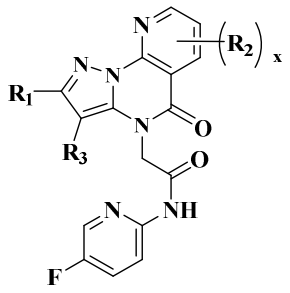
CLAIMS:

1. An acid salt of a compound of formula (I-a) or a stereoisomer thereof,



(I-a)

wherein:

R_1 is selected from the group consisting of hydrogen, deuterium, halogen, amino, hydroxy, cyano, nitro, C_{1-6} alkyl, C_{2-6} alkenyl, C_{2-6} alkynyl, C_{1-6} deuterated alkyl, C_{1-6} haloalkyl, C_{1-6} alkoxy, C_{1-6} haloalkoxy, C_{1-6} hydroxyalkyl, C_{3-12} cycloalkyl, $-(CH_2)_nC(O)R_a$, 3 to 12 membered heterocyclyl, C_{6-14} aryl and 5 to 14 membered heteroaryl, the amino, C_{1-6} alkyl, C_{2-6} alkenyl, C_{2-6} alkynyl, C_{1-6} deuterated alkyl, C_{1-6} haloalkyl, C_{1-6} alkoxy, C_{1-6} haloalkoxy, C_{1-6} hydroxyalkyl, C_{3-12} cycloalkyl, $-(CH_2)_nC(O)R_a$, 3 to 12 membered heterocyclyl, C_{6-14} aryl and 5 to 14 membered heteroaryl are each optionally substituted by one or more substituents selected from the group consisting of deuterium, halogen, amino, hydroxy, cyano, nitro, oxo, C_{1-6} alkyl, C_{2-6} alkenyl, C_{2-6} alkynyl, C_{1-6} deuterated alkyl, C_{1-6} haloalkyl, C_{1-6} alkoxy, C_{1-6} haloalkoxy, C_{1-6} hydroxyalkyl, cyano-substituted C_{1-6} alkyl, C_{3-12} cycloalkyl, 3 to 12 membered heterocyclyl, C_{6-12} aryl and 5 to 12 membered heteroaryl;

R_a is selected from the group consisting of hydrogen, deuterium, halogen, amino, nitro, hydroxy, cyano, C_{1-6} alkyl, C_{1-6} deuterated alkyl, C_{1-6} haloalkyl, C_{1-6} hydroxyalkyl, C_{1-6} alkoxy, C_{1-6} haloalkoxy, C_{2-6} alkenyl, C_{2-6} alkynyl, C_{3-8} cycloalkyl, 3 to 8 membered heterocyclyl, C_{6-10} aryl and 5 to 10 membered heteroaryl, the amino, C_{1-6} alkyl, C_{1-6} deuterated alkyl, C_{1-6} haloalkyl, C_{1-6} hydroxyalkyl, C_{1-6} alkoxy, C_{1-6} haloalkoxy, C_{2-6} alkenyl, C_{2-6} alkynyl, C_{3-8} cycloalkyl, 3 to 8 membered heterocyclyl, C_{6-10} aryl and 5 to 10 membered heteroaryl are each optionally substituted by one or more substituents selected from the group consisting of deuterium, halogen, amino, nitro, hydroxy, cyano, carboxy, oxo, thioxo, C_{1-6} alkyl, C_{1-6} deuterated alkyl, C_{1-6} haloalkyl, C_{1-6} hydroxyalkyl, C_{1-6} alkoxy, C_{1-6} haloalkoxy, C_{2-6} alkenyl, C_{2-6} alkynyl, C_{3-8} cycloalkyl, 3 to 8 membered heterocyclyl, C_{6-10} aryl and 5 to 10 membered heteroaryl;

R_2 is selected from the group consisting of hydrogen, deuterium, halogen, amino, hydroxy, cyano, nitro, C_{1-6} alkyl, C_{2-6} alkenyl, C_{2-6} alkynyl, C_{1-6} deuterated alkyl, C_{1-6} haloalkyl, C_{1-6} alkoxy, C_{1-6} haloalkoxy, C_{1-6} hydroxyalkyl, C_{3-12} cycloalkyl, 3 to 12 membered heterocyclyl, C_{6-14} aryl and 5 to 14 membered heteroaryl, the amino, C_{1-6} alkyl, C_{2-6} alkenyl, C_{2-6} alkynyl, C_{1-6} deuterated alkyl, C_{1-6} haloalkyl, C_{1-6} alkoxy, C_{1-6}

haloalkoxy, C_{1-6} hydroxyalkyl, C_{3-12} cycloalkyl, 3 to 12 membered heterocyclyl, C_{6-14} aryl and 5 to 14 membered heteroaryl are each optionally substituted by one or more substituents selected from the group consisting of deuterium, halogen, amino, hydroxy, cyano, nitro, oxo, C_{1-6} alkyl, C_{2-6} alkenyl, C_{2-6} alkynyl, C_{1-6} deuterated alkyl, C_{1-6} haloalkyl, C_{1-6} alkoxy, C_{1-6} haloalkoxy, C_{1-6} hydroxyalkyl, cyano-substituted C_{1-6} alkyl, C_{3-12} cycloalkyl, 3 to 12 membered heterocyclyl, C_{6-12} aryl and 5 to 12 membered heteroaryl;

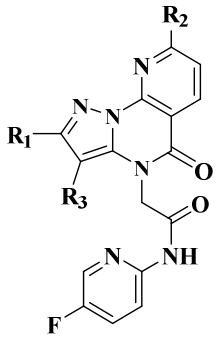
R_3 is selected from the group consisting of hydrogen, deuterium, halogen, amino, hydroxy, cyano, oxo, thioxo, C_{1-6} alkyl, C_{2-6} alkenyl, C_{2-6} alkynyl, C_{1-6} deuterated alkyl, C_{1-6} haloalkyl, C_{1-6} hydroxyalkyl, C_{1-6} alkoxy, C_{1-6} haloalkoxy, C_{3-8} cycloalkyl, 3 to 12 membered heterocyclyl, C_{6-14} aryl and 5 to 14 membered heteroaryl; and

x is 0, 1 or 2;

n is 0, 1 or 2;

