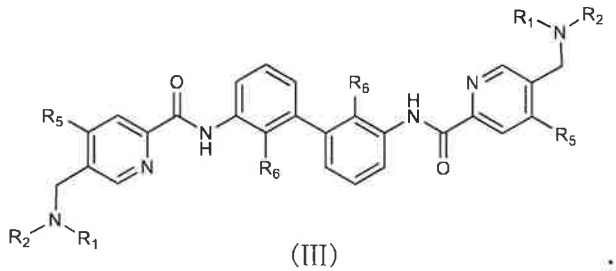
CLAIMS

We claim:

1. A compound of formula (III), a stereoisomer~~, prodrug~~ or pharmaceutically acceptable salt:



(III)

;

wherein, R_6 is methyl;

R_5 is selected from the group consisting of hydrogen, deuterium, methyl, ethyl, isopropyl, cyclopropyl, cyclobutyl and methoxy;

R_1 and R_2 are each independently selected from the group consisting of hydrogen, deuterium, hydroxy, C_{1-10} alkyl, C_{2-10} alkenyl, C_{2-10} alkynyl, C_{3-10} cycloalkyl, C_{3-10} cycloalkyl C_{1-8} alkyl, 3-10 membered heterocyclyl, 3-10 membered heterocyclyl C_{1-8} alkyl, C_{5-10} aryl, C_{5-10} aryl C_{1-8} alkyl and 5-10 membered heteroaryl, or, R_1 and R_2, together with the nitrogen atom directly attached thereto, form 3-10 membered heterocyclyl, wherein the above-mentioned groups of R_1 and R_2~~above-groups~~ are optionally further substituted by one or more substituents selected from the group consisting of deuterium, halogen, cyano, nitro, azido, C_{1-10} alkyl, C_{2-10} alkenyl, C_{2-10} alkynyl, C_{1-10} haloalkyl, C_{1-10} deuterioalkyl, C_{3-10} cycloalkyl, 3-10 membered heterocyclyl, C_{5-10} aryl, 5-10 membered heteroaryl, =O, -C_{0-8} alkyl-S(O)(=N-R_7)R_9, -C_{0-8} alkyl-N=S(O)R_9R_{10}, -C_{0-8} alkyl-N=SR_9R_{10}, -C_{0-8} alkyl-P(O)(OH)R_{12}, -C_{0-8} alkyl-SF_5, -C_{0-8} alkyl-O-S(O)$_2R_{12}$, -C_{0-8} alkyl-S(O)$_rR_{12}$, -C_{0-8} alkyl-O-R_{13}, -C_{0-8} alkyl-C(O)OR_{13}, -C_{0-8} alkyl-C(O)R_{14}, -C_{0-8} alkyl-O-C(O)R_{14}, -C_{0-8} alkyl-N$R_{15}R_{16}$, -C_{0-8} alkyl-C(=NR_{15})R_{14}, -C_{0-8} alkyl-N(R_{15})-C(=NR_{16})R_{14}, -C_{0-8} alkyl-C(O)N$R_{15}R_{16}$ and -C_{0-8} alkyl-N(R_{15})-C(O)R_{14};

R_7 is selected from the group consisting of hydrogen, deuterium, C_{1-10} alkyl, C_{2-10} alkenyl, C_{2-10} alkynyl, C_{3-10} cycloalkyl, 3-10 membered heterocyclyl, C_{5-10} aryl, 5-10 membered heteroaryl, -C_{0-8} ~~alkyl~~alkyl-S(O)$_rR_{12}$, -C_{0-8} ~~alkyl~~alkyl-C(O)OR_{13}, -C_{0-8} ~~alkyl~~alkyl-C(O)R_{14} and -C_{0-8} ~~alkyl~~alkyl-C(O)N$R_{15}R_{16}$, wherein R_7 is ~~above-groups are~~ optionally further substituted by one or more substituents selected from the group consisting of deuterium, halogen, cyano, nitro, azido, C_{1-10} alkyl, C_{2-10} alkenyl, C_{2-10} alkynyl, C_{1-10} haloalkyl, C_{1-10} deuterioalkyl, C_{3-10} cycloalkyl, 3-10 membered heterocyclyl, C_{5-10} aryl, 5-10 membered heteroaryl, -C_{0-8} ~~alkyl~~alkyl-S(O)$_rR_{12}$, -C_{0-8} ~~alkyl~~alkyl-O-R_{13}, -C_{0-8} alkyl-C(O)OR_{13}, -C_{0-8} alkyl-C(O)R_{14}, -C_{0-8} alkyl-O-C(O)R_{14}, -C_{0-8} alkyl-N$R_{15}R_{16}$, -C_{0-8} alkyl-C(=NR_{15})R_{14}, -C_{0-8} alkyl-N(R_{15})-C(=NR_{16})R_{14}, -C_{0-8} alkyl-C(O)N$R_{15}R_{16}$ and -C_{0-8} alkyl-N(R_{15})-C(O)R_{14};

R_9 and R_{10} are each independently selected from the group consisting of hydrogen, deuterium, hydroxy, C_{1-10} alkyl, C_{2-10} alkenyl, C_{2-10} alkynyl, C_{3-10} cycloalkyl, 3-10 membered heterocyclyl, C_{5-10} aryl and 5-10 membered heteroaryl, or, R_9 and R_{10}, together with the sulfur atom directly attached thereto, form 3-10 membered heterocyclyl, wherein the above-mentioned groups of R_9 and R_{10}~~above groups~~ are optionally further substituted by one or more substituents selected from the group consisting of deuterium, halogen, cyano, nitro, azido, C_{1-10} alkyl, C_{2-10} alkenyl, C_{2-10} alkynyl, C_{1-10} haloalkyl, C_{1-10} deuterioalkyl, C_{3-10} cycloalkyl, 3-10 membered heterocyclyl, C_{5-10} aryl, 5-10 membered heteroaryl, -C_{0-8} alkyl-$S(O)_rR_{12}$, -C_{0-8} alkyl-O-R_{13}, -C_{0-8} alkyl-$C(O)OR_{13}$, -C_{0-8} alkyl-$C(O)R_{14}$, -C_{0-8} alkyl-O-$C(O)R_{14}$, -C_{0-8} alkyl-$NR_{15}R_{16}$, -C_{0-8} alkyl-$C(=NR_{15})R_{14}$, -C_{0-8} alkyl-$N(R_{15})$-$C(=NR_{16})R_{14}$, -C_{0-8} alkyl-$C(O)NR_{15}R_{16}$ and -C_{0-8} ~~alkyl~~alkyl-$N(R_{15})$-$C(O)R_{14}$;

