is CR₃, and X₄ is CR₃ or N;

R₃, at each occurrence, is independently selected from the group consisting of hydrogen, halogen, C₁₋₄ alkyl, C₁₋₄ alkoxy, morpholinyl, C₂₋₆ alkenyl, C₁₋₄ alkylaminocarbonyl, (C₁₋₄ alkyl)₂ aminocarbonyl and aminocarbonyl, wherein C₁₋₄ alkyl, C₁₋₄ alkoxy, morpholinyl, C₂₋₆ alkenyl, C₁₋₄ alkylcarbonyl, C₁₋₄ alkylaminocarbonyl, (C₁₋₄ alkyl)₂ aminocarbonyl and aminocarbonyl are unsubstituted or optionally substituted with one or more groups independently selected from the group consisting of hydroxy, C₁₋₄ alkoxy, cyclopropyl, amino, C₁₋₄ alkylamino, (C₁₋₄ alkyl)₂ amino, and unsubstituted or C₁₋₄ alkyl-substituted 4-6 membered heterocyclyl;

L is a bond;

ring A is 4-7 membered monoheterocyclyl, wherein 4-7 membered monoheterocyclyl has one or two hetero atoms selected from the group consisting of O, S, and N, and contains at least one N, ring A is connected to L through N atom, and S atom can be optionally oxidized to S(O)₂;

~~preferably, ring A is selected from the group consisting of~~  ~~and~~

each R₁ is independently selected from the group consisting of hydrogen, halogen, C₁₋₄ alkyl, C₁₋₄ alkoxy, pyrazolyl, thiazolyl, and triazolyl, wherein C₁₋₄ alkyl, C₁₋₄ alkoxy, pyrazolyl, thiazolyl, and triazolyl are unsubstituted or substituted with hydroxy; and

m is 0, 1 or 2.

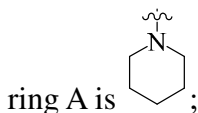
~~7.6.~~ The compound or a pharmaceutically acceptable salt or a stereoisomer thereof according to claim 56,

wherein,

X₂ is N, and X₃ and X₄ are each independently CR₃;

R₃, at each occurrence, is independently selected from the group consisting of hydrogen, halogen, C₁₋₄ alkyl, C₁₋₄ alkoxy, C₂₋₆ alkenyl, C₁₋₄ alkylaminocarbonyl, and aminocarbonyl, wherein C₁₋₄ alkyl, C₁₋₄ alkoxy, C₂₋₆ alkenyl, C₁₋₄ alkylaminocarbonyl, and aminocarbonyl are unsubstituted or optionally substituted with one or more groups independently selected from the group consisting of hydroxy, amino, C₁₋₄ alkyl, C₁₋₄ alkoxy, cyclopropyl, C₁₋₄ alkylamino, (C₁₋₄ alkyl)₂ amino and unsubstituted or C₁₋₄ alkyl-substituted 4-6 membered heterocyclyl;

L is a bond;



each R₁ is independently selected from the group consisting of hydrogen, C₁₋₄ alkyl, and C₁₋₄ alkoxy; and

m is 0, 1 or 2.

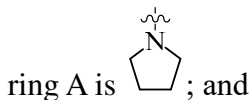
~~8.7.~~ The compound or a pharmaceutically acceptable salt or a stereoisomer thereof according to claim 56,

wherein,

X₂ is N, and X₃ and X₄ are each independently CR₃;

R₃, at each occurrence, is independently selected from the group consisting of hydrogen, halogen, C₁₋₄ alkyl, and morpholinyl, wherein C₁₋₄ alkyl is unsubstituted or substituted with one or more hydroxy;

L is a bond;



each R₁ is independently selected from the group consisting of pyrazolyl, thiazolyl, and triazolyl.