the acid in the acid salt is an inorganic acid or an organic acid; wherein, the inorganic acid is selected from the group consisting of hydrochloric acid, sulfuric acid, nitric acid, hydrobromic acid, hydrofluoric acid, hydroiodic acid and phosphoric acid; the organic acid is selected from the group consisting of 2,5-dihydroxybenzoic acid, 1-hydroxy-2-naphthoic acid, acetic acid, ethanesulfonic acid, dichloroacetic acid, trichloroacetic acid, acetohydroxamic acid, adipic acid, benzenesulfonic acid, 4-chlorobenzenesulfonic acid, benzoic acid, 4-acetamidobenzoic acid, 4-aminobenzoic acid, capric acid, caproic acid, caprylic acid, cinnamic acid, citric acid, cyclohexane sulfamic acid, camphorsulfonic acid, aspartic acid, camphoric acid, gluconic acid, glucuronic acid, glutamic acid, erythorbic acid, lactic acid, malic acid, mandelic acid, pyroglutamic acid, tartaric acid, dodecyl sulfuric acid, dibenzoyl tartaric acid, ethane-1,2-disulfonic acid, ethanesulfonic acid, formic acid, fumaric acid, galactonic acid, gentisic acid, glutaric acid, 2-oxoglutaric acid, glycolic acid, hippuric acid, isethionic acid, lactobionic acid, ascorbic acid, aspartic acid, lauric acid, camphoric acid, maleic acid, malonic acid, methanesulfonic acid, 1,5-naphthalenedisulfonic acid, naphthalene-2-sulfonic acid, nicotinic acid, oleic acid, orotic acid, oxalic acid, palmitic acid, pamoic acid, propionic acid, salicylic acid, 4-aminosalicylic acid, sebacic acid, stearic acid, succinic acid, thiocyanic acid, undecenoic acid, trifluoroacetic acid, benzenesulfonic acid, *p*-toluenesulfonic acid and L-malic acid.

2. The acid salt according to claim 1, characterized in that the formula (I-a) is further as shown in formula (II-a):



(II-a)

R_1 is selected from the group consisting of hydrogen, halogen, amino, cyano, C_{1-3} alkyl, C_{2-6} alkenyl, C_{1-6} haloalkyl, C_{1-6} alkoxy, C_{1-6} haloalkoxy, C_{1-6} hydroxyalkyl, C_{3-8} cycloalkyl, $-(CH_2)_nC(O)R_a$, 3 to 8 membered heterocyclyl containing 1 to 3 atoms selected from the group consisting of nitrogen, oxygen and sulfur, C_{6-10} aryl and 5 to 10 membered heteroaryl containing 1 to 3 atoms selected from the group consisting of nitrogen, oxygen and sulfur, the amino, C_{1-6} alkyl, C_{2-6} alkenyl, C_{1-6} haloalkyl, C_{1-6} alkoxy, C_{1-6} haloalkoxy, C_{1-6} hydroxyalkyl, $-(CH_2)_nC(O)R_a$, C_{3-8} cycloalkyl, 3 to 8 membered heterocyclyl containing 1 to 3 atoms selected from the group consisting of nitrogen, oxygen and sulfur, C_{6-10} aryl and 5 to 10 membered heteroaryl containing 1 to 3 atoms selected from the group consisting of nitrogen, oxygen and sulfur are each optionally substituted by one or more substituents selected from the group consisting of deuterium, halogen, amino, hydroxy, cyano, nitro, oxo, C_{1-3} alkyl, C_{1-3} deuterated alkyl, C_{1-3} haloalkyl, C_{1-3} alkoxy, C_{1-3} haloalkoxy, C_{1-3} hydroxyalkyl, cyano-substituted C_{1-3} alkyl, C_{3-8} cycloalkyl, 3 to 8 membered heterocyclyl, C_{6-10} aryl and 5 to 10 membered heteroaryl;

R_a is selected from the group consisting of hydrogen, deuterium, halogen, amino, cyano, C_{1-3} alkyl, C_{1-3} deuterated alkyl, C_{1-3} haloalkyl, C_{1-3} hydroxyalkyl, C_{1-3} alkoxy, C_{1-3} haloalkoxy, C_{3-6} cycloalkyl and 4 to 6 membered heterocyclyl containing 1 to 2 atoms selected from the group consisting of N and O, the amino, C_{1-3} alkyl, C_{1-3} deuterated alkyl, C_{1-3} haloalkyl, C_{1-3} hydroxyalkyl, C_{1-3} alkoxy, C_{1-3} haloalkoxy, C_{3-6} cycloalkyl and 4 to 6 membered heterocyclyl containing 1 to 2 atoms selected from the group consisting of N and O are each optionally substituted by one or more substituents selected from the group consisting of deuterium, halogen, amino, hydroxy, cyano, nitro, oxo, C_{1-3} alkyl, C_{1-3} deuterated alkyl, C_{1-3} haloalkyl, C_{1-3} alkoxy, C_{1-3} haloalkoxy, C_{1-3} hydroxyalkyl, cyano-substituted C_{1-3} alkyl, C_{3-8} cycloalkyl, 3 to 8 membered heterocyclyl, C_{6-10} aryl and 5 to 10 membered heteroaryl;

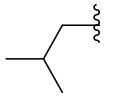
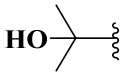
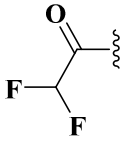
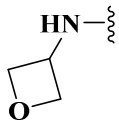
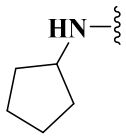
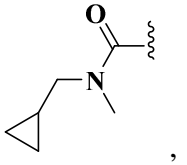
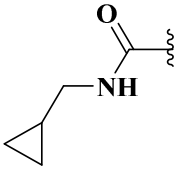
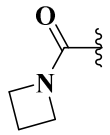
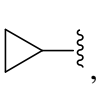
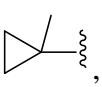
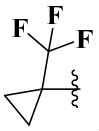
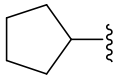
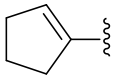
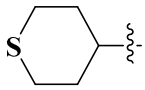
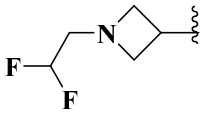
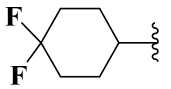
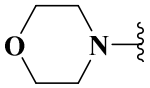
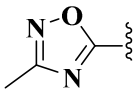
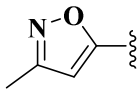
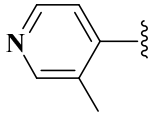
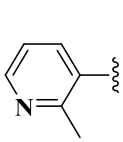
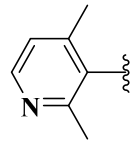
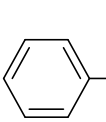
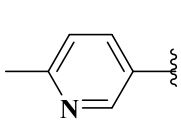
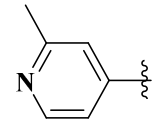
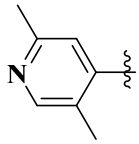
R_2 is selected from the group consisting of hydrogen, deuterium, halogen, amino, hydroxy, cyano, nitro, C_{1-3} alkyl, C_{2-3} alkenyl, C_{2-3} alkynyl, C_{1-3} deuterated alkyl, C_{1-3} haloalkyl, C_{1-3} alkoxy, C_{1-3} haloalkoxy, C_{1-3} hydroxyalkyl, C_{3-8} cycloalkyl, 3 to 8 membered heterocyclyl, C_{6-10} aryl and 5 to 10 membered heteroaryl;

R_3 is selected from the group consisting of hydrogen, deuterium, halogen, amino, hydroxy, cyano, oxo, thioxo, C_{1-3} alkyl, C_{2-3} alkenyl, C_{2-3} alkynyl, C_{1-3} deuterated alkyl,

C_{1-3} haloalkyl, C_{1-3} hydroxyalkyl, C_{1-3} alkoxy, C_{1-3} haloalkoxy, C_{3-8} cycloalkyl, 3 to 8 membered heterocyclyl, C_{6-10} aryl and 5 to 1 membered heteroaryl.