each R_{12} is independently selected from the group consisting of hydrogen, deuterium, hydroxy, halogen, C_{1-10} alkyl, C_{1-10} alkoxy, C_{2-10} alkenyl, C_{3-10} cycloalkyl, C_{3-10} cycloalkyloxy, 3-10 membered heterocyclyl, 3-10 membered heterocyclyloxy, C_{5-10} aryl, C_{5-10} aryloxy, 5-10 membered heteroaryl, 5-10 membered heteroaryloxy and -$NR_{15}R_{16}$, wherein each R_{12} is ~~above groups are~~ optionally further substituted by one or more substituents selected from the group consisting of deuterium, halogen, hydroxy, carbonyl, C_{1-10} alkyl, C_{1-10} alkoxy, C_{3-10} cycloalkyl, C_{3-10} cycloalkyloxy, 3-10 membered heterocyclyl, 3-10 membered heterocyclyloxy, C_{5-10} aryl, C_{5-10} aryloxy, 5-10 membered heteroaryl, 5-10 membered heteroaryloxy and -$NR_{15}R_{16}$;

each R_{13} is independently selected from the group consisting of hydrogen, deuterium, C_{1-10} alkyl, C_{2-10} alkenyl, C_{3-10} cycloalkyl, 3-10 membered heterocyclyl, C_{5-10} aryl and 5-10 membered heteroaryl, wherein each R_{13}~~above groups are~~ is optionally further substituted by one or more substituents selected from the group consisting of deuterium, halogen, hydroxy, carbonyl, cyano, C_{1-10} alkyl, C_{1-10} alkoxy, C_{3-10} cycloalkyl, C_{3-10} cycloalkyloxy, 3-10 membered heterocyclyl, 3-10 membered heterocyclyloxy, C_{5-10} aryl, C_{5-10} aryloxy, 5-10 membered heteroaryl, 5-10 membered heteroaryloxy and -$NR_{15}R_{16}$;

each R_{14} is independently selected from the group consisting of hydrogen, deuterium, hydroxy, C_{1-10} alkyl, C_{1-10} alkoxy, C_{2-10} alkenyl, C_{2-10} alkynyl, C_{3-10} cycloalkyl, C_{3-10} cycloalkyloxy, 3-10 membered heterocyclyl, 3-10 membered heterocyclyloxy, C_{5-10} aryl, C_{5-10} aryloxy, 5-10 membered heteroaryl, 5-10 membered heteroaryloxy and -$NR_{15}R_{16}$, wherein each R_{14}~~above groups are~~ is optionally further substituted by one or more substituents selected from the group consisting of deuterium, halogen, hydroxy, cyano, C_{1-10} alkyl, C_{1-10} alkoxy, C_{3-10} cycloalkyl, C_{3-10} cycloalkyloxy, 3-10 membered heterocyclyl, 3-10 membered heterocyclyloxy, C_{5-10} aryl, C_{5-10} aryloxy, 5-10 membered heteroaryl, 5-10 membered heteroaryloxy and -$NR_{15}R_{16}$;

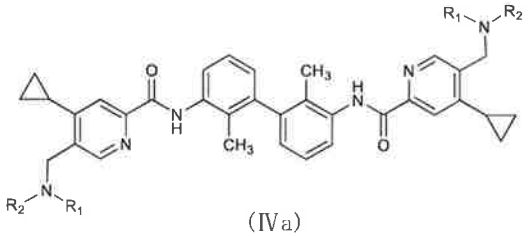
R_{15} and R_{16} are each independently selected from the group consisting of hydrogen, deuterium, hydroxy, C_{1-10} alkoxy, C_{1-10} alkyl, C_{2-10} alkenyl, C_{2-10} alkynyl, C_{3-10} cycloalkyl, 3-10 membered heterocyclyl, C_{5-10} aryl, 5-10 membered heteroaryl, sulfinyl, sulfonyl, methanesulfonyl, isopropylsulfonyl, cyclopropylsulfonyl, *p*-toluenesulfonyl,

aminosulfonyl, dimethylaminosulfonyl, amino, monoalkylamino, dialkylamino and C_{1-10} alkanoyl, wherein the above-mentioned groups of R_{15} and R_{16}~~above groups~~ are optionally further substituted by one or more substituents selected from the group consisting of deuterium, halogen, hydroxy, C_{1-10} alkyl, C_{2-10} alkenyl, C_{2-10} alkynyl, C_{1-10} haloalkyl, C_{1-10} deuterioalkyl, C_{1-10} alkoxy, C_{3-10} cycloalkyl, C_{3-10} cycloalkyloxy, 3-10 membered heterocyclyl, 3-10 membered heterocyclyloxy, C_{5-10} aryl, C_{5-10} aryloxy, 5-10 membered heteroaryl, 5-10 membered heteroaryloxy, amino, monoalkylamino, dialkylamino and C_{1-10} alkanoyl; or,

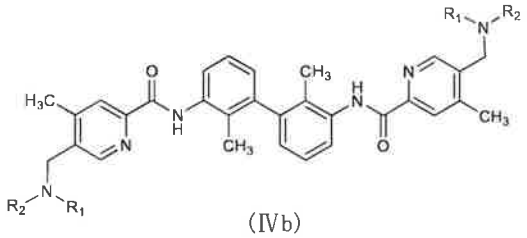
R_{15} and R_{16}, together with the nitrogen atom directly attached thereto, form 4-10 membered heterocyclyl or 4-10 membered heteroaryl, ~~above groups~~ the 4-10 membered heterocyclyl or 4-10 membered heteroaryl is~~are~~ optionally further substituted by one or more substituents selected from the group consisting of deuterium, halogen, hydroxy, C_{1-10} alkyl, C_{2-10} alkenyl, C_{2-10} alkynyl, C_{1-10} haloalkyl, C_{1-10} deuterioalkyl, C_{1-10} alkoxy, C_{3-10} cycloalkyl, C_{3-10} cycloalkyloxy, 3-10 membered heterocyclyl, 3-10 membered heterocyclyloxy, C_{5-10} aryl, C_{5-10} aryloxy, 5-10 membered heteroaryl, 5-10 membered heteroaryloxy, amino, monoalkylamino, dialkylamino and C_{1-10} alkanoyl;

each r is 0, 1 or 2.

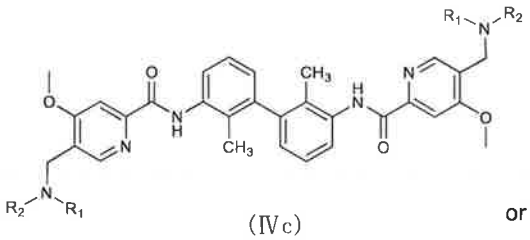
2. The compound of formula (III), the stereoisomer~~, prodrug~~ or pharmaceutically acceptable salt thereof of claim 1, wherein, the compound of formula (III) is a compound with the structure shown as formula (IVa), (IVb), (IVc) or (IVd):



(IVa)

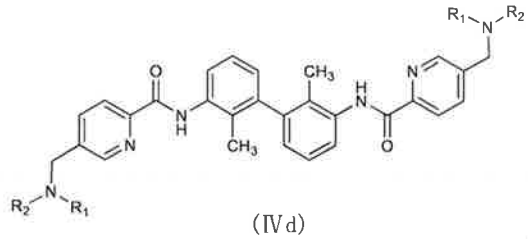


(IVb)



(IVc)

or



(IVd);

wherein, R_1 and R_2 are each independently defined as in claim 1.