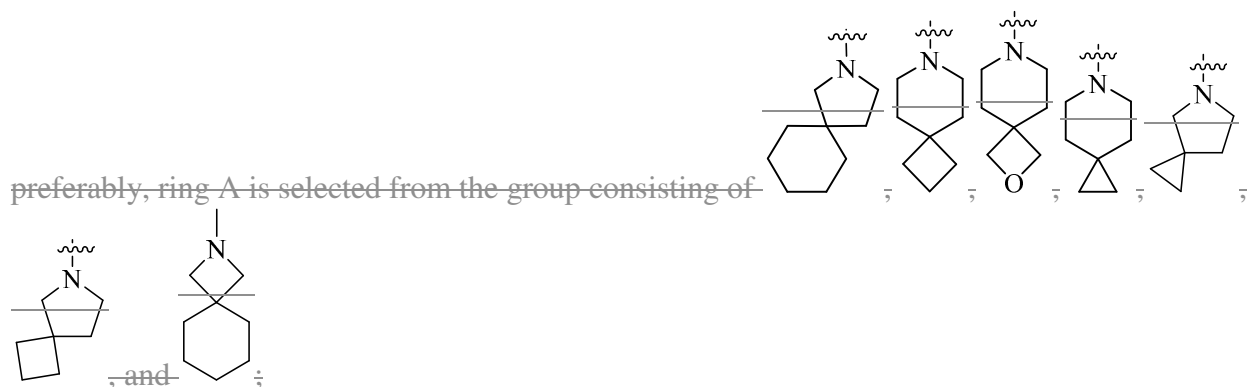
~~9.8.~~ The compound or a pharmaceutically acceptable salt or a stereoisomer thereof according to claim ~~34 or 5~~,

wherein,

R₃, at each occurrence, is independently selected from the group consisting of hydrogen, amino, cyano, halogen, carboxyl, C₁₋₄ alkyl, C₁₋₄ alkoxy, C₁₋₄ alkylcarbonyl, C₂₋₆ alkynyl, C₁₋₄ alkylaminocarbonyl, (C₁₋₄ alkyl)₂ aminocarbonyl, C₁₋₄ alkylthio, C₁₋₄ alkylsulfonyl, C₁₋₄ alkylamino, (C₁₋₄ alkyl)₂ amino, azetidiny, morpholinyl, piperazinyl, C₂₋₆ alkenyl and cyclopropyl, wherein C₁₋₄ alkyl, C₁₋₄ alkoxy, C₁₋₄ alkylcarbonyl, C₂₋₆ alkynyl, C₁₋₄ alkylaminocarbonyl, (C₁₋₆ alkyl)₂ aminocarbonyl, C₁₋₄ alkylthio, C₁₋₄ alkylsulfonyl, C₁₋₄ alkylamino, (C₁₋₄ alkyl)₂ amino, azetidiny, morpholinyl, piperazinyl, C₂₋₆ alkenyl and cyclopropyl are unsubstituted or optionally substituted with one or more groups independently selected from the group consisting of hydroxy, amino, halogen, C₁₋₄ alkyl, C₁₋₄ alkylamino, (C₁₋₄ alkyl)₂ amino, cyclopropyl, and C₁₋₄ alkylcarbonyloxy;

L is a bond;

ring A is 7-12 membered spiroheterocyclyl, wherein spiroheterocyclyl has one or two hetero atoms selected from the group consisting of O, S, and N, and contains at least one N, ring A is connected to L through N atom, and S atom can be optionally oxidized to S(O)₂;



each R₁ is independently selected from the group consisting of hydrogen, cyano, halogen, hydroxy, and unsubstituted or hydroxy-substituted C₁₋₄ alkyl; and

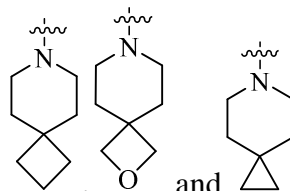
m is 0, 1, or 2.

~~9.10.~~ The compound or a pharmaceutically acceptable salt or a stereoisomer thereof according to claim ~~89~~,

wherein,

X₂ is N, and X₃ and X₄ are each independently CR₃ or N;

L is a bond;



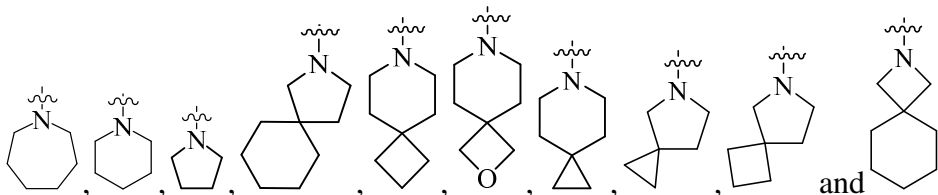
ring A is selected from the group consisting of ,  and ; and