3. The acid salt according to claim 1 or 2, characterized in that,

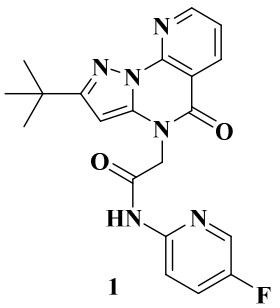
R_1 is selected from the group consisting of:

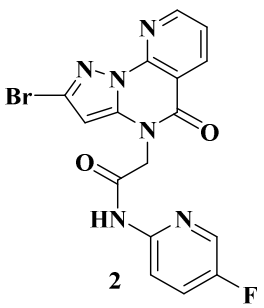
-H, -NH_2, -F, -Cl, -Br, -CN, -CH_3, -CH_2CH_3, -CF_3, , , , , , , , , , , , , , , , , , , , , , , , , , , , , , and ;

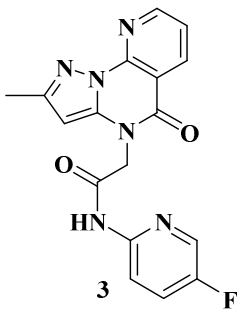
R_2 is selected from the group consisting of hydrogen, amino, cyano, fluorine, chlorine, bromine, methyl, isopropyl, trifluoromethyl, methoxy, cyclopropyl and morpholinyl;

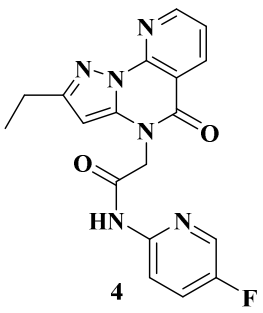
R_3 is selected from the group consisting of hydrogen and cyano.

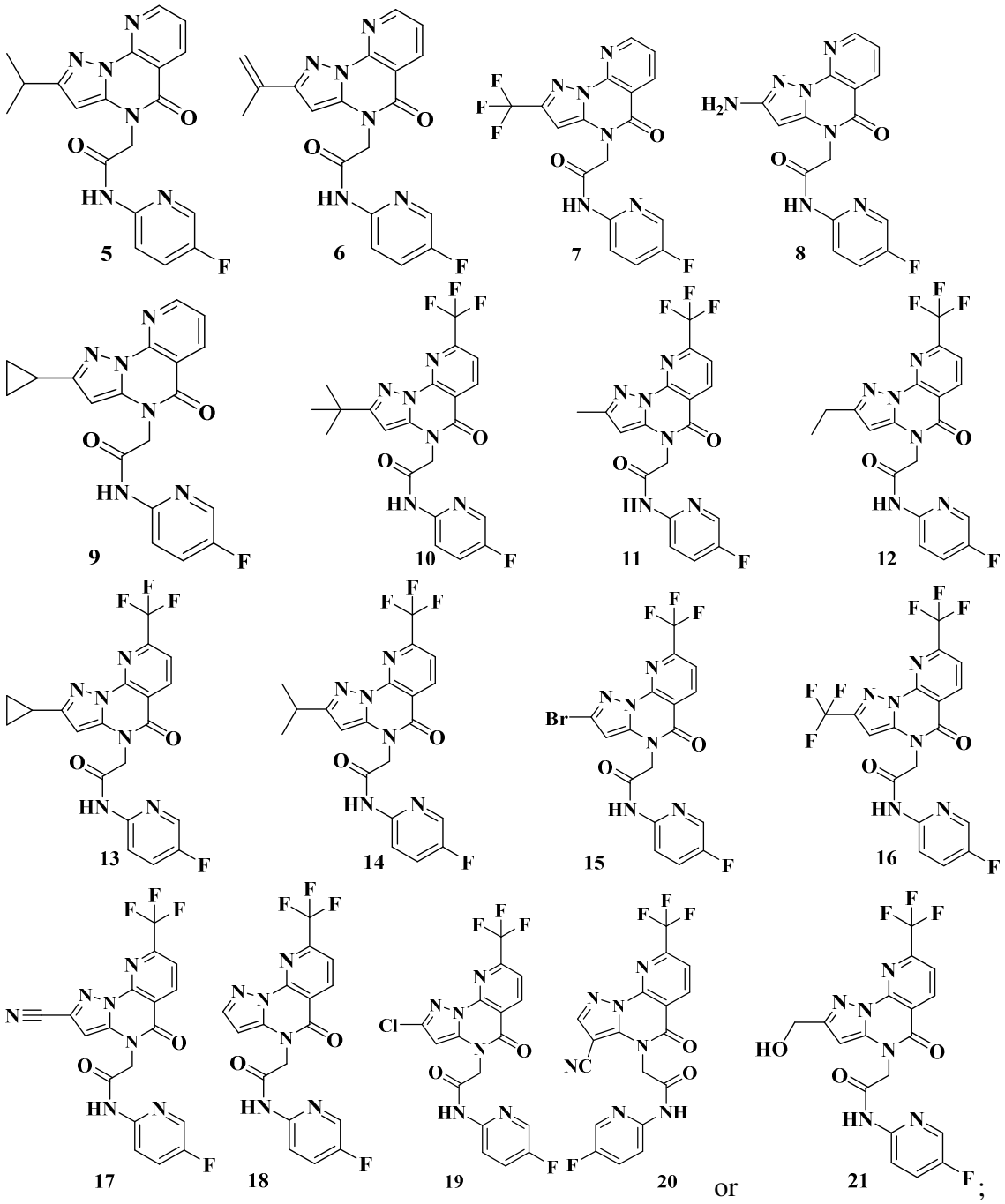
4. The acid salt according to any one of claims 1 to 3, characterized in that, the specific structure of the compound is as follows:


1


2


3


4



or ;

the acid in the acid salt is selected from the group consisting of isethionic acid, hydrochloric acid, sulfuric acid, 1,5-naphthalene disulfonic acid, methanesulfonic acid, hydrobromic acid, ethanesulfonic acid, phosphoric acid, benzenesulfonic acid, oxalic acid, maleic acid, adipic acid, hydrochloric acid, citric acid, malonic acid, L-malic acid, pamoic acid, *p*-toluenesulfonic acid and fumaric acid.

5. The acid salt according to any one of claims 1 to 4, characterized in that, the number of acid in the acid salt is 0.2, 0.5, 1, 1.5, 2, 2.5 or 3.

6. The acid salt according to any one of claims 1 to 5, characterized in that, the acid salt is a hydrate or anhydrate; when the acid salt is a hydrate, the number of water is 0.2,

0.5, 1, 1.5, 2, 2.5 or 3.