3. The compound of formula (III), the stereoisomer~~, prodrug~~ or pharmaceutically acceptable salt thereof of claim 1 or 2, wherein, R_1 and R_2 are each independently selected from the group consisting of hydrogen, deuterium, hydroxy, C_{1-4} alkyl, C_{2-4} alkenyl, C_{2-4} alkynyl, C_{3-8} cycloalkyl, C_{3-8} cycloalkyl C_{1-4} alkyl, 3-8 membered heterocyclyl, C_{5-8} aryl

and 5-8 membered heteroaryl, or, R_1 and R_2, together with the nitrogen atom directly attached thereto, form 3-8 membered heterocyclyl, the heteroatom in the heterocyclyl is selected from the group consisting of N, O, S and/or Si, wherein the above-mentioned groups of R_1 and R_2~~above groups~~ are optionally further substituted by one or more substituents selected from the group consisting of deuterium, halogen, cyano, nitro, azido, C_{1-4} alkyl, C_{2-4} alkenyl, C_{2-4} alkynyl, C_{1-4} haloalkyl, C_{1-4} deuterioalkyl, C_{3-8} cycloalkyl, 3-8 membered heterocyclyl, C_{5-8} aryl, 5-8 membered heteroaryl, =O, $-S(O)(=N-R_7)R_9$, $-N=S(O)R_9R_{10}$, $-N=SR_9R_{10}$, $-P(O)(OH)R_{12}$, $-SF_5$, $-O-S(O)_2R_{12}$, $-S(O)_rR_{12}$, $-O-R_{13}$, $-C(O)OR_{13}$, $-C(O)R_{14}$, $-O-C(O)R_{14}$, $-NR_{15}R_{16}$, $-C(=NR_{15})R_{14}$, $-N(R_{15})-C(=NR_{16})R_{14}$, $-C(O)NR_{15}R_{16}$ and $-N(R_{15})-C(O)R_{14}$; and

R_7, R_9, R_{10}, R_{12}, R_{13}, R_{14}, R_{15}, R_{16} and r are defined as in claim 1.

4. The compound of formula (III), the stereoisomer~~, prodrug~~ or pharmaceutically acceptable salt thereof of claim 3, wherein, R_1 is hydrogen, deuterium or methyl;

R_2 is selected from the group consisting of hydrogen, deuterium, hydroxy, C_{1-4} alkyl, C_{3-8} cycloalkyl, C_{3-8} cycloalkyl C_{1-4} alkyl, 3-8 membered heterocyclyl, C_{5-8} aryl and 5-8 membered heteroaryl, or, R_1 and R_2, together with the nitrogen atom directly attached thereto, form 3-8 membered heterocyclyl, the heteroatom in the heterocyclyl is selected from the group consisting of N, O, S and/or Si, wherein the above-mentioned groups of R_1 and R_2~~above groups~~ are optionally further substituted by one or more substituents selected from the group consisting of deuterium, halogen, cyano, nitro, azido, C_{1-4} alkyl, C_{2-4} alkenyl, C_{2-4} alkynyl, C_{1-4} haloalkyl, C_{1-4} deuterioalkyl, C_{3-8} cycloalkyl, 3-8 membered heterocyclyl, C_{5-8} aryl, 5-8 membered heteroaryl, =O, $-S(O)(=N-R_7)R_9$, $-N=S(O)R_9R_{10}$, $-N=SR_9R_{10}$, $-P(O)(OH)R_{12}$, $-SF_5$, $-O-S(O)_2R_{12}$, $-S(O)_rR_{12}$, $-O-R_{13}$, $-C(O)OR_{13}$, $-C(O)R_{14}$, $-O-C(O)R_{14}$, $-NR_{15}R_{16}$, $-C(=NR_{15})R_{14}$, $-N(R_{15})-C(=NR_{16})R_{14}$, $-C(O)NR_{15}R_{16}$ and $-N(R_{15})-C(O)R_{14}$;

R_7 is selected from the group consisting of hydrogen, deuterium, C_{1-4} alkyl, C_{2-4} alkenyl, C_{3-6} cycloalkyl, 3-6 membered heterocyclyl, phenyl, 5-8 membered heteroaryl, methanesulfonyl and acetyl, wherein R_7~~above groups are~~ is optionally further substituted by one or more substituents selected from the group consisting of deuterium, fluorine, chlorine, cyano, hydroxy, methyl, ethyl, trifluoromethyl, difluoromethyl, trideuteriomethyl, dideuteriomethyl, cyclopropyl, phenyl, diazole, triazole, methoxy, ethoxy, carboxyl, methoxycarbonyl, ethoxycarbonyl, acetyl, acetoxy, amino and dimethylamino;

R_9 and R_{10} are each independently selected from the group consisting of hydrogen, deuterium, hydroxy, C_{1-4} alkyl, C_{2-4} alkenyl, C_{3-6} cycloalkyl, 3-6 membered heterocyclyl, phenyl and 5-8 membered heteroaryl, or, R_9 and R_{10}, together with the sulfur atom directly attached thereto, form 3-6 membered heterocyclyl, wherein the above-mentioned groups of R_9 and R_{10}~~above groups~~ are optionally further substituted by one or more substituents selected from the group consisting of deuterium, fluorine, chlorine, cyano, hydroxy, methyl, ethyl, trifluoromethyl, difluoromethyl, trideuteriomethyl, dideuteriomethyl, cyclopropyl, phenyl, diazole, triazole, methoxy, ethoxy, carboxyl, methoxycarbonyl, ethoxycarbonyl, acetyl, acetoxy, amino and dimethylamino;

each R_{12} is independently selected from the group consisting of hydrogen, deuterium, hydroxy, halogen, C_{1-4} alkyl, C_{3-6} cycloalkyl, 3-6 membered heterocyclyl, phenyl, 5-8 membered heteroaryl and $-NR_{15}R_{16}$, wherein each R_{12}~~above groups are~~ is optionally further substituted by one or more substituents selected from the group consisting of deuterium, fluorine, chlorine, hydroxy, carbonyl, C_{1-4} alkyl, C_{1-4} alkoxy, C_{3-6} cycloalkyl, C_{3-6} cycloalkyloxy, 3-6 membered heterocyclyl, phenyl, 5-8 membered heteroaryl, amino and dimethylamino;

each R_{13} is independently selected from the group consisting of hydrogen, deuterium, C_{1-4} alkyl, C_{2-4} alkenyl, C_{3-6} cycloalkyl, 3-6 membered heterocyclyl, phenyl and 5-8 membered heteroaryl, wherein each R_{13}~~above groups are~~ is optionally further substituted by one or more substituents selected from the group consisting of deuterium, halogen, hydroxy, carbonyl, cyano, C_{1-4} alkyl, C_{1-4} alkoxy, C_{3-6} cycloalkyl, C_{3-6} cycloalkyloxy, 3-6 membered heterocyclyl, 3-6 membered heterocyclyloxy, phenyl, phenoxy, 5-8 membered heteroaryl, 5-8 membered heteroaryloxy and $-NR_{15}R_{16}$;

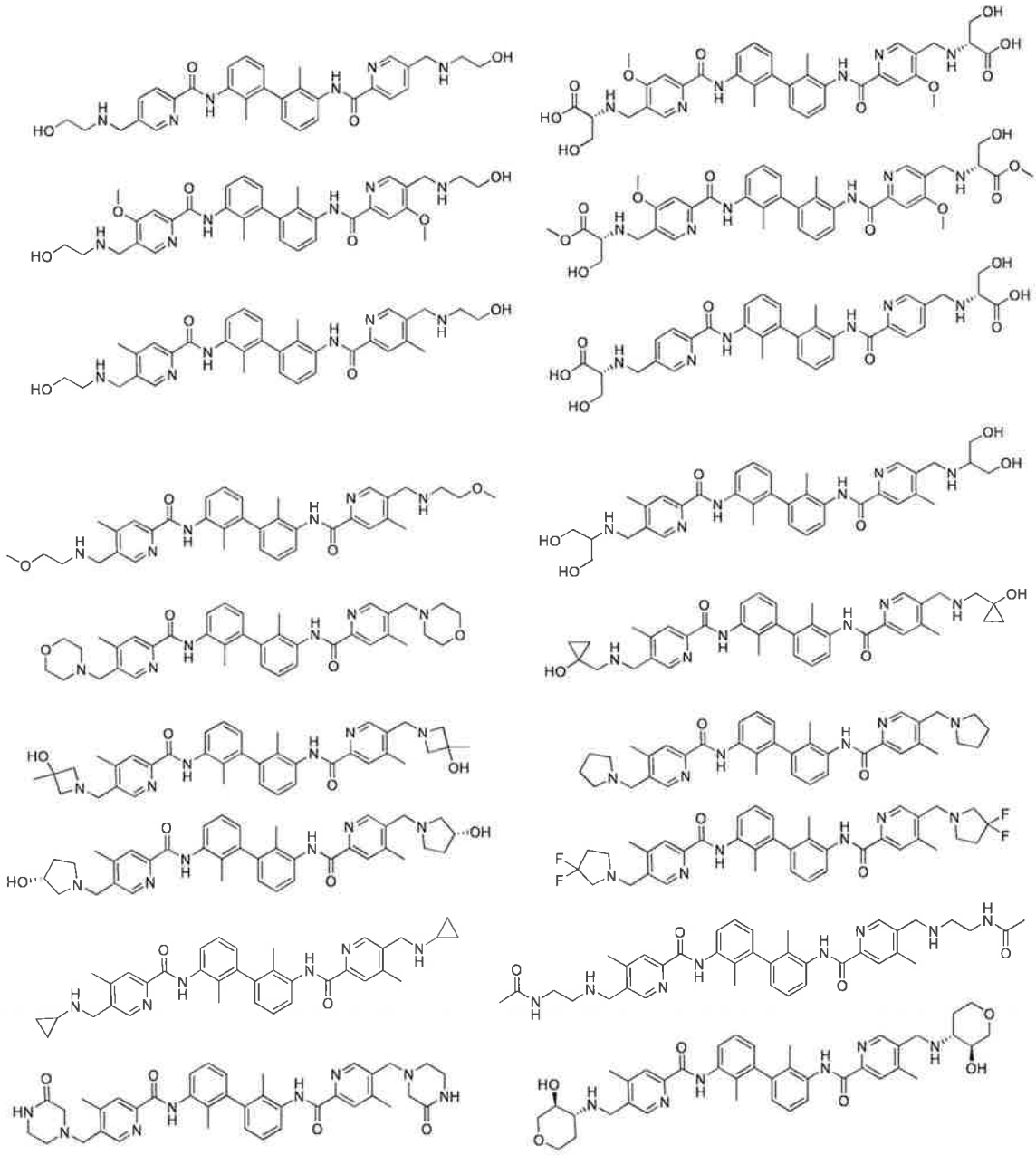
each R_{14} is independently selected from the group consisting of hydrogen, deuterium, hydroxy, C_{1-4} alkyl, C_{1-4} alkoxy, C_{2-4} alkenyl, C_{2-4} alkynyl, C_{3-6} cycloalkyl, C_{3-6} cycloalkyloxy, 3-6 membered heterocyclyl, 3-6 membered heterocyclyloxy, phenyl, phenoxy, 5-8 membered heteroaryl, 5-8 membered heteroaryloxy and $-NR_{15}R_{16}$, wherein each R_{14}~~above groups are~~ is optionally further substituted by one or more substituents selected from the group consisting of deuterium, halogen, hydroxy, cyano, C_{1-4} alkyl, C_{1-4} alkoxy, C_{3-6} cycloalkyl, C_{3-6} cycloalkyloxy, 3-6 membered heterocyclyl, 3-6 membered heterocyclyloxy, phenyl, phenoxy, 5-8 membered heteroaryl, 5-8 membered heteroaryloxy and $-NR_{15}R_{16}$;

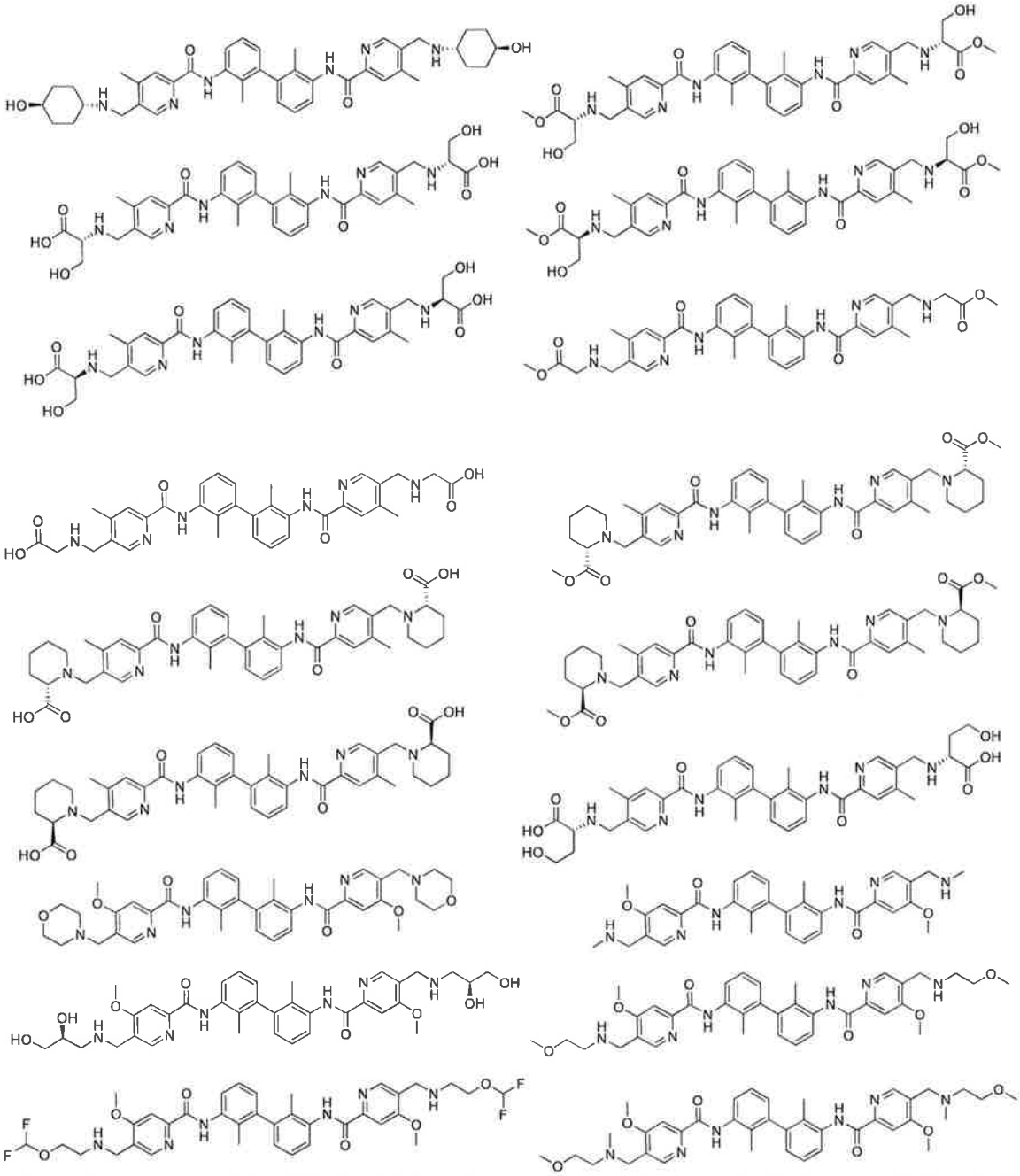
each of R_{15} and R_{16} is independently selected from the group consisting of hydrogen, deuterium, hydroxy, C_{1-4} alkoxy, C_{1-4} alkyl, C_{2-4} alkenyl, C_{2-4} alkynyl, C_{3-6} cycloalkyl, 3-6 membered heterocyclyl, phenyl, 5-8 membered heteroaryl, sulfinyl, sulfonyl, methanesulfonyl, isopropylsulfonyl, cyclopropylsulfonyl, *p*-toluenesulfonyl, aminosulfonyl, dimethylaminosulfonyl, amino, monoalkylamino, dialkylamino and C_{1-4} alkanoyl, wherein the above-mentioned groups of R_{15} and R_{16}~~above groups~~ are optionally further substituted by one or more substituents selected from the group consisting of deuterium, halogen, hydroxy, C_{1-4} alkyl, C_{2-4} alkenyl, C_{2-4} alkynyl, C_{1-4} haloalkyl, C_{1-4} deuterioalkyl, C_{1-4} alkoxy, C_{3-6} cycloalkyl, C_{3-6} cycloalkyloxy, 3-6 membered heterocyclyl, 3-6 membered heterocyclyloxy, phenyl, phenoxy, 5-8 membered heteroaryl, 5-8 membered heteroaryloxy, amino, monoalkylamino, dialkylamino and C_{1-4} alkanoyl; or,

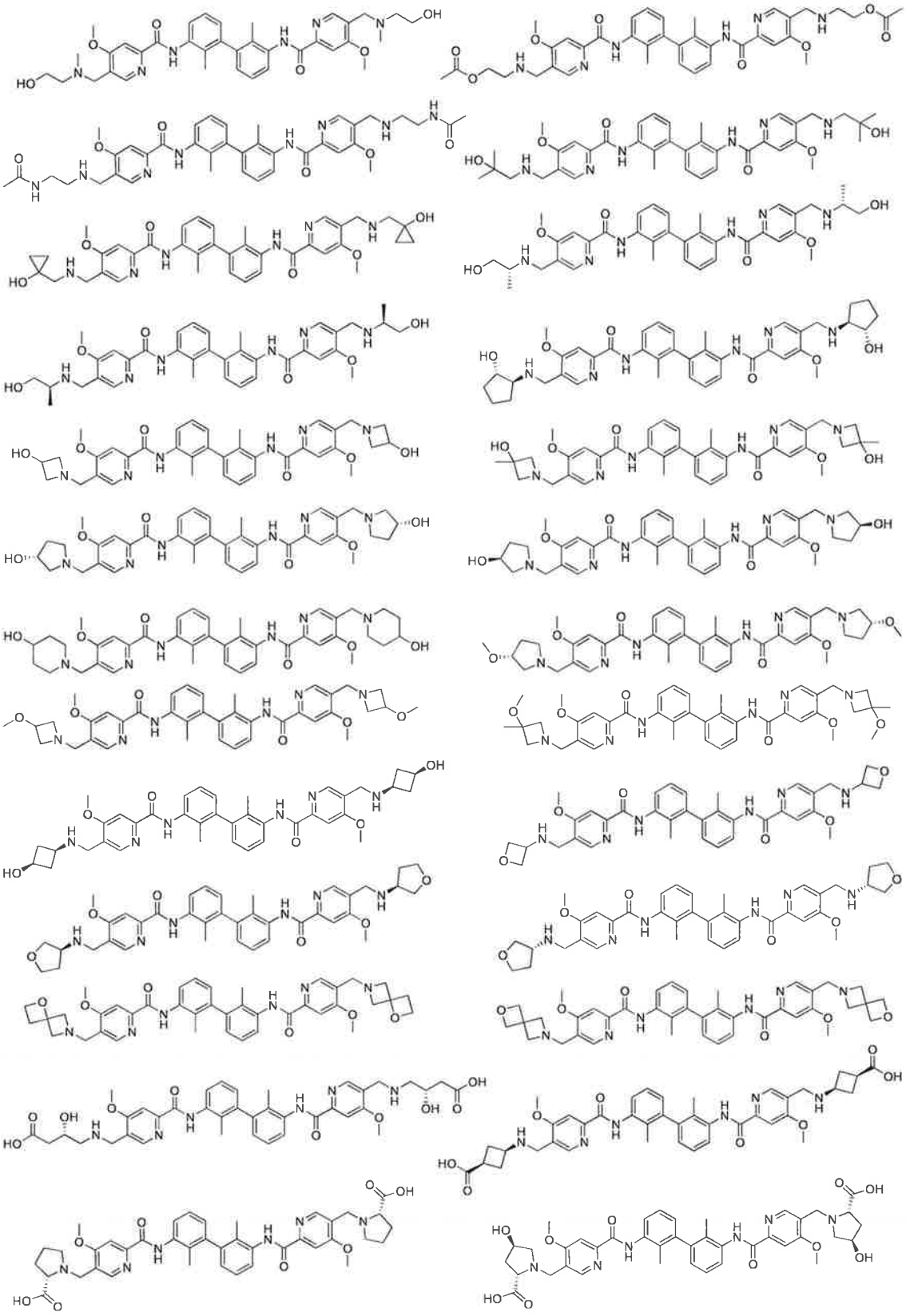
R_{15} and R_{16}, together with the nitrogen atom directly attached thereto, form 4-6 membered heterocyclyl or 4-6 membered heteroaryl, ~~above groups are~~the 4-6 membered heterocyclyl or 4-6 membered heteroaryl is optionally further substituted by one or more substituents selected from the group consisting of deuterium, halogen, hydroxy, C_{1-4} alkyl, C_{2-4} alkenyl, C_{2-4} alkynyl, C_{1-4} haloalkyl, C_{1-4} deuterioalkyl, C_{1-4} alkoxy, C_{3-6} cycloalkyl, C_{3-6} cycloalkyloxy, 3-6 membered heterocyclyl, 3-6 membered heterocyclyloxy, phenyl, phenoxy, 5-8 membered heteroaryl, 5-8 membered heteroaryloxy, amino, monoalkylamino, dialkylamino and C_{1-4} alkanoyl; and

r is independently 0, 1 or 2.

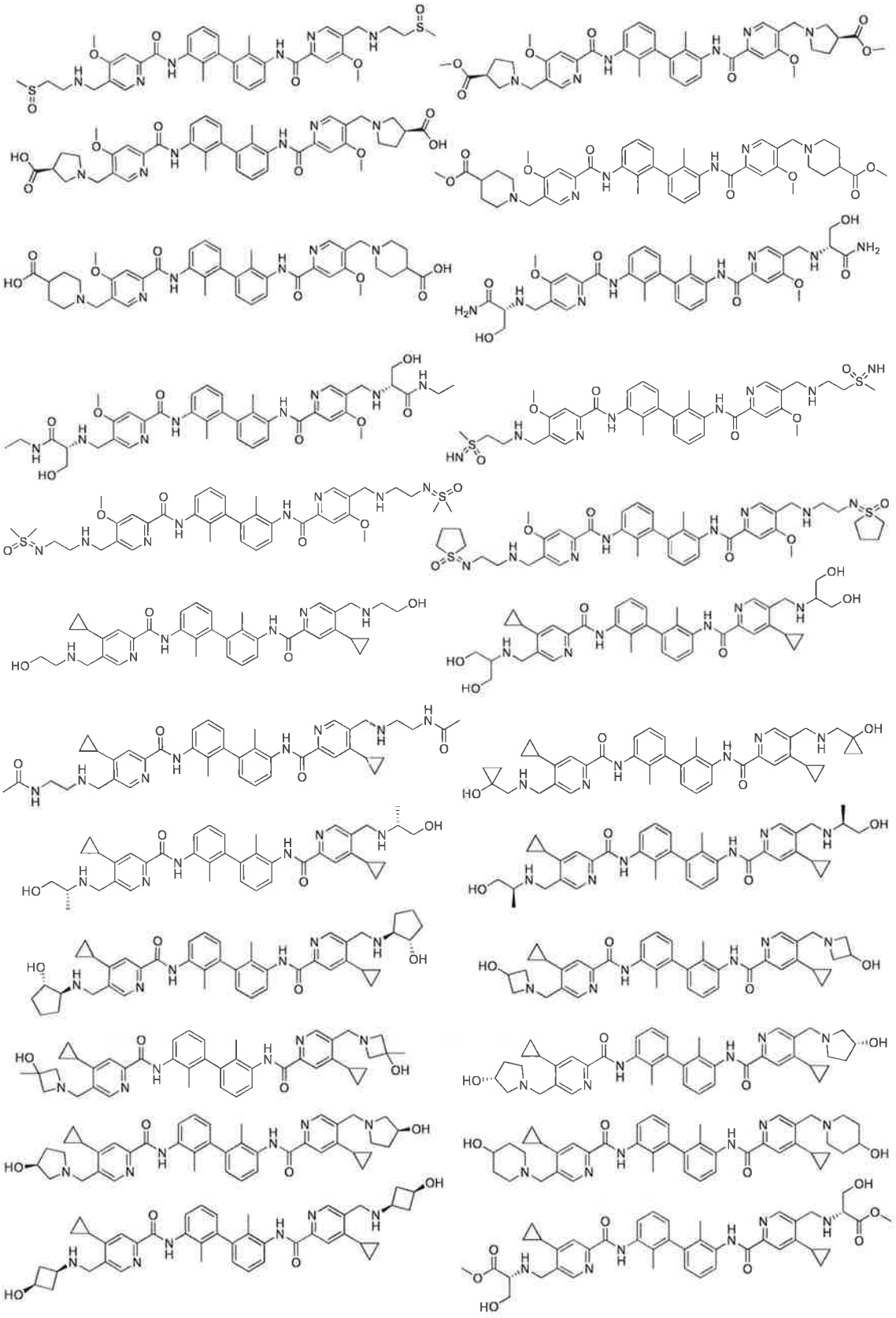
5. The compound of formula (III), the stereoisomer, ~~prodrug~~ or pharmaceutically acceptable salt thereof of any one of claims 1 to 4, wherein the compound is selected from the following compounds:

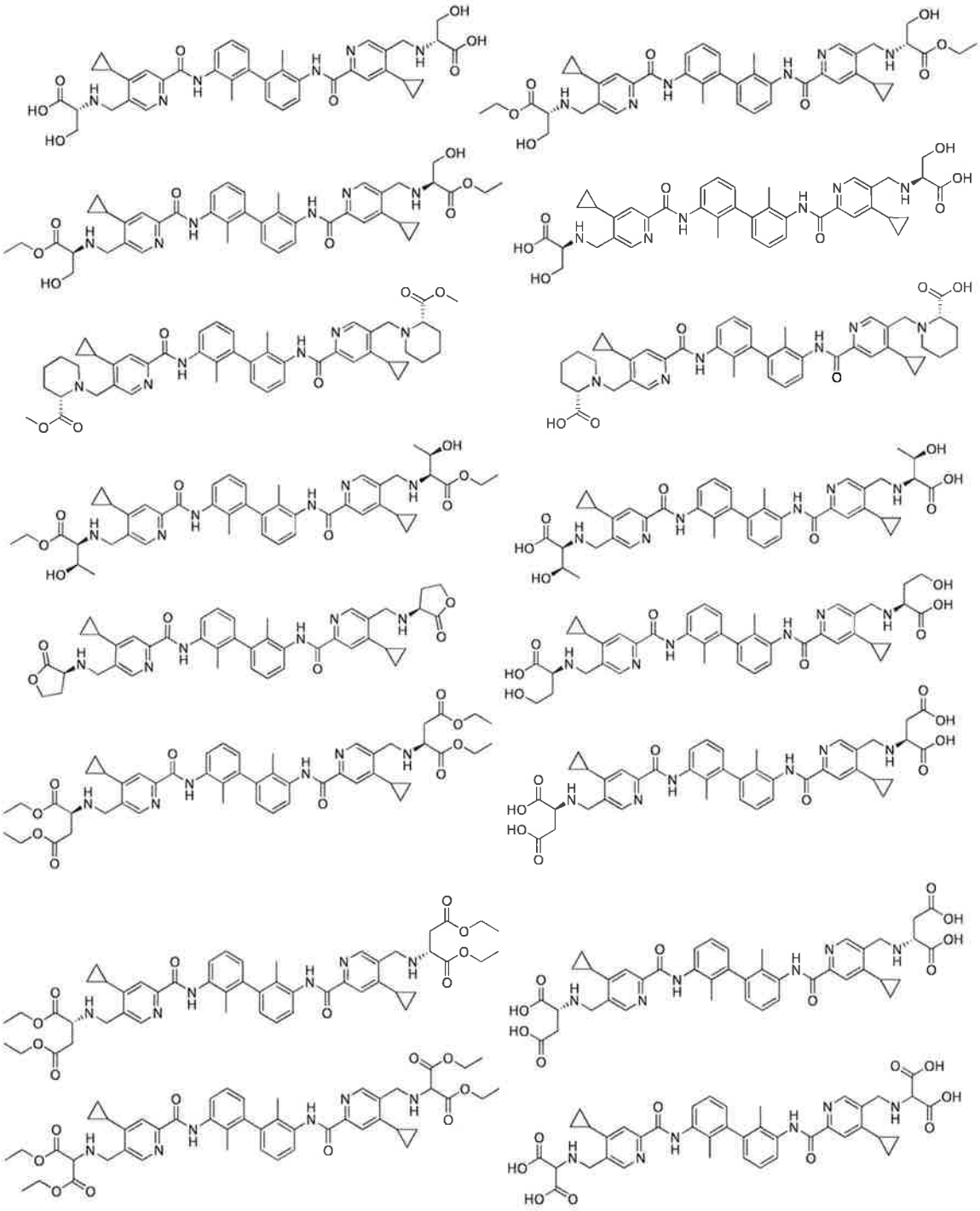


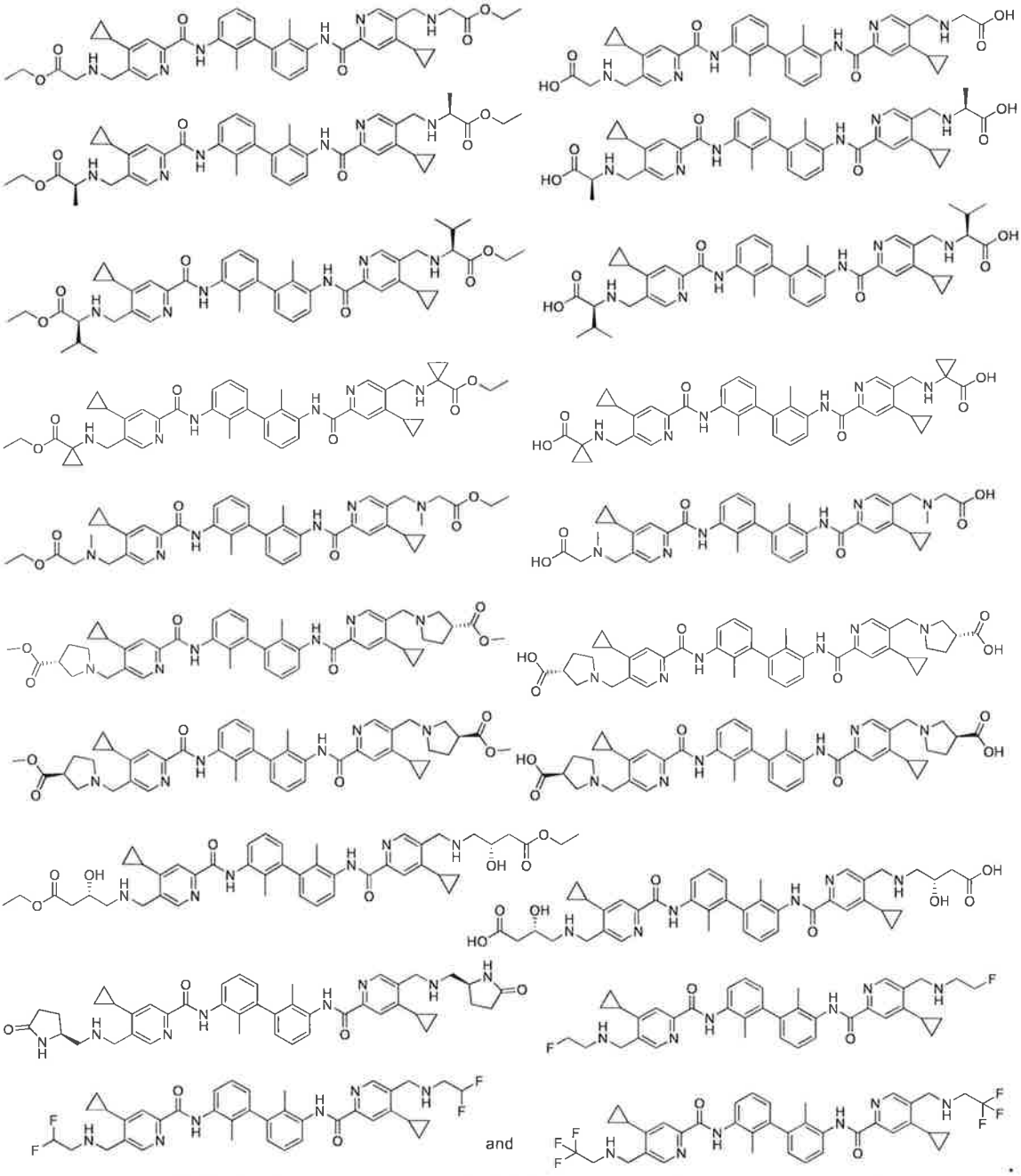




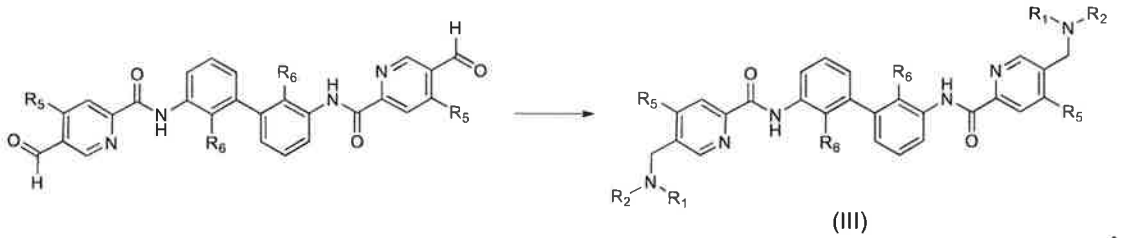








6. A process for preparing the compound of formula (III), the stereoisomer~~, prodrug~~ or pharmaceutically acceptable salt thereof of any one of claims 1 to 5, comprising the following steps:



(III)

wherein R_1, R_2, R_5 and R_6 are defined as in claim 1.

7. A pharmaceutical composition, comprising the compound of formula (III), the stereoisomer~~, prodrug~~ or pharmaceutically acceptable salt thereof of any one of claims 1 to 5 and a pharmaceutically acceptable carrier.

8. Use of the compound of formula (III), the stereoisomer~~, prodrug~~ or pharmaceutically acceptable salt thereof of any one of claims 1 to 5 or the pharmaceutical composition of claim 7 in the preparation of a medicament for preventing and/or treating PD-1/PD-L1 ~~signal pathway-mediated~~ protein-protein interaction related disease.

9. The use of claim 8, wherein the PD-1/PD-L1 ~~signal pathway-mediated~~ protein-protein interaction related disease is cancer or tumor, immune-related disease and disorder, communicable disease, infectious disease or metabolic disease.

10. The use of claim 9, wherein the infectious disease is bacterial infectious disease, viral infectious disease or fungal infectious disease.

11. The use of claim 9, wherein the cancer or tumor is selected from lymphoma, sarcoma, melanoma, glioblastoma, synovioma, meningioma, biliary tract tumor, thymic tumor, neuroma, seminoma, nephroblastoma, pleomorphic adenoma, hepatocellular papilloma, renal tubule adenoma, cystadenoma, papilloma, adenoma, leiomyoma, rhabdomyoma, hemangioma, lymphangioma, osteoma, chondroma, lipoma, fibroma, central nervous system tumor, rhachiophyma, brain stem glioma, pituitary adenoma, multiple myeloma, ovarian tumor, myelodysplastic syndrome or mesothelioma, prostate cancer, recurrent prostate cancer or prostate cancer having developed resistance to existing medicaments, thyroid cancer, parathyroid cancer, anal cancer, testicular cancer, urethral carcinoma, penile cancer, bladder cancer, ureteral cancer, uterine cancer, ovarian cancer, fallopian tube cancer, endometrial cancer, cervical cancer, vaginal cancer, vulvar cancer, adrenal cancer, Merkel cell carcinoma, embryonal carcinoma, chronic or acute leukemia, bronchial carcinoma, esophageal cancer, nasopharyngeal carcinoma, hepatocellular carcinoma, renal cell carcinoma, small cell lung cancer, basal cell carcinoma, lung cancer, breast cancer, adenocarcinoma, papillary carcinoma, cystadenocarcinoma, squamous non-small cell lung cancer, non-squamous non-small cell

lung cancer, rectal cancer, colon cancer, colorectal cancer, gastric cancer, pancreatic cancer, head and neck squamous cell carcinoma, head and neck cancer, gastrointestinal cancer, bone cancer, skin cancer, small intestine cancer, endocrine cancer, renal pelvic carcinoma, epidermoid carcinoma, abdominal wall carcinoma, renal cell carcinoma, transitional cell carcinoma, choriocarcinoma, or metastatic tumor~~, especially metastatic tumor expressing PD-L1~~;

the immune-related disease and disorder is selected from rheumatic arthritis, renal failure, lupus erythematosus, asthma, psoriasis, ulcerative colitis, pancreatitis, allergy, fibrosis, anemia, fibromyalgia, Alzheimer's disease, congestive heart failure, stroke, aortic valve stenosis, arteriosclerosis, osteoporosis, Parkinson's disease, infection, Crohn's disease, ulcerative colitis, allergic contact dermatitis and eczema, systemic sclerosis or multiple sclerosis;

the communicable disease or infectious disease is selected from sepsis, liver infection, HIV, hepatitis A, hepatitis B, hepatitis C, hepatitis D, herpes virus, papillomavirus or influenza;

the metabolic disease is selected from diabetes, diabetic ketoacidosis, hyperglycemic hyperosmolar syndrome, hypoglycemia, gout, malnutrition, vitamin A deficiency, scurvy, vitamin D deficiency or osteoporosis.

12. The use of claim 11, wherein said lymphoma is selected from the group consisting of lymphocytic lymphoma, primary central nervous system lymphoma, T cell lymphoma, diffuse large B cell lymphoma, follicle center lymphoma, Hodgkin lymphoma, non-Hodgkin lymphoma and primary mediastinal large B cell lymphoma;

said sarcoma is selected from the group consisting of Kaposi's sarcoma, fibrosarcoma, liposarcoma, chondrosarcoma, osteosarcoma, leiomyosarcoma, rhabdomyosarcoma, soft tissue sarcoma, angiosarcoma or lymphangiosarcoma;

said chronic or acute leukemia is selected from the group consisting of acute myeloid leukemia, chronic myeloid leukemia, acute lymphoblastic leukemia, chronic granulocytic leukemia and chronic lymphoblastic leukemia.

13. The compound of formula (III), the stereoisomer~~, prodrug~~ or pharmaceutically acceptable salt thereof of any one of claims 1 to 5 or the pharmaceutical composition of claim 7 for use as a medicament for preventing and/or treating PD-1/PD-L1 protein-protein interaction related~~signal pathway mediated~~ cancer or tumor, immune-related disease and disorder, communicable disease, infectious disease or metabolic disease.