10. 11._____The compound or a pharmaceutically acceptable salt or a stereoisomer thereof according to claim ~~34~~ or 5,

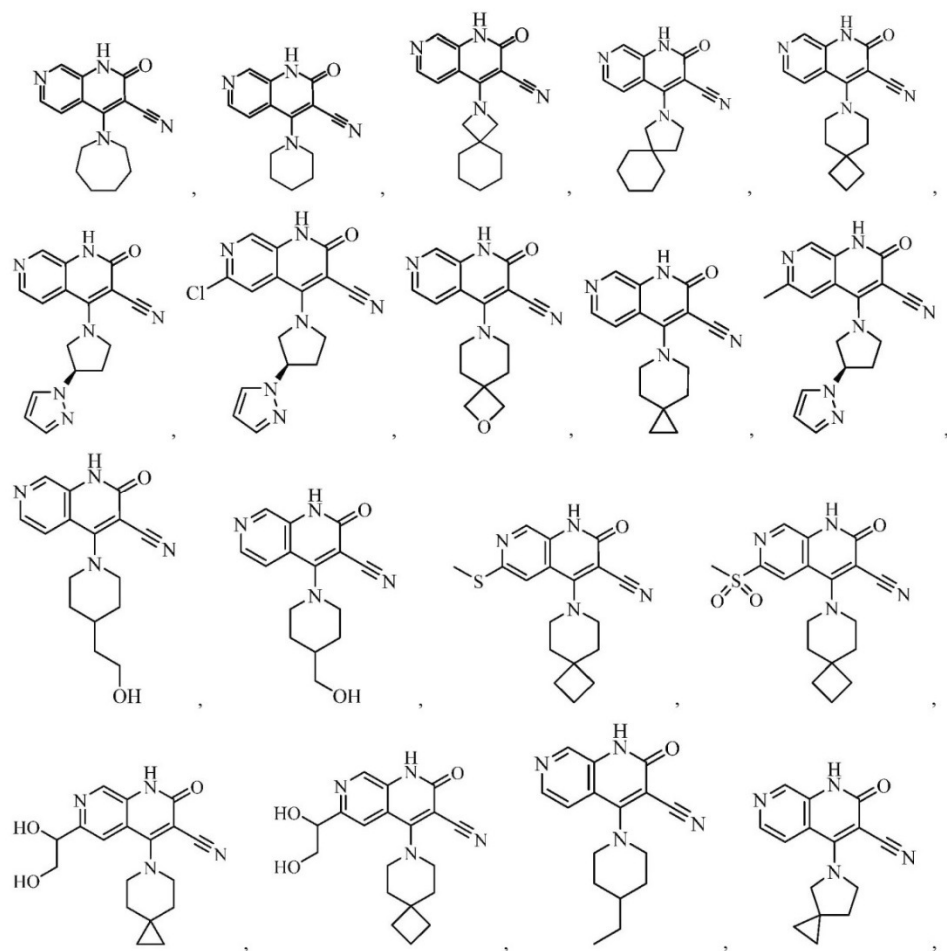
L is bond;