7. The acid salt according to any one of claims 1 to 6, characterized in that, the acid salt is a crystal form;

wherein, the crystal form is a crystal form of the acid salt of compound 2-(2-(*tert*-butyl)-5-oxopyrazolo[1,5-a]pyrido[3,2-e]pyrimidin-4(5H)-yl)-N-(5-fluoropyridin-2-yl)acetamide;

a crystal form of the acid salt of 2-(2-(*tert*-butyl)-5-oxo-8-(trifluoromethyl)pyrazolo[1,5-a]pyrido[3,2-e]pyrimidin-4(5H)-yl)-N-(5-fluoropyridin-2-yl)acetamide;

a crystal form of the acid salt of 2-(2-ethyl-5-oxo-8-(trifluoromethyl)pyrazolo[1,5-a]pyrido[3,2-e]pyrimidin-4(5H)-yl)-N-(5-fluoropyridin-2-yl)acetamide;

a crystal form of the acid salt of 2-(2-cyclopropyl-5-oxo-8-(trifluoromethyl)pyrazolo[1,5-a]pyrido[3,2-e]pyrimidin-4(5H)-yl)-N-(5-fluoropyridin-2-yl)acetamide;

a crystal form of the acid salt of 2-(2,5-dimethylpyridin-4-yl)-5-oxo-8-(trifluoromethyl)pyrazolo[1,5-a]pyrido[3,2-e]pyrimidin-4(5H)-yl)-N-(5-fluoropyridin-2-yl)acetamide;

a crystal form of the acid salt of N-(5-fluoropyridin-2-yl)-2-(2-(1-methylcyclopropyl)-5-oxo-8-(trifluoromethyl)pyrazolo[1,5-a]pyrido[3,2-e]pyrimidin-4(5H)-yl)acetamide;

a crystal form of the acid salt of 2-(2-bromo-5-oxo-8-(trifluoromethyl)pyrazolo[1,5-a]pyrido[3,2-e]pyrimidin-4(5H)-yl)-N-(5-fluoropyridin-2-yl)acetamide;

a crystal form of the acid salt of 2-(2-cyano-5-oxo-8-(trifluoromethyl)pyrazolo[1,5-a]pyrido[3,2-e]pyrimidin-4(5H)-yl)-N-(5-fluoropyridin-2-yl)acetamide;

a crystal form of the acid salt of N-(5-fluoropyridin-2-yl)-2-(5-oxo-8-(trifluoromethyl)pyrazolo[1,5-a]pyrido[3,2-e]pyrimidin-4(5H)-yl)acetamide;

a crystal form of the acid salt of 2-(3-cyano-5-oxo-8-(trifluoromethyl)pyrazolo[1,5-a]pyrido[3,2-e]pyrimidin-4(5H)-yl)-N-(5-fluoropyridin-2-yl)acetamide;

the crystal form of the acid salt is a crystal form of isethionate, a crystal form of sulfate, a crystal form of hydrochloride, a crystal form of 1,5-naphthalene disulfonate, a crystal form of methanesulfonate, a crystal form of ethanesulfonate, a crystal form of hydrobromide, a crystal form of phosphate, a crystal form of benzenesulfonate, a crystal form of oxalate, a crystal form of maleate, a crystal form of adipate, a crystal form of hydrochloride, a crystal form of citrate, a crystal form of malonate, a crystal form of L-malate, a crystal form of pamoate, a crystal form of *p*-toluenesulfonate or a crystal

form of fumarate.

8. The crystal form of the acid salt according to claim 7, characterized in that,

the crystal form of the acid salt 2-(2-cyano-5-oxo-8-(trifluoromethyl)pyrazolo[1,5-a]pyrido[3,2-e]pyrimidin-4(5H)-yl)-N-(5-fluoropyridin-2-yl)acetamide is:

crystal form A of methanesulfonate, the X-ray powder diffraction pattern of which has a diffraction peak of 13.7±0.2°, or a diffraction peak of 21.9±0.2°, or a diffraction peak of 20.4±0.2°, or a diffraction peak of 15.4±0.2°, or a diffraction peak of 19.6±0.2°, or a diffraction peak of 16.4±0.2°, or a diffraction peak of 9.3±0.2°, or a diffraction peak of 5.3±0.2°, or a diffraction peak of 7.9±0.2°, or a diffraction peak of 11.9±0.2°; comprises any 6, 7 or 8 of the above diffraction peaks;

or, crystal form A of ethanesulfonate, the X-ray powder diffraction pattern of which has a diffraction peak of 15.0±0.2°, or a diffraction peak of 21.1±0.2°, or a diffraction peak of 23.1±0.2°, or a diffraction peak of 19.8±0.2°, or a diffraction peak of 12.5±0.2°, or a diffraction peak of 9.0±0.2°, or a diffraction peak of 12.3±0.2°, or a diffraction peak of 24.6±0.2°, or a diffraction peak of 10.3±0.2°, or a diffraction peak of 6.1±0.2°; comprises any 6, 7 or 8 of the above diffraction peaks;

or, crystal form A of sulfate, the X-ray powder diffraction pattern of which has a diffraction peak of 22.5±0.2°, or a diffraction peak of 15.9±0.2°, or a diffraction peak of 22.3±0.2°, or a diffraction peak of 16.8±0.2°, or a diffraction peak of 22.9±0.2°, or a diffraction peak of 32.1±0.2°, or a diffraction peak of 14.0±0.2°, or a diffraction peak of 21.1±0.2°, or a diffraction peak of 11.2±0.2°, or a diffraction peak of 26.1±0.2°; comprises any 6, 7 or 8 of the above diffraction peaks;

or, crystal form B of sulfate, the X-ray powder diffraction pattern of which has a diffraction peak of 15.3±0.2°, or a diffraction peak of 21.5±0.2°, or a diffraction peak of 10.6±0.2°, or a diffraction peak of 19.8±0.2°, or a diffraction peak of 20.1±0.2°, or a diffraction peak of 12.6±0.2°, or a diffraction peak of 25.2±0.2°, or a diffraction peak of 9.2±0.2°, or a diffraction peak of 9.9±0.2°, or a diffraction peak of 23.4±0.2°; comprises any 6, 7 or 8 of the above diffraction peaks;

or, crystal form A of hydrochloride, the X-ray powder diffraction pattern of which has a diffraction peak of 15.0±0.2°, or a diffraction peak of 23.9±0.2°, or a diffraction peak of 9.7±0.2°, or a diffraction peak of 5.3±0.2°, or a diffraction peak of 24.8±0.2°, or a diffraction peak of 29.5±0.2°, or a diffraction peak of 7.5±0.2°, or a diffraction peak of 21.8±0.2°, or a diffraction peak of 21.3±0.2°, or a diffraction peak of 10.6±0.2°; comprises any 6, 7 or 8 of the above diffraction peaks;