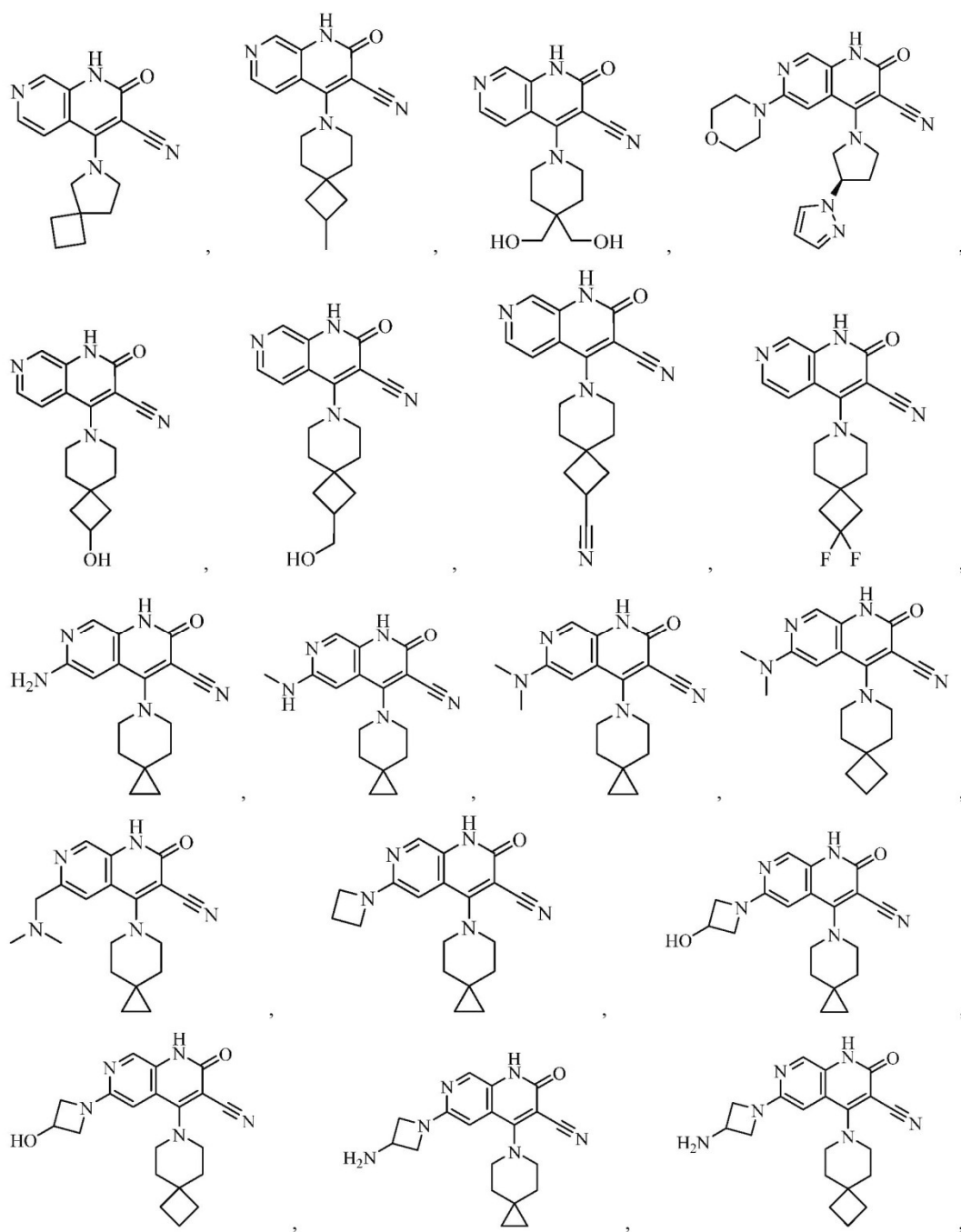
X_2 is N , and X_3 and X_4 are each independently CR_3 or N ; and

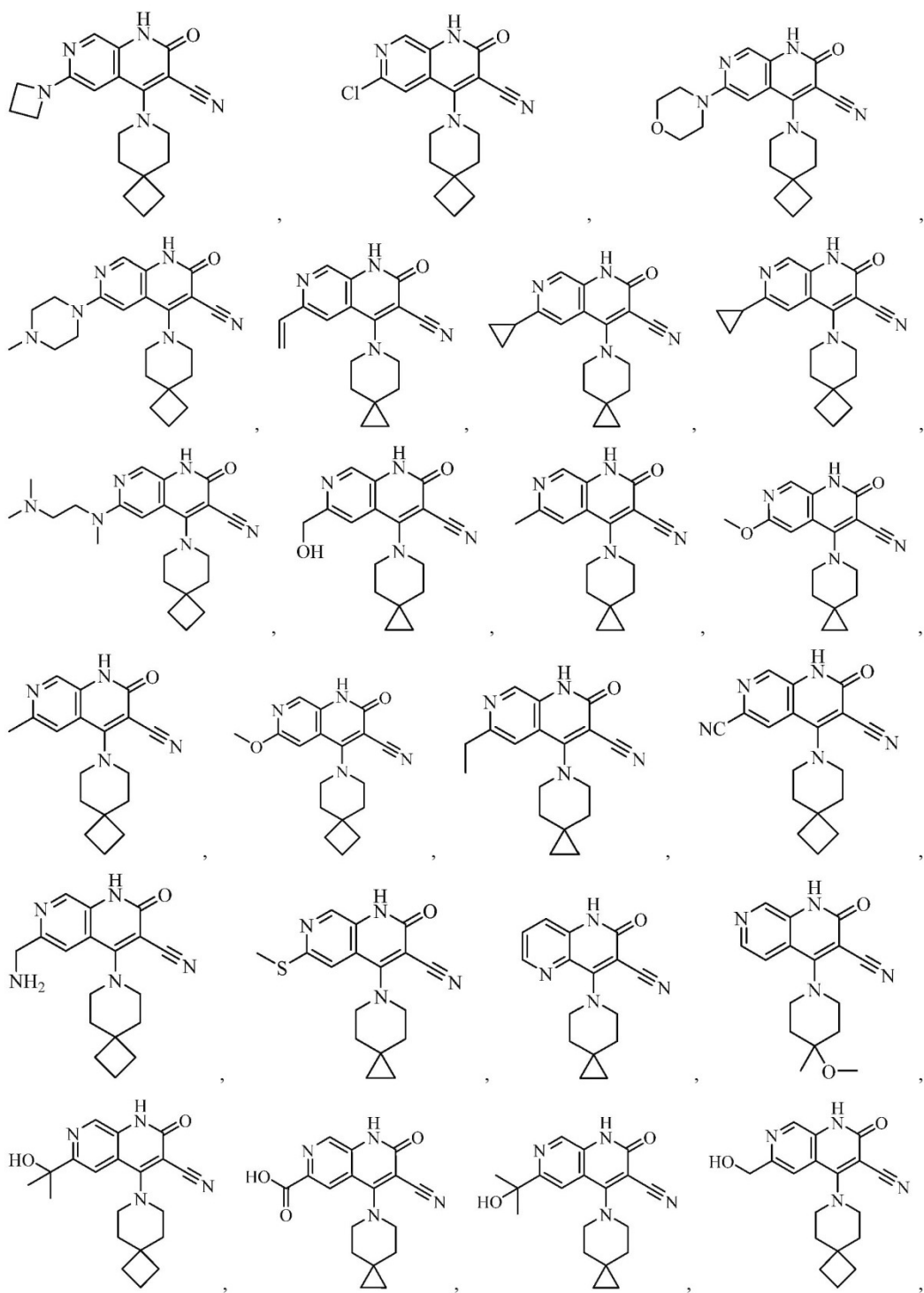
ring A is selected from the group consisting of:

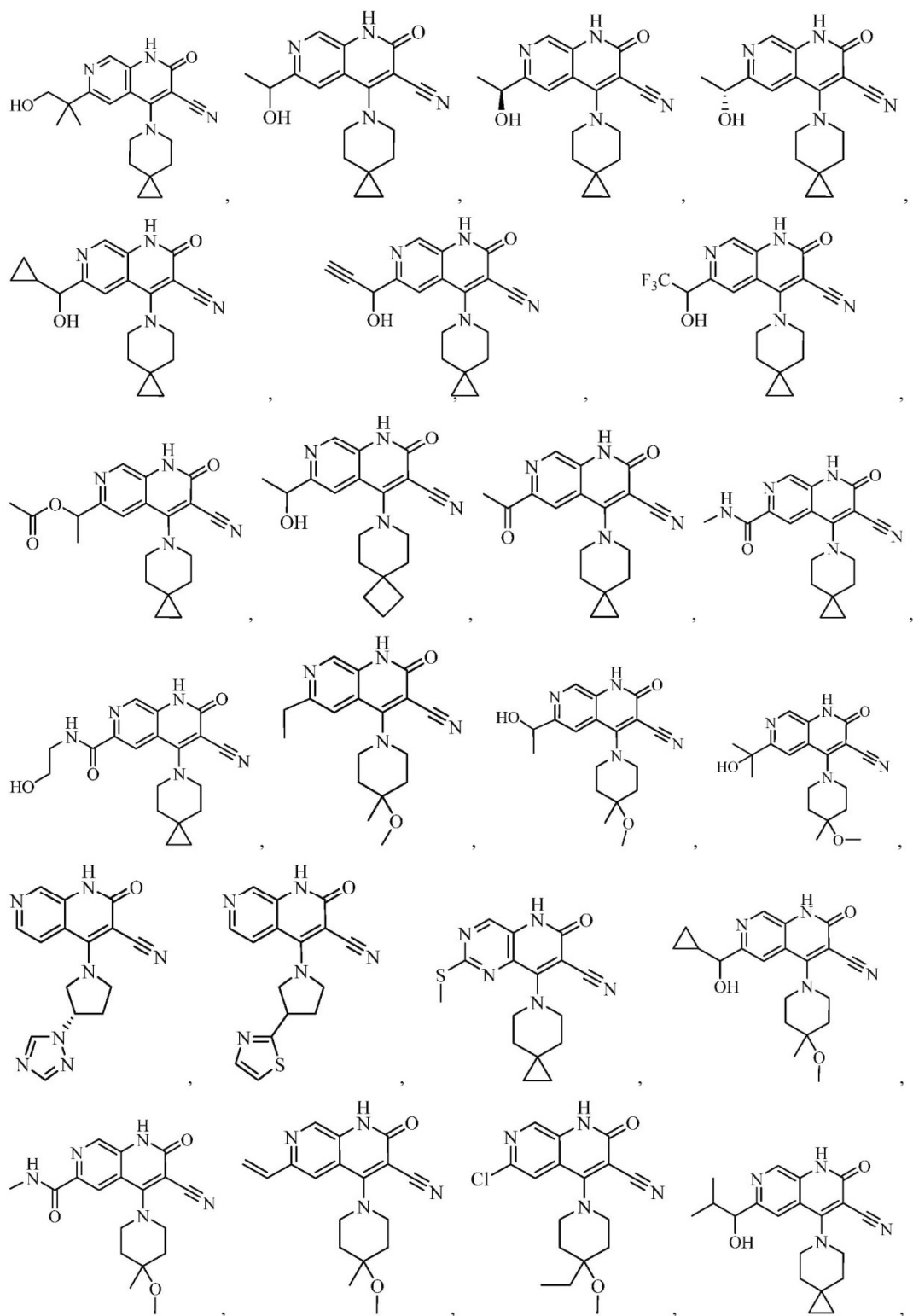


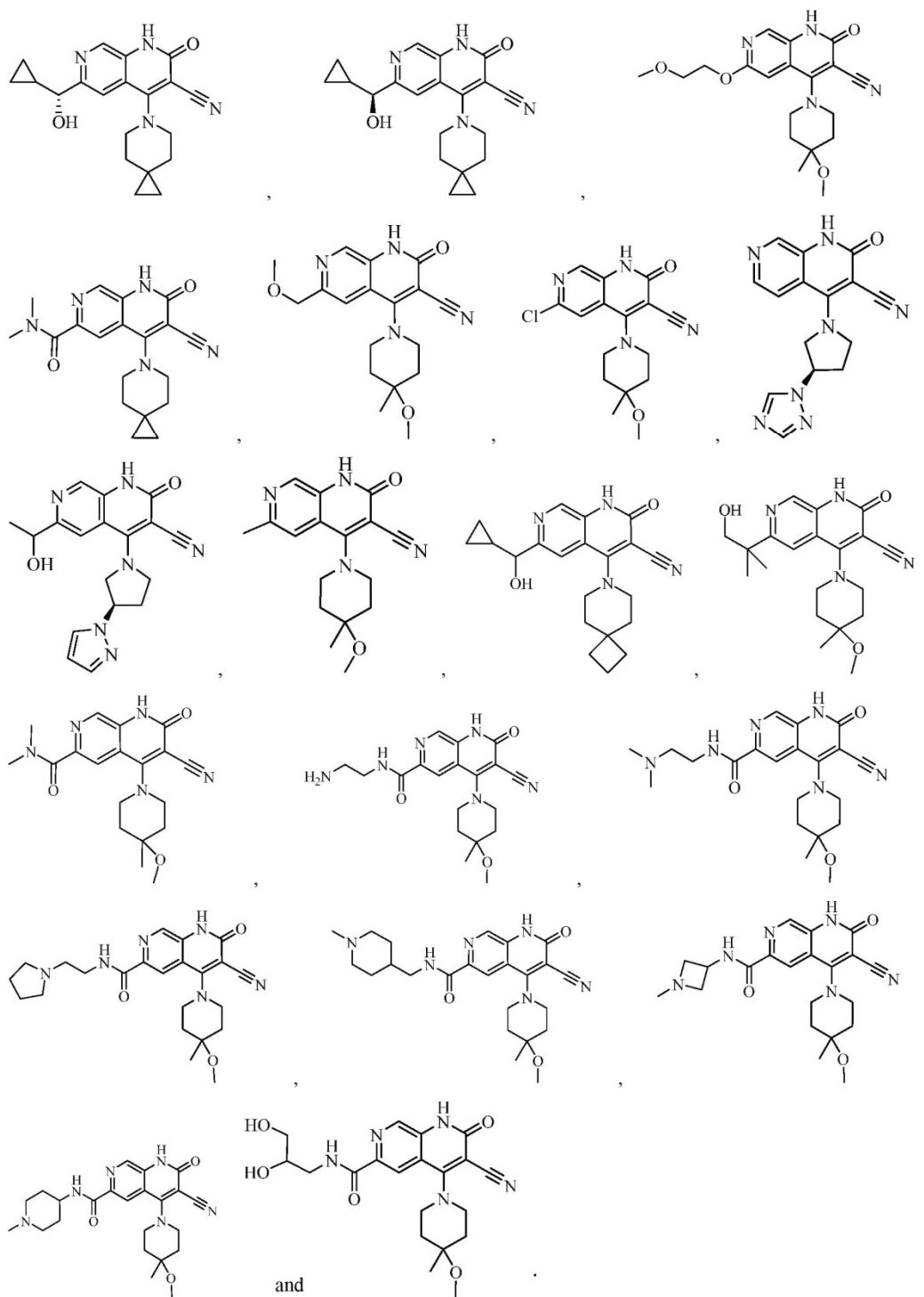
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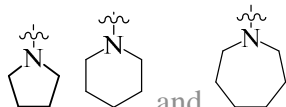