or, crystal form B of hydrochloride, the X-ray powder diffraction pattern of which has a diffraction peak of 15.9±0.2°, or a diffraction peak of 22.2±0.2°, or a diffraction peak of 5.2±0.2°, or a diffraction peak of 21.7±0.2°, or a diffraction peak of 26.0±0.2°, or a diffraction peak of 4.6±0.2°, or a diffraction peak of 28.4±0.2°, or a diffraction peak of 9.2±0.2°, or a diffraction peak of 17.3±0.2°, or a diffraction peak of 15.2±0.2°;

comprises any 6, 7 or 8 of the above diffraction peaks;

or, crystal form A of hydrobromide, the X-ray powder diffraction pattern of which has a diffraction peak of 5.3±0.2°, or a diffraction peak of 22.7±0.2°, or a diffraction peak of 14.8±0.2°, or a diffraction peak of 10.5±0.2°, or a diffraction peak of 22.5±0.2°, or a diffraction peak of 28.0±0.2°, or a diffraction peak of 30.0±0.2°, or a diffraction peak of 23.4±0.2°, or a diffraction peak of 23.3±0.2°, or a diffraction peak of 26.5±0.2°; comprises any 6, 7 or 8 of the above diffraction peaks;

or, crystal form B of hydrobromide, the X-ray powder diffraction pattern of which has a diffraction peak of 23.4±0.2°, or a diffraction peak of 15.9±0.2°, or a diffraction peak of 16.2±0.2°, or a diffraction peak of 14.2±0.2°, or a diffraction peak of 5.3±0.2°, or a diffraction peak of 10.6±0.2°, or a diffraction peak of 23.1±0.2°, or a diffraction peak of 24.1±0.2°, or a diffraction peak of 14.8±0.2°, or a diffraction peak of 9.5±0.2°; comprises any 6, 7 or 8 of the above diffraction peaks;

or, crystal form C of hydrobromide, the X-ray powder diffraction pattern of which has a diffraction peak of 5.2±0.2°, or a diffraction peak of 15.7±0.2°, or a diffraction peak of 22.3±0.2°, or a diffraction peak of 10.5±0.2°, or a diffraction peak of 17.4±0.2°, or a diffraction peak of 38.0±0.2°, or a diffraction peak of 26.3±0.2°, or a diffraction peak of 28.0±0.2°; comprises any 6, 7 or 8 of the above diffraction peaks.

9. The crystal form of the acid salt according to claim 7, characterized in that,

the crystal form of the acid salt 2-(2-cyano-5-oxo-8-(trifluoromethyl)pyrazolo[1,5-a]pyrido[3,2-e]pyrimidin-4(5H)-yl)-N-(5-fluoropyridin-2-yl)acetamide is:

crystal form A of methanesulfonate, the X-ray powder diffraction pattern of crystal form A of methanesulfonate comprises 3 of the diffraction peaks at 2θ of 13.7±0.2°, 16.4±0.2°, 21.9±0.2°; further comprise 3, 4 or 5 of the diffraction peak at 2θ of 13.9±0.2°, 20.4±0.2°, 15.4±0.2°, 5.3±0.2°, 11.9±0.2°, 9.3±0.2°;

or, crystal form A of ethanesulfonate, the X-ray powder diffraction pattern of crystal form A of ethanesulfonate comprises 3 of the diffraction peaks at 2θ of 15.0±0.2°, 21.1±0.2°, 23.1±0.2°; further comprise 3, 4 or 5 of the diffraction peak at 2θ of 19.8±0.2°, 12.5±0.2°, 9.0±0.2°, 12.3±0.2°, 24.6±0.2°;

or, crystal form A of sulfate, the X-ray powder diffraction pattern of crystal form A of sulfate comprises 3 of the diffraction peaks at 2θ of 22.5±0.2°, 15.9±0.2°, 22.3±0.2°; further comprise 3, 4 or 5 of the one diffraction peak at 2θ of 16.8±0.2°, 22.9±0.2°, 32.1±0.2°, 14.0±0.2°, 21.1±0.2°;

or, crystal form B of sulfate, the X-ray powder diffraction pattern of crystal form B of sulfate comprises 3 of the diffraction peaks at 2θ of 15.3±0.2°, 21.5±0.2°, 10.6±0.2°; further comprise 3, 4 or 5 of the diffraction peak at 2θ of 19.8±0.2°, 20.1±0.2°, 12.6±0.2°, 25.2±0.2°, 9.2±0.2°;

or, crystal form A of hydrochloride, the X-ray powder diffraction pattern of crystal form A of hydrochloride comprises 3 of the diffraction peaks at 2θ of 15.0±0.2°,

23.9±0.2°, 9.7±0.2°; further comprise 3, 4 or 5 of the diffraction peak at 2θ of 5.3±0.2°, 24.8±0.2°, 29.5±0.2°, 7.5±0.2°, 21.8±0.2°;

or, crystal form B of hydrochloride, the X-ray powder diffraction pattern of crystal form B of hydrochloride comprises 3 of the diffraction peaks at 2θ of 15.9±0.2°, 22.2±0.2°, 5.2±0.2°; further comprise 3, 4 or 5 of the diffraction peak at 2θ of 21.7±0.2°, 26.0±0.2°, 4.6±0.2°, 28.4±0.2°, 9.2±0.2°;

or, crystal form A of hydrobromide, the X-ray powder diffraction pattern of crystal form A of hydrobromide comprises 3 of the diffraction peaks at 2θ of 5.3±0.2°, 22.7±0.2°, 14.8±0.2°; optionally, can further comprise 3, 4 or 5 of the diffraction peak at 2θ of 10.5±0.2°, 22.5±0.2°, 28.0±0.2°, 30.0±0.2°, 23.4±0.2°;

or, crystal form B of hydrobromide, the X-ray powder diffraction pattern of crystal form B of hydrobromide comprises 3 of the diffraction peaks at 2θ of 23.4±0.2°, 15.9±0.2°, 16.2±0.2°; optionally, can further comprise 3, 4 or 5 of the diffraction peak at 2θ of 14.2±0.2°, 5.3±0.2°, 10.6±0.2°, 23.1±0.2°, 24.1±0.2°;

or, crystal form C of hydrobromide, the X-ray powder diffraction pattern of crystal form C of hydrobromide comprises 3 of the diffraction peaks at 2θ of 5.2±0.2°, 15.7±0.2°, 22.3±0.2°; further comprise 3, 4 or 5 of the diffraction peak at 2θ of 10.5±0.2°, 17.4±0.2°, 38.0±0.2°, 26.3±0.2°, 28.0±0.2°.

10. The crystal form of the acid salt according to claim 9, characterized in that,

the X-ray powder diffraction pattern of crystal form A of methanesulfonate optionally further comprises one or more diffraction peaks at 2θ of 7.9±0.2°, 19.6±0.2°, 17.6±0.2°, 18.8±0.2°, 21.0±0.2°, 23.3±0.2°, 24.1±0.2°;

the X-ray powder diffraction pattern of crystal form A of ethanesulfonate optionally further comprises one or more diffraction peaks at 2θ of 10.3±0.2°, 6.1±0.2°, 16.1±0.2°, 19.2±0.2°, 23.6±0.2°, 30.7±0.2°, 9.6±0.2°;

the X-ray powder diffraction pattern of crystal form A of sulfate optionally also comprises one or more diffraction peaks at 2θ of 11.2±0.2°, 26.1±0.2°, 28.2±0.2°, 37.8±0.2°, 15.5±0.2°, 26.5±0.2°, 36.4±0.2°;

the X-ray powder diffraction pattern of crystal form B of sulfate optionally further comprises one or more diffraction peaks at 2θ of 9.9±0.2°, 23.4±0.2°, 6.3±0.2°, 16.7±0.2°, 23.9±0.2°, 33.8±0.2°, 16.3±0.2°;

the X-ray powder diffraction pattern of crystal form A of hydrochloride optionally also comprises one or more diffraction peaks at 2θ of 21.3±0.2°, 10.6±0.2°, 16.9±0.2°, 16.0±0.2°, 18.4±0.2°, 25.8±0.2°, 28.4±0.2°;

the X-ray powder diffraction pattern of crystal form B of hydrochloride optionally further comprises one or more diffraction peaks at 2θ of 17.3±0.2°, 15.2±0.2°, 10.5±0.2°, 38.0±0.2°, 20.3±0.2°, 23.8±0.2°, 29.5±0.2°;

the X-ray powder diffraction pattern of crystal form A of hydrobromide optionally also comprises one or more diffraction peaks at 2θ of 23.3±0.2°, 26.5±0.2°, 34.9±0.2°, 15.8±0.2°, 25.0±0.2°, 31.9±0.2°, 37.0±0.2°;

the X-ray powder diffraction pattern of crystal form B of hydrobromide optionally also comprises one or more diffraction peaks at 2θ of 14.8±0.2°, 9.5±0.2°, 16.9±0.2°, 13.9±0.2°, 29.5±0.2°, 32.2±0.2°, 22.2±0.2°.

11. The crystal form of the acid salt according to claim 7, characterized in that,

the crystal form of the acid salt 2-(2-cyano-5-oxo-8-(trifluoromethyl)pyrazolo[1,5-a]pyrido[3,2-e]pyrimidin-4(5H)-yl)-N-(5-fluoropyridin-2-yl)acetamide is:

crystal form A of methanesulfonate, the X-ray powder diffraction pattern of crystal form A of methanesulfonate comprises 6, 8 or 10 of the diffraction peaks at 2θ of 5.3±0.2°, 7.9±0.2°, 9.3±0.2°, 11.9±0.2°, 13.7±0.2°, 13.9±0.2°, 15.4±0.2°, 16.4±0.2°, 17.6±0.2°, 18.8±0.2°, 19.6±0.2°, 20.4±0.2°, 21.0±0.2°, 21.9±0.2°, 23.3±0.2°, 24.1±0.2°;

or, crystal form A of ethanesulfonate, the X-ray powder diffraction pattern of crystal form A of ethanesulfonate comprises 6, 8 or 10 of the diffraction peaks at 2θ of 15.0±0.2°, 21.1±0.2°, 23.1±0.2°, 19.8±0.2°, 12.5±0.2°, 9.0±0.2°, 12.3±0.2°, 24.6±0.2°, 10.3±0.2°, 6.1±0.2°, 16.1±0.2°, 19.2±0.2°, 23.6±0.2°, 30.7±0.2°, 9.6±0.2°;

or, crystal form A of sulfate, the X-ray powder diffraction pattern of crystal form A of sulfate comprises 6, 8 or 10 of the diffraction peaks at 2θ of 22.5±0.2°, 15.9±0.2°, 22.3±0.2°, 16.8±0.2°, 22.9±0.2°, 32.1±0.2°, 14.0±0.2°, 21.1±0.2°, 11.2±0.2°, 26.1±0.2°, 28.2±0.2°, 37.8±0.2°, 15.5±0.2°, 26.5±0.2°, 36.4±0.2°;

or, crystal form B of sulfate, the X-ray powder diffraction pattern of crystal form B of sulfate comprises 6, 8 or 10 of the diffraction peaks at 2θ of 15.3±0.2°, 21.5±0.2°, 10.6±0.2°, 19.8±0.2°, 20.1±0.2°, 12.6±0.2°, 25.2±0.2°, 9.2±0.2°, 9.9±0.2°, 23.4±0.2°, 6.3±0.2°, 16.7±0.2°, 23.9±0.2°, 33.8±0.2°, 16.3±0.2°;

or, crystal form A of hydrochloride, the X-ray powder diffraction pattern of crystal form A of hydrochloride comprises 6, 8 or 10 of the diffraction peaks at 2θ of 15.0±0.2°, 23.9±0.2°, 9.7±0.2°, 5.3±0.2°, 24.8±0.2°, 29.5±0.2°, 7.5±0.2°, 21.8±0.2°, 21.3±0.2°, 10.6±0.2°, 16.9±0.2°, 16.0±0.2°, 18.4±0.2°, 25.8±0.2°, 28.4±0.2°;

or, crystal form B of hydrochloride, the X-ray powder diffraction pattern of crystal form B of hydrochloride comprises 6, 8 or 10 of the diffraction peaks at 2θ of 15.9±0.2°, 22.2±0.2°, 5.2±0.2°, 21.7±0.2°, 26.0±0.2°, 4.6±0.2°, 28.4±0.2°, 9.2±0.2°, 17.3±0.2°, 15.2±0.2°, 10.5±0.2°, 38.0±0.2°, 20.3±0.2°, 23.8±0.2°, 29.5±0.2°;

or, crystal form A of hydrobromide, the X-ray powder diffraction pattern of crystal form A of hydrobromide comprises 6, 8 or 10 of the diffraction peaks at 2θ of 5.3±0.2°, 22.7±0.2°, 14.8±0.2°, 10.5±0.2°, 22.5±0.2°, 28.0±0.2°, 30.0±0.2°, 23.4±0.2°, 23.3±0.2°, 26.5±0.2°, 34.9±0.2°, 15.8±0.2°, 25.0±0.2°, 31.9±0.2°, 37.0±0.2°;

or, crystal form B of hydrobromide, the X-ray powder diffraction pattern of crystal form B of hydrobromide comprises 6, 8 or 10 of the diffraction peaks at 2θ of 23.4±0.2°, 15.9±0.2°, 16.2±0.2°, 14.2±0.2°, 5.3±0.2°, 10.6±0.2°, 23.1±0.2°, 24.1±0.2°, 14.8±0.2°, 9.5±0.2°, 16.9±0.2°, 13.9±0.2°, 29.5±0.2°, 32.2±0.2°, 22.2±0.2°;

or, crystal form C of hydrobromide, the X-ray powder diffraction pattern of crystal

form C of hydrobromide comprises 6 or 8 of the diffraction peaks at 2θ of 5.2±0.2°, 15.7±0.2°, 22.3±0.2°, 10.5±0.2°, 17.4±0.2°, 38.0±0.2°, 26.3±0.2°, 28.0±0.2°.

12. The crystal form of the acid salt according to claim 7, characterized in that,

the crystal form of the acid salt 2-(2-cyano-5-oxo-8-(trifluoromethyl)pyrazolo[1,5-a]pyrido[3,2-e]pyrimidin-4(5H)-yl)-N-(5-fluoropyridin-2-yl)acetamide is:

crystal form A of methanesulfonate, the X-ray powder diffraction pattern of crystal form A of methanesulfonate is as shown in Figure 1, or the DSC spectrum thereof is substantially as shown in Figure 2, or the TGA spectrum thereof is substantially as shown in Figure 3;

or, crystal form A of ethanesulfonate, the X-ray powder diffraction pattern of crystal form A of ethanesulfonate is as shown in Figure 4, or the DSC spectrum thereof is substantially as shown in Figure 5, or the TGA spectrum thereof is substantially as shown in Figure 6;

or, crystal form A of sulfate, the X-ray powder diffraction pattern of crystal form A of sulfate is as shown in Figure 7, the DSC spectrum thereof is substantially as shown in Figure 8;

or, crystal form B of sulfate, the X-ray powder diffraction pattern of crystal form B of sulfate is as shown in Figure 9, the DSC spectrum thereof is substantially as shown in Figure 10, the TGA spectrum thereof is substantially as shown in Figure 11;

or, crystal form A of hydrochloride, the X-ray powder diffraction pattern of crystal form A of hydrochloride is as shown in Figure 12, or the DSC spectrum thereof is substantially as shown in Figure 13, or the TGA spectrum thereof is substantially as shown in Figure 14;

or, crystal form B of hydrochloride, the X-ray powder diffraction pattern of crystal form B of hydrochloride is as shown in Figure 15;

or, crystal form A of hydrobromide, the X-ray powder diffraction pattern of crystal form A of hydrobromide is as shown in Figure 16, or the DSC spectrum thereof is substantially as shown in Figure 17;

or, crystal form B of hydrobromide, the X-ray powder diffraction pattern of crystal form B of hydrobromide is as shown in Figure 18, or the DSC spectrum thereof is substantially as shown in Figure 19, or the TGA spectrum thereof is substantially as shown in Figure 20;

or, crystal form C of hydrobromide, the X-ray powder diffraction pattern of crystal form C of hydrobromide is as shown in Figure 21.

13. The crystal form of the acid salt according to any one of claims 8 to 12, characterized in that,

positions of diffraction peaks with relative peak intensity of top ten in the X-ray powder diffraction pattern of each crystal form have a 2θ error of ±0.2° relative to the

diffraction peaks at the corresponding positions in the X-ray powder diffraction pattern figure.

14. The crystal form of the acid salt according to any one of claims 8 to 12, characterized in that, the crystal form of the acid salt is a hydrate or anhydrate.

15. A method for preparing the acid salt according to any one of claims 1 to 7 or the crystal form of acid salt according to any one of claims 8 to 14, comprising the following steps of:

1) weighing an appropriate amount of free base and dissolving it in a solvent;

2) adding an appropriate amount of acid and stirring;

3) centrifuging rapidly or standing to obtain the acid salt;

or, comprising the following steps of:

1) weighing an appropriate amount of free base and dissolving it in a solvent;

2) adding an appropriate amount of acid and stirring;

3) centrifuging and drying to obtain the acid salt crystal form;

the solvent is at least one of methanol, ethanol, tetrahydrofuran, 2-methyltetrahydrofuran, toluene, isopropyl acetate, *tert*-butanol, *n*-butanol, acetone, 2-butanone, dichloromethane, ethyl acetate or 1,4-dioxane;

the acid is selected from the group consisting of hydrochloric acid, sulfuric acid, nitric acid, hydrobromic acid, hydrofluoric acid, hydroiodic acid, phosphoric acid, 2,5-dihydroxybenzoic acid, 1-hydroxy-2-naphthoic acid, acetic acid, dichloroacetic acid, trichloroacetic acid, acetohydroxamic acid, adipic acid, benzenesulfonic acid, 4-chlorobenzenesulfonic acid, benzoic acid, 4-acetamidobenzoic acid, 4-aminobenzoic acid, capric acid, caproic acid, caprylic acid, cinnamic acid, citric acid, cyclohexane sulfamic acid, camphorsulfonic acid, aspartic acid, camphoric acid, gluconic acid, glucuronic acid, glutamic acid, erythorbic acid, lactic acid, malic acid, mandelic acid, pyroglutamic acid, tartaric acid, dodecyl sulfuric acid, dibenzoyl tartaric acid, ethane-1,2-disulfonic acid, methanesulfonic acid, ethanesulfonic acid, formic acid, fumaric acid, galactonic acid, gentisic acid, glutaric acid, 2-oxoglutaric acid, glycolic acid, hippuric acid, isethionic acid, lactobionic acid, ascorbic acid, aspartic acid, lauric acid, camphoric acid, maleic acid, malonic acid, 1,5-naphthalenedisulfonic acid, naphthalene-2-sulfonic acid, nicotinic acid, oleic acid, orotic acid, oxalic acid, palmitic acid, pamoic acid, propionic acid, salicylic acid, 4-aminosalicylic acid, sebacic acid, stearic acid, succinic acid, thiocyanic acid, undecenoic acid, trifluoroacetic acid, benzenesulfonic acid, *p*-toluenesulfonic acid and L-malic acid.

16. A pharmaceutical composition, comprising a therapeutically effective amount of the acid salt according to any one of claims 1 to 7 or the crystal form of the acid salt according to any one of claims 8 to 14, and one or more pharmaceutically acceptable carriers, diluents or excipients.

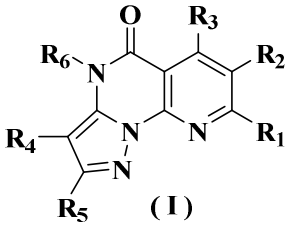
17. Use of the acid salt according to any one of claims 1 to 7 or the crystal form of acid salt according to any one of claims 8 to 14 or the pharmaceutical composition according to claim 16 in the preparation of a P2X3 inhibitor drug.

18. Use of the acid salt according to any one of claims 1 to 7 or the crystal form of the acid salt according to any one of claims 8 to 14 or the pharmaceutical composition according to claim 16 in the preparation of a medicament for treating neurogenic disease;

the neurogenic disease is selected from the group consisting of gynecological disease, urinary tract disease state, respiratory disorder and pain-related disease or condition.

19. The use according to claim 18, characterized in that, the neurogenic disease is selected from the group consisting of endometriosis, overactive bladder, pulmonary fibrosis and chronic cough; the pain-related disease or condition is selected from the group consisting of neuropathic pain and uterine fibroid-related pain or discomfort.

20. A compound of formula (I) or a pharmaceutically acceptable salt thereof:



(I)

wherein:

R_1, R_2, R_3 are each independently selected from the group consisting of hydrogen, deuterium, halogen, amino, nitro, hydroxy, cyano, alkyl, deuterated alkyl, haloalkyl, hydroxyalkyl, alkoxy, haloalkoxy, alkenyl, alkynyl, heterocyclylalkyl, cycloalkyl, heterocyclyl, aryl, aryloxy, heteroaryl, heteroaryloxy and $-(CH_2)_{n1}C(O)R_a$;

R_4 is independently selected from the group consisting of hydrogen, deuterium, halogen, amino, nitro, hydroxy, cyano, alkyl, deuterated alkyl, haloalkyl, hydroxyalkyl, alkoxy, haloalkoxy, alkenyl, alkynyl, heterocyclylalkyl, cycloalkyl, heterocyclyl, aryl, aryloxy, heteroaryl, heteroaryloxy and $-(CH_2)_{n1}C(O)R_a$;

R_5 is independently selected from the group consisting of cyano and $-(CH_2)_{n1}C(O)R_a$;

R_6 is selected from the group consisting of hydrogen and a protecting group;

R_a is selected from the group consisting of amino;

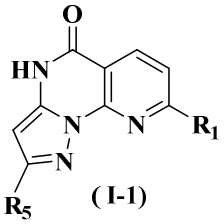
the amino, alkyl, deuterated alkyl, haloalkyl, hydroxyalkyl, alkoxy, haloalkoxy, alkenyl, alkynyl, heterocyclylalkyl, cycloalkyl, heterocyclyl, aryl, aryloxy, heteroaryl, heteroaryloxy and $-(CH_2)_{n1}-$ are each optionally substituted by one or more substituents selected from the group consisting of hydrogen, deuterium, halogen, amino, nitro,

hydroxy, cyano, alkyl, deuterated alkyl, haloalkyl, hydroxyalkyl, alkoxy, haloalkoxy, alkenyl, alkynyl, heterocyclylalkyl, cycloalkyl, heterocyclyl, aryl, aryloxy, heteroaryl and heteroaryloxy; n1 is 0, 1, 2, 3 or 4;

provided that,

when R_1, R_2, R_3, R_4 and R_6 are hydrogen at the same time, R_5 is not -$COOCH_3$.

21. The compound or a pharmaceutically acceptable salt thereof according to claim 20, characterized in that, the structure of the compound of formula (I) is shown in formula (I-1):



(I-1)

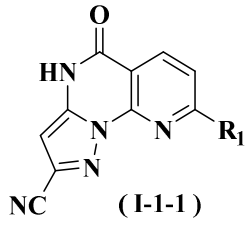
wherein,

R_1 is selected from the group consisting of hydrogen, deuterium, halogen, cyano, C_{1-8} alkyl, C_{1-8} alkoxy, C_{1-8} haloalkyl and C_{1-8} haloalkoxy;

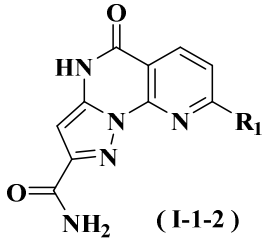
R_5 is selected from the group consisting of cyano and -$C(O)R_a$;

R_a is selected from the group consisting of amino.

22. The compound or a pharmaceutically acceptable salt thereof according to claim 30, characterized in that, the structure of the compound is selected from the group consisting of formula (I-1-1) and formula (I-1-2):



(I-1-1) ,



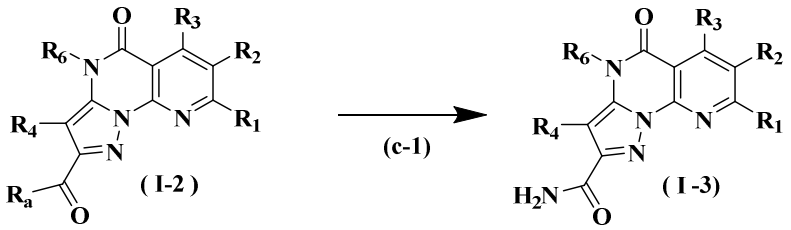
(I-1-2)

wherein,

R_1 is selected from the group consisting of cyano, C_{1-3} alkyl, C_{1-3} alkoxy, C_{1-3} haloalkyl and C_{1-3} haloalkoxy.

23. The compound or a pharmaceutically acceptable salt thereof according to claim 22, characterized in that, R_1 is selected from the group consisting of methyl, ethyl, trifluoromethyl, methoxy and cyano.

24. A method for preparing a compound of formula (I-3), characterized by comprising step (c-1):



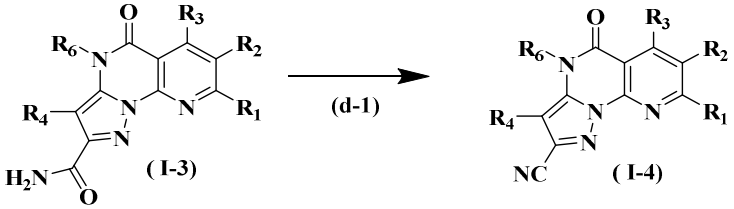
subjecting a compound of formula (I-2) to an amination reduction reaction in the presence of ammonia gas or ammonia gas equivalents to obtain the compound of formula (I-3);

the ammonia gas equivalent is an organic solution of ammonia or aqueous ammonia; the organic solution of ammonia is ammonia in methanol, ammonia in ethanol, ammonia in isopropanol, or ammonia in dioxane;

R_a is selected from the group consisting of hydrogen, deuterium, halogen, hydroxy, alkoxy, haloalkoxy, aryloxy and heteroaryloxy, the alkoxy, haloalkoxy, aryloxy and heteroaryloxy are each optionally substituted by one or more substituents selected from the group consisting of deuterium, halogen, amino, nitro, hydroxy, cyano, alkyl, deuterated alkyl, haloalkyl, hydroxyalkyl, alkoxy, haloalkoxy, alkenyl, alkynyl, heterocyclylalkyl, cycloalkyl, heterocyclyl, aryl, aryloxy, heteroaryl and heteroaryloxy;

R_1, R_2, R_3, R_4, R_6 are as defined in claim 20.

25. A method for preparing a compound of formula (I-4), characterized by comprising step (d-1):



reacting a compound of formula (I-3) in the presence of a dehydrating agent to obtain the compound of formula (I-4); the dehydrating agent is one or more of acetic anhydride, trifluoroacetic anhydride, P_2O_5, cyanuric chloride, phosphorus oxychloride, phosphorus trichloride, and concentrated sulfuric acid;

R_1, R_2, R_3, R_4, R_6 are as defined in claim 20.