~~12.13.~~ A pharmaceutical composition comprising a compound or a pharmaceutically acceptable salt or a stereoisomer thereof according to ~~any one of claims 1-12~~claim 1, and one or more second therapeutically active agents.

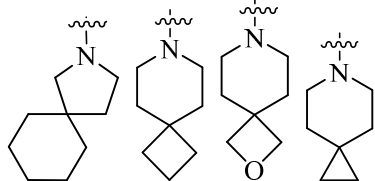
13.14. A pharmaceutical formulation comprising a compound or a pharmaceutically acceptable salt or a stereoisomer thereof according to ~~any one of claims 1-12, preferably, the pharmaceutical formulation comprises one or more pharmaceutically acceptable carriers~~claim 1.

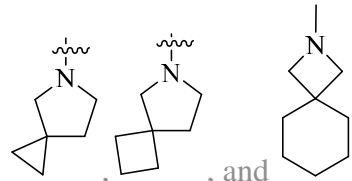
15. Use of the compound or a pharmaceutically acceptable salt or a stereoisomer thereof according to any one of claims 1-12, or the pharmaceutical composition according to claim 13 or the pharmaceutical formulation according to claim 14 in the manufacture of a medicament for ~~treating or preventing a PDE9 mediated related disease; preferably, the PDE9 mediated related disease is cognitive impairment caused by a central nervous system disorder, and more preferably, the cognitive impairment is selected from the group consisting of perception, attention, memory and learning impairment.~~

14. The compound or a pharmaceutically acceptable salt or a stereoisomer thereof according

to claim 5, wherein ring A is selected from the group consisting of  and .

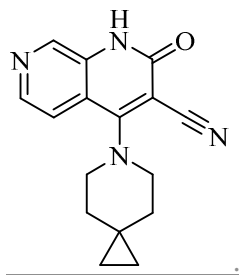
15. The compound or a pharmaceutically acceptable salt or a stereoisomer thereof according

to claim 8, wherein ring A is selected from the group consisting of  ,

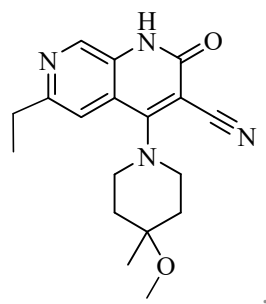
, and  .

16. The pharmaceutical formulation according to claim 13, wherein the pharmaceutical formulation comprises one or more pharmaceutically acceptable carriers.

17. A compound or a pharmaceutically acceptable salt thereof, wherein the compound is:



18. A compound or a pharmaceutically acceptable salt thereof, wherein the compound is:



19. A compound or a pharmaceutically acceptable salt thereof, wherein the compound is:

