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(54) **Polycyclic carbamoylpyridone derivative having HIV integrase inhibitory activity**

Polyzyklisches Carbamoylpyridon-Derivat mit HIV-integrasehemmender Aktivität

Dérivé de carbamoylpyridone polycyclique doté d'une activité inhibitrice de l'intégrase du VIH

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EP-A1- 1 544 199

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Description

[Technical Field]

[0001] The present invention relates to a novel compound possessing an antiviral activity, in detail a polycyclic carbamoylpyridone derivative possessing an inhibitory activity against HIV integrase and a pharmaceutical composition containing the same, especially an anti-HIV agent.

[Background Art]

[0002] Among viruses, human immunodeficiency virus (HIV), a kind of retrovirus, is known to cause acquired immunodeficiency syndrome (AIDS). The therapeutic agent for AIDS is mainly selected from a group of reverse transcriptase inhibitors (e.g., AZT, 3TC) and protease inhibitors (e.g., Indinavir), but they are proved to be accompanied by side effects such as nephropathy and the emergence of resistant viruses. Thus, the development of anti-HIV agents having the other mechanism of action has been desired.

[0003] On the other hand, a combination therapy is reported to be efficient in treatment for AIDS because of the frequent emergence of the resistant mutant. Reverse transcriptase inhibitors and protease inhibitors are clinically used as an anti-HIV agent, however agents having the same mechanism of action often exhibit cross-resistance or only an additional activity. Therefore, anti-HIV agents having the other mechanism of action are desired.

[0004] Under the circumstances above, an HIV integrase inhibitor has been focused on as an anti-HIV agent having a novel mechanism of action (Ref: Patent Documents 1 and 2) . As an anti-HIV agent having such a mechanism of action, known are carbamoyl-substituted hydroxypyrimidinone derivative (Ref: Patent Documents 3 and 4) and carbamoyl-substituted hydroxypyrrolidione derivative (Ref: Patent Document 5). Further, a patent application concerning carbamoyl-substituted hydroxypyridone derivative has been filed (Ref: Patent Document 6, Example 8) .

[0005] Other known carbamoylpyridone derivatives include 5-alkoxypyridine-3-carboxamide derivatives and γ-pyrone-3-carboxamide derivatives, which are a plant growth inhibitor or herbicide (Ref: Patent Documents 7-9). Other HIV integrase inhibitors include N-containing condensed cyclic compounds (Ref: Patent Document 10).

[Patent Document 1]WO03/0166275
[Patent Document 2]WO2004/024693
[Patent Document 3]WO03/035076
[Patent Document 4]WO03/035077
[Patent Document 5]WO2004/004657
[Patent Document 6]JP Patent Application 2003-32772
[Patent Document 7]JP Patent Publication 1990-108668
[Patent Document 8]JP Patent Publication 1990-108683
[Patent Document 9]JP Patent Publication 1990-96506
[Patent Document 10]WO2005/016927

[Disclosure of Invention]

[Problem to be Solved by the Invention]

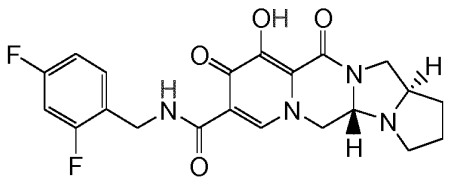
[0006] The development of a novel integrase inhibitor has been desired.

[Means to Solve the Problem]

[0007] The present inventors have intensively studied to find that a novel polycyclic carbamoylpyridone derivative possesses a potent HIV integrase inhibitory activity.

[0008] Moreover, the present inventors have discovered that the compound of the present invention and a pharmaceutical composition containing the same are useful as an antiviral agent, an antiretroviral agent, an anti-HIV agent, an anti-HTLV-1 (Human T cell leukemia virus type 1) agent, an anti-FIV (Feline immunodeficiency virus) agent or an anti-SIV (Simian immunodeficiency virus) agent, especially an anti-HIV agent or anti-AIDS agent, to accomplish the present invention shown below.

(1)A compound which is (4a*S*,13a*R*)-*N*-[(2,4-Difluorophenyl)methyl]-10-hydroxy-9,11-dioxo-2,3,4a,5,9,11,13,13a-octahydro-1*H*-pyrido[1,2-*a*]pyrrolo[1',2':3,4]imidazo[1,2-*d*]pyrazine-8-carboxamide:



or a pharmaceutically acceptable salt or solvate thereof.

(2) A compound according to the above (1), which is (4a*S*,3a*R*)-*N*-[(2,4-difluorophenyl)methyl]-10-hydroxy-9,11-dioxo-2,3,4a,5,9,11,13,13a-octahydro-1*H*-pyrido[1,2-*a*]pyrrolo[1',2':3,4]imidazo[1,2-*d*]pyrazine-8-carboxamide or a pharmaceutically acceptable salt thereof

(3) A compound according to the above (1) or (2), wherein the pharmaceutically acceptable salt is a sodium salt.

(4) A pharmaceutical composition comprising a compound according to the above (1), (2) or (3), or a pharmaceutically acceptable salt, or solvate thereof.

(5) A pharmaceutical composition according to (4), which is an anti-HIV agent.

(6) A pharmaceutical composition according to (4) wherein said composition comprises at least one additional therapeutic agent selected from reverse transcriptase inhibitors and protease inhibitors.

(7) A compound as defined in any one of (1) to (3) for use in medical therapy.

(8) A compound as defined in any one of (1) to (3) for use in the treatment or prophylaxis of an HIV infection.

(9) Use of a compound as defined in any one of (1) to (3) in the manufacture of a medicament for the treatment or prophylaxis of an HIV infection.

[0009] Pharmaceutically acceptable salts of a compound of the present invention include, as basic salts, for example, alkali metal salts such as sodium or potassium salts; alkaline-earth metal salts such as calcium or magnesium salts; ammonium salts; aliphatic amine salts such as trimethylamine, triethylamine, dicyclohexylamine, ethanolamine, diethanolamine, triethanolamine or procaine salts; aralkyl amine salts such as N, N-dibenzylethylenediamine salts; heterocyclic aromatic amine salts such as pyridin salts, picoline salts, quinoline salts or isoquinoline salts; quaternary ammonium salts such as tetramethylammonium salts, tetraethylammonium salts, benzyltrimethylammonium salts, benzyltriethylammonium salts, benzyltributylammonium salts, methyltrioctylammonium salts or tetrabutylammonium salts; and basic amino acid salts such as arginine salts or lysine salts. Acid salts include, for example, mineral acid salts such as hydrochloride, sulfates salts, nitrate salts, phosphates salts, carbonates salts, hydrogencarbonates or perchlorate; organic acid salts such as acetates, propionates, lactates, maleates, fumarates, tararic acid salts, malates, citrates salts, ascorbates, formic acid; sulfonates such as methanesulfonates, isethionates, benzenesulfonates, or p-toluenesulfonates; and acidic amino acid salts such as aspartates or glutamates.

[0010] Solvates of a compound of the present invention include alcholates and hydrates.

[0011] The present compound is useful, for example, as a drug such as an anti-virus drug. The present compound has the remarkable inhibitory action on integrase of a virus. Therefore, the present compound can be expected to have the preventive or therapeutic effect for various diseases derived from a virus which produces at least integrase, and is grown at infection in an animal cell, and is useful as an integrase inhibiting agent for retrovirus (e.g. HIV-1, HIV-2, HTLV-1, SIV, FIV etc.), and is useful as an anti-HIV drug etc.

[0012] In addition, the present compound may be used in joint use therapy by combining an anti-HIV drug having the different action methanism such as a reverse trascriptase inhibiter and/or a protease inhibiting agent. Particularly, currently, an integrase inhibiter is not marketed, and it is useful to use in joint use therapy by combining the present compound with a reverse transcriptase inhibiter and/or a protease inhibiter.

[0013] Further, the above use includes not only use as a medical mixture for anti-HIV, but also use as a joint use agent for increasing the anti-HIV activity of other anti-HIV drug such as cocktail therapy.

[0014] In addition, the present compound can be used in order to prevent infection with a retrovirus vector from spreading into a tissue other than an objective tissue, upon use of a retrovirus vector based on HIV or MLV in the field of gene therapy. Particularly, when a cell is infected with a vector in vitro, and the cell is returned into a body, if the present compound is administered in advance, extra infection can be prevented in a body.

[0015] The present compound can be administered orally or parenterally. In the case of oral administration, the present compound can be also used as a conventional preparation, for example, as any dosage form of a solid agent such as tablets, powders, granules, capsules and the like; an aqueous agent; an oily suspension; or a liquid agent such as syrup and elixir. In the case of parenteral administration, the present compound can be used as an aqueous or oily suspension injectable, or a nasal drop. Upon preparation of it, conventional excipients, binders, lubricants, aqueous solvents, oily solvents, emulsifiers, suspending agents, preservatives, stabilizers and the like may be arbitrarily used. As an anti-HIV-drug, particularly, an oral agent is preferable. A preparation of the present invention is prepared by combining (e.g. mixing) a therapeutically effective amount of the present compound with a pharmaceutically acceptable carrier or diluent.

[0016] A dose of the present invention is different depending on an administration method, an age, a weight and conditionn of a patient, and a kind of a disease and, usually, in the case of oral administraton, about 0.05mg to 3000mg, preferably about 0.1mg to 1000mg may be administered per adult a day, if necessary, by dividing the dose. In addition, in the case of parenteral administration, about 0.01mg to 1000mg, preferably about 0.05mg to 500mg is administered per adult a day.

[0017] Examples are shown below.

Reference Example A-1)

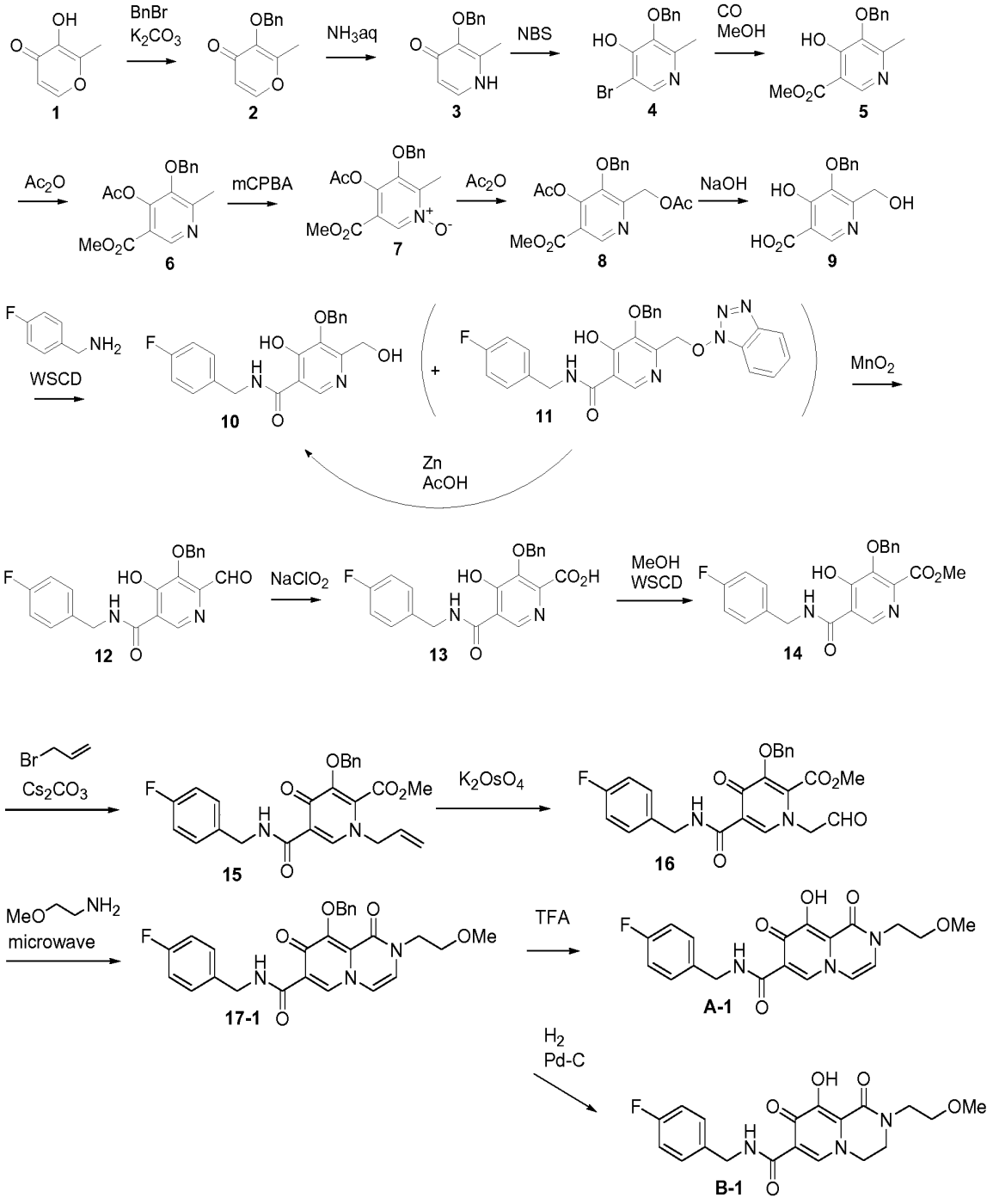
9-Hydroxy-2-(2-methoxy-ethyl)-1,8-dioxo-1,8-dihydro-2H-pyrid[1,2-a]pyrazine -7-carboxylic acid 4-fluoro-banzylamide

Reference Example B-1)

9-Hydroxy-2-(2-methoxy-ethyl)-1,8-dioxo-1,3,4,8-tetrahydro-2H-pyrid[1,2-a]py razine-7-carboxylic acid 4-fluoro-benzylamide

[0018]

[Chemical formula 52]



1) Mantol 1 (189g, 1.5mol) was dissolved in dimethylformamide (1890ml), and benzyl bromide (184ml, 1.5mol) was added. After the solution was stirred at 80°C for 15 minutes, potassium carbonate (228g, 1.65mol) was added, and the mixture was stirred for 1 hour. After the reaction solution was cooled to room temperature, an inorganic salt was filtered, and the filtrate was distilled off under reduced pressure. To the again precipitated inorganic salt was added tetrahydrofuran (1000ml), this was filtered, and the filtrate was distilled off under reduced pressure to obtain the crude product (329g, >100%) of 3-benzyloxy-2-methyl-pyran-4-one 2 as a brown oil.
NMR ($CDCl_3$)δ: 2.09(3H, s), 5.15(2H, s), 6.36(1H, d, J=5.6Hz), 7.29-7.41(5H, m), 7.60(1H, d, J=5.6Hz).

2) The compound 2 (162.2g, 750mmol) was dissolved in ethanol (487ml), and aqueous ammonia (28%, 974ml) and

a 6N aqueous sodium hydroxide solution (150ml, 900mmol) were added. After the reaction solution was stirred at 90 °C for 1 hour, this was cooled to under ice-cooling, and ammonium chloride (58g, 1080mmol) was added. To the reaction solution was added chloroform, this was extracted, and the organic layer was washed with an aqueous saturated sodium bicarbonate solution, and dried with anhydrous sodium sulfate. The solvent was distilled off under reduced pressure, isopropyl alcohol and diethyl ether were added to the residue, and precipitated crystals were filtered to obtain 3-benzyloxy-2-methyl-1H-pyridine-4-one 3 (69.1g, 43%) as a pale yellow crystal.
NMR (DMSO-d_6)δ: 2.05(3H, s), 5.04(2H, s), 6.14(1H, d, J=7.0Hz), 7.31-7.42(5H, m), 7.46(1H, d, J=7.2Hz), 11.29(1H, brs).

3) The above compound 3 (129g, 599mmol) was suspended in acetonitrile (1300ml), and N-bromosuccinic acid imide (117g, 659mmol) was added, followed by stirring at room temperature for 90 minutes. Precipitated crystals were filtered, and washed with acetonitrile and diethyl ether to obtain 3-benzyloxy-5-bromo-2-methyl-pyridine-4-ol 4(154g, 88%) as a colorless crystal. NMR (DMSO-d_6)δ: 2.06(3H, s), 5.04(2H, s), 7.32-7.42(5H, m), 8.03(1H, d, J=5.5Hz), 11.82(1H, brs).

4) To a solution of the compound 4 (88g, 300mmol), palladium acetate (13.4g, 60mmol) and 1,3-bis(diphenylphosphino)propane (30.8g, 516mmol) in dimethylformamide (660ml) were added methanol (264ml) and triethylamine (210ml, 1.5mol) at room temperature. The interior of a reaction vessel was replaced with carbon monoxide, and the material was stirred at room temperature for 30 minutes, and stirred at 80 degree for 18 hours. A vessel to which ethyl acetate (1500ml), an aqueous saturated ammonium chloride solution (1500ml) and water (1500ml) had been added was stirred under ice-cooling, and the reaction solution was added thereto. Precipitates were filtered, and washed with water (300ml), ethyl acetate (300ml) and diethyl ether (300ml) to obtain 5-benzyloxy-4-hydroxy-6-methyl-nicotinic acid methyl ester 5 (44.9g, 55%) as a colorless crystal.
NMR (DMSO-d_6)δ: 2.06(3H, s), 3.72(3H, s), 5.02(2H, s), 7.33-7.42(5H, m), 8.07(1H, s).

5) After a solution of the compound 5 (19.1g, 70mmol) in acetic anhydride (134ml) was stirred at 130 °C for 40 minutes, the solvent was distilled off under reduced pressure to obtain 4-acetoxy-5-benzyloxy-6-methyl-nicotinic acid methyl ester 6 (19.9g, 90%) as a flesh colored crystal.
NMR ($CDCl_3$)δ: 2.29(3H, s), 2.52(3H, s), 3.89(3H, s), 4.98(2H, s), 7.36-7.41(5H, m), 8.85(1H, s).

6) To a solution of the compound 6 (46.2g, 147mmol) in chloroform (370ml) was added metachloroperbenzoic acid (65%) (42.8g, 161mmol) in portions under ice-cooling, and this was stirred at room temperature for 90 minutes. To the reaction solution was added a 10% aqueous potassium carbonate solution, and this was stirred for 10 minutes, followed by extraction with chloroform. The organic layer was washed with successively with a 10% aqueous potassium carbonate solution, an aqueous saturated ammonium chloride solution, and an aqueous saturated sodium chloride solution, and dried with anhydrous sodium sulfate. The solvent was distilled off under reduced pressure, and the residue was washed with diisopropyl ether to obtain 4-acetoxy-5-benzyloxy-6-methyl-1-oxy-nicotinic acid methyl ester 7 (42.6g, 87%) as a colorless crystal.
NMR ($CDCl_3$)δ: 2.30(3H, s), 2.41(3H, s), 3.90(3H, s), 5.02(2H, s), 7.37-7.39(5H, m), 8.70(1H, s).

7) To acetic anhydride (500ml) which had been heated to stir at 130 °C was added the compound 7 (42.6g, 129mmol) over 2 mintues, and this was stirred for 20 minutes. The sovent was distilled off under reduced pressure to obtain 4-acetoxy-6-acetoxymethyl-5-benzyloxy-nicotinic acid methyl ester 8 (49.6g, >100%) as a black oil.
NMR ($CDCl_3$)δ: 2.10(3H, s), 2.28(3H, s), 3.91(3H, s), 5.07(2H, s), 5.20(2H, s), 7.35-7.41(5H, m), 8.94(1H, s).

8) To a solution of the compound 8 (46.8g, 125mmol) in methanol (140ml) was added a 2N aqueous sodium hydroxide solution (376ml) under ice-cooling, and this was stirred at 50 °C for 40 minutes. To the reaction solution were added diethyl ether and 2N hydrochloric acid under ice-cooling, and precipitated crystals were filtered. Resulting crystals were washed with water and diethyl ether to obtain 5-benzyloxy-4-hydroxy-6-hydroxymethyl-nicotinic acid 9 (23.3g, 68%) as a colorless crystal.
NMR (DMSO-d_6)δ: 4.49(2H, s), 5.19(2H, s), 5.85(1H, brs), 7.14-7.20(2H, m), 7.33-7.43(7H, m), 8.30(1H, s), 10.73(1H, t, J=5.8Hz), 11.96(1H, brs).

9) To a solution of the compound 9 (131g, 475mmol), 1-(3-dimethylaminopropyl)-3-ethylcarbodiimide hydrochloride (219g, 1140mmol) and 1-hydroxybenzotriazole (128g, 950mmol) in dimethylformamide (1300ml) was added 4-fluorobenzylamine (109ml, 950mmol), and this was stirred at 80°C for 1.5 hours. After the reaction solution was cooled to room temperature, hydrochloric acid was added, followed by extraction with ethyl acetate. The extract was washed with a 5% aqueous potassium carbonate solution, an aqueous saturated ammonium chloride solution,

and an aqueous saturated sodium chloride solution, and dried with anhydrous sodium sulfate. The solvent was distilled off under reduced pressure to obtain a mixture (175g) of 10 and 11. the resulting mixture was dissolved in acetic acid (1050ml) and water (1050ml), and zinc (31.1g, 475mmol) was added, followed by heating to reflux for 1 hour. After the reaction solution was cooled to room tempreture, a 10% aqueous potassium carbonate solution was added, followed by extraction with ethyl acetate. The extract was washed with an aqueous saturated ammonium chloride solution, and an aqueous saturated sodium chloride solution, and dried with anhydrous sodium sulfate. After the solvent was distilled off under reduced pressure, this was washed with diethyl ether to obtain 5-benzyloxy-N-(4-fluoro-benzyl)-4-hydroxy-6-hydroxymethyl-nicotinic acid amide 10 (107g, 59%) as a colorless crystal.
NMR (DMSO-d_6)δ: 4.45(2H, d, J=4.3Hz), 4.52(2H, d, J=5.8Hz), 5.09(2H, s), 6.01(1H, brs), 7.36-7.43(5H, m), 8.31(1H, s), 12.63(1H, brs).

10) After manganese dioxide (49g) was added to a suspension of the compound 10 (9.8g, 25.6mmol) in chloroform (490ml), the mixture was stirred at room temperature for 1 hour. After the reaction solution was stirred at 60 °C for 20 minutes, Celite filtration was performed, and this was washed with chloroform heated at 50 °C. The filtrate was distilled off under reduced pressure to obtain 5-benzyloxy-N-(4-fluoro-benzyl)-6-formyl-4-hydroxy-nicotinic acid amide 12 (8.2g, 84%) as a pale yellow crystal.
NMR (DMSO-d_6)δ: 4.53(2H, d, J=5.8Hz), 5.38 (2H, s), 7.15-7.21(2H, m), 7.35-7.46(7H, m), 8.33(1H, s), 9.90(1H, s), 10.35(1H, t, J=5.8Hz), 12.49(1H, brs).

11) To an aqueous solution (105ml) of sodium chlorite (7.13g, 78.8mmol), and sulfamic acid (7.65g, 78.8mmol) was added a solution of the compound 12 (15.0g, 39.4mmol) in tetrahydrofuran (630ml) under ice-coling, and the mixture was stirred at room temperature for 1 hour. After water (2500ml) was added to the reaction solution, precipitated crystals were filtered. Washing with diethyl ether afforded 3-benzyloxy-5-(4-fluoro-benzylcarbamoyl)-4-hydroxy-pyridine-2-carboxylic acid 13 (14.0g, 90%) as a colorless crystal.
NMR (DMSO-d_6)δ: 4.52(2H, d, J=5.8Hz), 5.13 (2H, s), 7.14-7.19(2H, m), 7.31-7.40(5H, m), 7.47-7.49(2H, m), 8.31(1H, d, J=4.5Hz), 10.44(1H, t, J=5.9Hz), 12.47(1H, brs).

12) A solution of the compound 13 (198mg, 0.500mmol), 1-(3-dimethylaminopropyl)-3-ethylcarbodiimide hydrochloride (115mg, 0.600mmol) and 1-hydroxybenzotriazole (81mg, 0.600mmol) in dimethylformamide (3ml) was stirred at room temperature for 1.5 hours. Then, methanol (3ml) and triethylamine (153ul, 1.10mmol) were added, and the mixture was heated to reflux for 1.5 hours. The reaction solution was diluted with ethyl acetate, washed with an aqueous saturated sodium bicarbonate solution, a 10% aqueous citric acid solution, and an aqueous saturated sodium chloride solution, and dried with anhydrous sodium sulfate. The solvent was distilled off under reduced pressure, and the residue was washed with diethyl ether to obtain 3-benzyloxy-5-(4-fluoro-benzylcarbamoyl)-4-hydroxy-pyridine-2-carboxylic acid methyl ester 14 (141mg, 69%) as a colorless crystal.
NMR (DMSO-d_6)δ: 3.85(3H, s), 4.52(2H, d, J=6.0Hz), 5.15(2H, s), 7.13-7.21(2H, m), 7.31-7.47(7H, m), 8.33(1H, s), 10.441(1H, t, J=6.0Hz), 12.59(1H, brs).

13) After 3-bromopropene (2.15ml, 24.8mmol) was added to a solution of the compound 14 (6.79g, 16.5mmol), and cesium carbonate (8.09g, 24.8mmol) in dimethylformamide (54ml), the mixture was stirred at room temperature for 4.5 hours. To the reaction solution was added an aqueous ammonium chloride solution, and this was extracted with ethyl acetate, washed with water and an aqueous saturated sodium chloride solution, and dried with anhydrous sodium sulfate. The solvent was distilled off under reduced pressure, and the residue was washed with diethyl ether to obtain 1-allyl-3-benzyloxy-5-(4-fluoro-benzylcarbamoyl)-4-oxo-1,4-dihydro-pyridine-2-carboxy lic acid methyl ester 15 (6.15g, 83%) as a colorless crystal.
NMR ($CDCl_3$) δ: 3.76(3H, s), 4.54(2H, d, J=6.0Hz), 4.60(2H, d, J=6.0Hz), 5.20-5.37(2H, m), 5.25(2H, s), 5.80-5.93(1H, m), 6.98-7.04(2H, m), 7.31-7.35(7H, m), 8.45(1H, s), 10.41(1H, m).

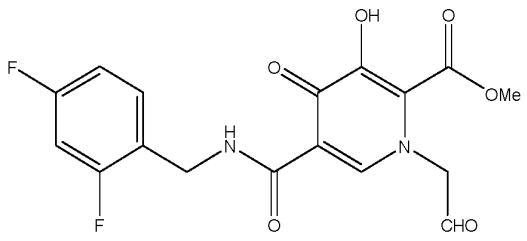
14) To a solution of the compound 15 (7.6g, 16.9mmol) in 1,4-dioxane (228ml) was added an aqueous solution (38ml) of potassium osmate dihydrate (372mg, 1.01mmol), and sodium metaperiodate (14.5g, 67.6mmol) was further added, followed by stirring at room temperature for 2 hours. The reaction solution was added to a vessel to which ethyl acetate (300ml) and water (300ml) had been added, while stirring. The organic layer was washed with water, a 5% aqueous sodium hydrogen sulfite solution and an aqueous saturated sodium chloride solution, and dried with anhydrous sodium sulfate. The solvent was distilled off under reduced pressure, and the residue was washed with diethyl ether to obtain 3-benzyloxy-5-(4-fluoro-benzylcarbamoyl)-4-oxo-1-(2-oxo-ethyl)-1,4-dihydro-pyridine-2 -carboxylic acid methyl ester 16 (5.39g, 71%) as a colorless crystal.
NMR ($CDCl_3$)δ: 3.74(3H, s), 4.60(2H, d, J=5.9Hz), 4.87(2H, s), 5.27(2H, s), 6.98-7.04(2H, m), 7.30-7.40(7H, m), 8.39(1H, s), 9.58(1H, s), 10.38(1H, s).

15) To a solution of the compound 16 (400mg, 0.884mmol) in methylene chloride (12ml) were added 2-methoxyethylamine (77ul, 0.884mmol) and acetic acid (18ul), and the mixture was stirred at room temperature for 5 minutes. Thereafter, the reaction was performed at 140 °C for 30 minutes in a microwave reaction apparatus. The solvent was distilled off under reduced pressure, the residue was subjected to silica gel column chromatography, and fractions eluting with toluene-acetone were concentrated under reduced pressure to obtain 9-benzyloxy-2-(2-methyethyl)-1,8-dioxo-1,8-dihydro-2H-pyrid[1,2-a]pyrazine-7-carbox ylic acid 4-fluoro-benzylamide 17-1 (226mg, 54%) as a yellow solid.
NMR ($CDCl_3$)δ: 3.35(3H, s), 3.65(2H, t, J=5.1Hz), 3.97(2H, t, J=4.5Hz), 4.63(2H, d, J=5.7Hz), 5.28(2H, s), 6.56(2H, m), 7.01(2H, t, J=8.7Hz), 7.38-7.30(5H, m), 7.65(2H, d, J=6.6Hz), 10.63(1H, s).

16) To the compound 17-1 (140mg, 0.293mmol) was added trifluoroacetic acid (1.4ml) under ice-cooling, and the mixture was stirred at 0 °C for 5 minutes and, then, at room temperature for 1.5 hours. The solvent was distilled off under reduced pressure, and this was diluted with chloroform, and added to ice water. This was washed with an aqueous saturated sodium bicarbonate solution, a 10% aqueous citric acid solution and water, and dried with anhydrous sodium sulfate. The solvent was distilled off under reduced pressure, and the residue was recrystallized with methylene chloride-ethanol to obtain Example A-1 (89mg, 79%) as a yellow crystal. melting point: 223-224 °C
NMR (DMSO-d_6)δ: 3.25(3H, s), 3.58(2H, t, J=5.4Hz), 3.92(2H, t, J=5.1Hz), 4.53(2H, d, J=5.7Hz), 6.87(1H, d, 6.3Hz), 7.14(2H, t, J=9.0Hz), 7.33-7.38(2H, m), 7.47(1H, d, J=6.0Hz), 8.77(1H, s), 10.56(1H, t, J=6.0Hz), 12.00(1H, brs).

17) The compound 17-1 (157mg, 0.329mmol) was dissolved in dimethylformamide (18ml) and methanol (1ml), 10% palladium-carbon powder (31mg) was added, and the mixture was stirred at room temperature for 20 hours under the hydrogen atmosphere. The reaction solution was filtered with Celite, and the filtrate was concentrated under reduced pressure. The residue was dissolved in chloroform, this was filtered with Celite again, and the filtrate was concentrated under reduced pressure. The residue was recrystallized with methylene chloride-methanol to obtain Example B-1 (66mg, 52%) as a browm crystal.
melting point: 197-199 °C
NMR (DMSO-d_6)δ:3.27(3H, s), 3.55(2H, t, J=5.1Hz), 3.68(2H, t, J=5.1Hz), 3.79(2H, s), 4.36(2H, s), 4.51(2H, d, J=5.7Hz), 7.15(2H, t, J=8.7Hz), 7.32-7.37(2H, m), 8.38(1H, s), 10.46(1H, t, J=5.4Hz), 12.41(1H, s).

[0019] All examples below consist of >95% ee and >6:1 diastereomeric purity unless indicated otherwise. The compounds shown in table ZZ consist of mixtures of diastereomers at the depicted stereocenter in ratios of 1:1 to >10:1. Stereocenters that were formed during the process' below have been assigned using NMR techniques well know in the art (1D and 2D method) and/or using vibrational circular dichroism techniques. Stereochemical assignment determinatons were performed on representative examples and closely related compounds were assigned by analogy in some cases. The schemes below are meant to be general guidance to how examples were synthesized. It will be possible that one skilled in the art may rearrange the order of steps or change substituents to apply the method described below and in the examples to construct compounds of the general formula. Additional methods known to those skilled in the art or commonly present in the literature may also be applied to perform similar transformations and arriving at the same compounds of the general formula or amino alcohol and diamine precursors.



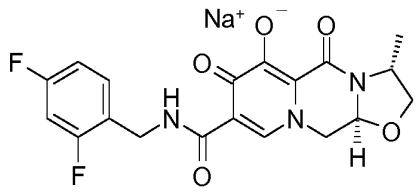
16a

[0020] Compound 16a will be referred to in the below Examples.

Reference Example Z-1:

(3R,11aS)-N-[(2,4-Difluorophenyl)methyl]-6-hydroxy-3-methyl-5,7-dioxo-2,3,5,7,11,11a -hexahydro[1,3]oxazolo[3,2-a]pyrido[1,2-d]pyrazine-8-carboxamide sodium salt.

[0021]



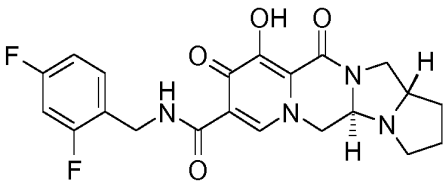
a) *(3R,11aS)-N*-[(2,4-Difluorophenyl)methyl]-3-methyl-5,7-dioxo-6-[(phenylmethyl)oxy]-2, 3,5,7,11,11a-hexahydro[1,3]oxazolo[3,2-a]pyrido[1,2-d]pyrazine-8-carboxamide. To a solution of **16a** (409 mg, 0.87 mmol) in dichloroethane (20 mL) was added (2*R*)-2-amino-1-propanol (0.14 mL, 1.74 mmol) and 10 drops of glacial acetic acid. The resultant solution was heated at reflux for 2 h. Upon cooling, Celite was added to the mixture and the solvents removed *in vacuo* and the material was purified via silica gel chromatography (2% CH_3OH/CH_2Cl_2 gradient elution) to give (3*R*,11a*S*)-*N*-[(2,4-difluorophenyl)methyl]-3-methyl-5,7-dioxo-6-[(phenylmethyl)oxy]-2, 3,5,7,11,11a-hexahydro[1,3]oxazolo[3,2-*a*]pyrido[1,2-*d*]pyrazine-8-carboxamide (396 mg, 92%) as a glass. ^{1}H NMR ($CDCl_3$) δ 10.38 (m, 1 H), 8.42 (s, 1 H), 7.54-7.53 (m, 2 H), 7.37-7.24 (m, 4 H), 6.83-6.76 (m, 2 H), 5.40 (d, *J*= 10.0 Hz, 1 H), 5.22 (d, *J*= 10.0 Hz, 1 H), 5.16 (dd, *J* = 9.6, 6.0 Hz, 1 H), 4.62 (m, 2 H), 4.41 (m, 1 H), 4.33-4.30 (m, 2 H), 3.84 (dd, *J* = 12.0, 10.0 Hz, 1 H), 3.63 (dd, *J* = 8.4, 7.2 Hz, 1 H), 1.37 (d, *J*= 6.0 Hz, 3 H); ES+ MS: 496 (M+1).

b) (3*R*,11a*S*)-*N*-[(2,4-Difluorophenyl)methyl]-6-hydroxy-3-methyl-5,7-dioxo-2,3,5,7,11,11a -hexahydro[1,3]oxazolo[3,2-*a*]pyrido[1,2-*d*]pyrazine-8-carboxamide sodium salt. To a solution of (3*R*,11a*S*)-N-[(2,4-difluorophenyl)methyl]-3-methyl-5,7-dioxo-6-[(phenylmethyl)oxy]-2, 3,5,7,11,11a-hexahydro[1,3]oxazolo[3,2-*a*]pyrido[1,2-*d*]pyrazine-8-carboxamide (396 mg, 0.80 mmol) in methanol (30 mL) was added 10% Pd/C (25 mg). Hydrogen was bubbled through the reaction mixture via a balloon for 2 h. The resultant mixture was filtered through Celite with methanol and dichloromethane. The filtrate was concentrated *in vacuo* to give (3*R*,11a*S*)-*N*-[(2,4-difluorophenyl)methyl]-6-hydroxy-3-methyl-5,7-dioxo-2,3,5,7,11,11a-hexahydro[1,3]oxazolo[3,2-*a*]pyrido[1,2-*d*]pyrazine-8-carboxamide as a pink tinted white solid (278 mg, 86%). ^{1}H NMR ($CDCl_3$) δ 11.47 (m, 1 H), 10.29 (m, 1 H), 8.32 (s, 1 H), 7.36 (m, 1 H), 6.82 (m, 2 H), 5.31 (dd, *J* = 9.6, 3.6 Hz, 1 H), 4.65 (m, 2 H), 4.47-4.38 (m, 3 H), 3.93 (dd, *J* = 12.0, 10.0 Hz, 1 H), 3.75 (m, 1 H), 1.49 (d, *J* = 5.6 Hz, 3 H); ES$^+$ MS: 406 (M+1). The above material (278 mg, 0.66 mmol) was taken up in ethanol (10 mL) and treated with 1 *N* sodium hydroxide (aq) (0.66 mL, 0.66 mmol). The resulting suspension was stirred at room temperature for 30 min. Ether was added and the liquids were collected to provide the sodium salt of the title compound as a white powder (291 mg, 99%). ^{1}H NMR (DMSO-d_6) δ 10.68 (m, 1 H), 7.90 (s, 1 H), 7.35 (m, 1 H), 7.20 (m, 1 H), 7.01 (m, 1 H), 5.20 (m, 1 H), 4.58 (m, 1 H), 4.49 (m, 2 H), 4.22 (m, 2 H), 3.74 (dd, *J* = 11.2, 10.4 Hz, 1 H), 3.58 (m, 1 H), 1.25 (d, *J* = 4.4 Hz, 3 H).

Reference Example Z-2:

(4a-*R*,13a*S*)-*N*-[(2,4-Difluorophenyl)methyl]-10-hydroxy-9,11-dioxo-2,3,4a,5,9,11,13,13a -octahydro-1***H***-pyrido[1,2-a]pyrrolo[1',2':3,4]imidazo[1,2-*d*]pyrazine-8-carboxamide.

[0022]



a) (4a*R*,13a*S*)-*N*-[(2,4-Difluorophenyl)methyl]-9,11-dioxo-10-[(phenylmethyl)oxy]-2,3,4a,5 ,9,11,13,13a-octahydro-1*H*-pyrido[1,2-*a*]pyrrolo[1',2':3,4]imidazo[1,2-*d*]pyrazine-8-carb oxamide. A solution of **16a** (24 mg, 0.05 mmol), [(2*S*)-2-pyrrolidinylmethyl]amine (0.1 mL) and 2 drops of glacial acetic acid were heated under microwave conditions at 140 °C for 10 min. Upon cooling, Celite was added to the mixture and the solvents removed *in vacuo* and the material was purified via silica gel chromatography (2% CH_3OH/CH_2Cl_2 gradient elution) to give (4a*R*,43a*S*)-*N*-[(2,4-difluorophenyl)methyl]-9,11-dioxo-10-[(phenylmethyl)oxy]-2,3,4a,5, 9,11,13,13a-octahydro-1*H*-pyrido[1,2-*a*]pyrrolo[1',2':3,4]imidazo[1,2-*d*]pyrazine-8-carbo xamide (19 mg, 71%) as a white solid. ^{1}H NMR ($CDCl_3$) δ 10.41 (m, 1 H), 8.38 (s, 1 H), 7.56 (m, 2 H), 7.38-7.24 (m, 4 H), 6.80 (m, 2 H), 5.38 (d, *J* = 9.6 Hz, 1 H), 5.10 (d, *J* = 10.0 Hz, 1 H), 4.62 (m, 2 H), 4.40 (m, 1 H), 4.25 (dd, *J* = 12.0, 6.8 Hz, 1 H), 4.10 (d, *J* = 12.8 Hz, 1 H), 3.83 (m, 1 H), 3.71 (m,

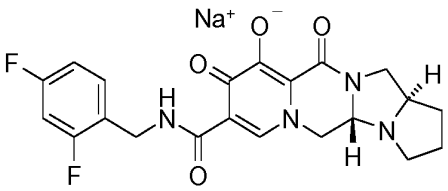
1 H), 3.14-3.04 (m, 2 H), 2.78 (m, 1 H), 2.11-1.58 (m, 4 H); ES+ MS: 521 (M+1).

b) (4a*R*,13a*S*)-*N*-[(2,4-Difluorophenyl)methyl]-10-hydroxy-9,11-dioxo-2,3,4a,5,9,11,13,13a -octahydro-1*H*-pyrido[1,2-*a*]pyrrolo[1',2':3,4]imidazo[1,2-*d*]pyrazine-8-carboxamide. To a solution of (4a-*R*,13a*S*)-*N*-[(2,4-difluorophenyl)methyl]-9,11-dioxo-10-[(phenylmethyl)oxy]-2,3,4a,5, 9,11,13,13a-octahydro-1*H*-pyrido[1,2-*a*]pyrrolo[1',2':3,4]imidazo[1,2-*d*]pyrazine-8-carbo xamide (19 mg, 0.04 mmol) in methanol (8 mL) was added 10% Pd/C (10 mg). Hydrogen was bubbled through the reaction mixture via a balloon for 2 h. The resultant mixture was filtered through Celite with methanol and dichloromethane. The filtrate was concentrated *in vacuo* to give the title compound (6 mg, 38%) as a white solid. ^{1}H NMR ($CDCl_3$) δ 11.73 (m, 1 H), 10.36 (m, 1 H), 8.31 (s, 1 H), 7.33 (m, 1 H), 6.78 (m, 2 H), 4.62 (m, 2 H), 4.50 (m, 1 H), 4.27-4.19 (m, 2 H), 3.87-3.77 (m, 2 H), 3.16-3.08 (m, 2 H), 2.83 (m, 1 H), 2.11-1.65 (m, 4 H); ES+ MS: 431 (M+1).

Example Z-4:

(4a*S*,13a*R*)-*N*-[(2,4-Difluorophenyl)methyl]-10-hydroxy-9,11-dioxo-2,3,4a,5,9,11,13,13a -octahydro-1*H*-pyrido[1,2-*a*]pyrrolo[1',2':3,4]imidazo[1,2-*d*]pyrazine-8-carboxamide sodium salt.

[0023]



a) [(2*R*)-2-Pyrrolidinylmethyl]amine. To a solution of *N*-BOC-(2*R*)-2-(aminomethyl)-1-pyrrolidine (1.37 g, 6.85 mmol) in THF (20 mL) was added 4 *N* HCl (aq) (8 mL). The resultant solution was stirred at room temperature overnight. The solvents were removed *in vacuo* and the residue was treated with MP-carbonate resin in methanol and dichloromethane. After 1 h, the resin was removed via filtration through a fritted tube and the volatiles were removed carefully *in vacuo* to produce the free based amine (760 mg crude >100%) as a oil. This material was used without further purification. ^{1}H NMR ($CDCl_3$) δ 3.13 (m, 1 H), 2.92 (m, 1 H), 2.82-2.62 (m, 5 H), 1.88-1.30 (m, 4 H).

b) (4a*S*,13a*R*)-*N*-[(2,4-Difluorophenyl)methyl]-9,11-dioxo-10-[(phenylmethyl)oxy]-2,3,4a, 5 ,9,11,13,13a-octahydro-1*H*-pyrido[1,2-*a*]pyrrolo[1',2':3,4]imidazo[1,2-*d*]pyrazine-8-carb oxamide. In a similar manner as described in Reference example Z-2 from **16a** (435 mg, 0.93 mmol) and [(2*R*)-2-pyrrolidinylmethyl]amine (200 mg, 2.0 mmol) in 1,2-dichloroethane (20 mL) and 15 drops of glacial acetic acid was obtained (4a*S*,13a*R*)-*N*-[(2,4-difluorophenyl)methyl]-9,11-dioxo-10-[(phenylmethyl)oxy]-2,3,4a,5, 9,11,13,13a-octahydro-1*H*-pyrido[1,2-a]pyrrolo[1',2':3,4]imidazo[1,2-*d*]pyrazine-8-carbo xamide (321 mg, 67%) as a white solid. ^{1}H NMR ($CDCl_3$) δ 10.41 (m, 1 H), 8.35 (s, 1 H), 7.56 (m, 2 H), 7.55-7.24 (m, 4 H), 6.80 (m, 2 H), 5.35 (d, *J*= 10.0 Hz, 1 H), 5.13 (d, *J*= 10.0 Hz, 1 H), 4.60 (m, 2 H), 4.38 (dd, J= 10.4, 3.2 Hz, 1 H), 4.21 (dd, J= 12.0, 6.8 Hz, 1 H), 4.04 (dd, J= 12.4, 2.8 Hz, 1 H), 3.77 (apparent t, J= 11.6 Hz, 1 H), 3.68 (m, 1 H), 3.11-3.00 (m, 2 H), 2.75 (m, 1 H), 2.08-1.84 (m, 3 H), 1.65 (m, 1 H); ES+ MS: 521 (M+1).

c) (4a*S*,13a*R*)-*N*-[(2,4-Difluorophenyl)methyl]-10-hydroxy-9,11-dioxo-2,3,4a,5,9,11,13,13a -octahydro-1*H*-pyrido[1,2-*a*]pyrrolo[1',2':3,4]imidazo[1,2-*d*]pyrazine-8-carboxamide. In a similar manner as described in Reference example Z-2 from (4a*S*,13a*R*)-*N*-[(2,4-difluorophenyl)methyl]-9,11-dioxo-10-[(phenylmethyl)oxy]-2,3,4a,5, 9,11,13,13a-octahydro-1*H*-pyrido[1,2-*a*]pyrrolo[1',2':3,4]imidazo[1,2-*d*]pyrazine-8-carbo xamide (518 mg, 0.99 mmol) and 10% Pd/C (35 mg) in methanol (40 mL) was obtained (4a*S*,13a*R*)-*N*-[(2,4-Difluorophenyl)methyl]-10-hydroxy-9,11-dioxo-2,3,4a,5,9,11,13,13a -octahydro-1*H*-pyrido[1,2-*a*]pyrrolo[1',2':3,4]imidazo[1,2-*d*]pyrazine-8-carboxamide (430 mg, 99%) as a white solid. ^{1}H NMR ($CDCl_3$) δ 11.73 (m, 1 H), 10.36 (m, 1 H), 8.32 (s, 1 H), 7.35 (m, 1 H), 6.79 (m, 2 H), 4.64 (m, 2 H), 4.54 (dd, J= 10.8, 4.0 Hz, 1 H), 4.28-4.19 (m, 2 H), 3.90-3.79 (m, 2 H), 3.18-3.10 (m, 2 H), 2.84 (m, 1 H), 2.14-1.92 (m, 3 H), 1.72 (m, 1 H).

d) (4a*S*,13a*R*)-*N*-[(2,4-Difluorophenyl)methyl]-10-hydroxy-9,11-dioxo-2,3,4a,5,9,11,13,13a -octahydro-1*H*-pyrido[1,2-a]pyrrolo[1',2':3,4]imidazo[1,2-*d*]pyrazine-8-carboxamide sodium salt. In a similar manner as described in Reference example Z-1 from (4a*S*,13a*R*)-*N*-[(2,4-Difluorophenyl)methyl]-10-hydroxy-9,11-dioxo-2,3,4a,5,9,11,13,13a "octahydro-1*H*-pyrido[1,2-*a*]pyrrolo[1',2':3,4]imidazo[1,2-*d*]pyrazine-8-carboxamide (430 mg,

1.0 mmol) and sodium hydroxide (1.0 mL, 1.0 M aq, 1.0 mmol) in 20 mL of ethanol was formed the corresponding sodium salt (425 mg, 94%) as a white solid.
^{1}H NMR (D_2O δ 7.85 (s, 1 H), 7.23 (m, 1 H), 6.82 (m, 2 H), 4.51-4.46 (m, 3 H), 4.28 (m, 1 H),3.95 (m, 1 H), 3.84 (m, 1 H), 3.62 (m, 1 H), 3.16 (m, 1 H), 2.89 (m, 1 H), 2.84 (m, 1H), 1.90 (m, 2 H), 1.73 (m, 1 H), 1.60 (m, 1 H). ES$^+$ MS: 431 (M+1).

Experimental Example 2

[0024] A derivative of 293T cells expressing an attachment factor to improve adherence to plastic were used for the assay. A VSV-g pseudotyped HIV vector that expresses luciferase (herein referred to as PHIV) was produced by transfection of cells with the pGJ3-Luci vector plasmid (Jármy, G. et al., J. Medical Virology, 64:223-231, 2001) and pVSV-g (Clontech). Cells were mixed with the PHIV vector and then mixed with serially diluted compounds. After incubation at 37°C and 5% CO_2 for two days, the plates were read by using Steady Glo luciferase assay reagent (Promega) as recommended by the manufacturer. To assess non-HIV specific inhibition, a similar assay was performed, except that cell/PHIV vector mixture was replaced by cells which had been previously transduced and constitutively expressed luciferase.

[Table 2]

Example number	PHIV IC_{50}
Z-1	<10 nM
Z-2	<10 nM
Z-4	<10 nM

Formulation Example

[0025] A term "active ingredient" means the present compound, a tautomer thereof, a pharmaceutically acceptable thereof, or a solvate thereof.

(Formulation Example 1)

[0026] A hard gelatin capsule is prepared using the following ingredients:

	dose (mg/capsule)
Active ingredient	250
Starch (dried)	200
Magnesium stearate	10
Total	460mg

(Formulation Example 2)

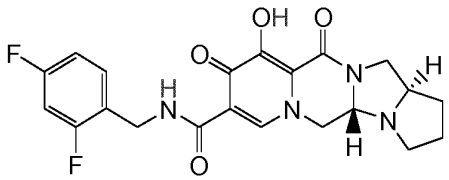
[0027] A tablet is prepared using the following ingredients:

	dose (mg/tablet)
Active ingredient	250
Cellulose (microcrystalline)	400
Silicon dioxide (fumed)	10
Stearic acid	5
Total	665mg

[0028] Ingredients are mixed, and compressed to obtain tablets, each weighing 665 mg.

Claims

1. A compound which is (4a*S*,13a*R*)-*N*-[(2,4-Difluorophenyl)methyl]-10-hydroxy-9,11-dioxo-2,3,4a,5,9,11,13,13a-octahydro-1*H*-pyrido[1,2-*a*]pyrrolo[1',2':3,4]imidazo[1,2-*d*]pyrazine-8-carboxamide:



or a pharmaceutically acceptable salt or solvate thereof.

2. A compound according to claim 1 which is (4a*S*,13a*R*)-*N*-[(2,4-difluorophenyl)methyl]-10-hydroxy-9,11-dioxo-2,3,4a,5,9,11,13,13a-octahydro-1*H*-pyrido[1,2-a]pyrrolo[1',2':3,4]imidazo[1,2-*d*]pyrazine-8-carboxamide or a pharmaceutically acceptable salt thereof

3. A compound according to claim 1 or claim 2 wherein the pharmaceutically acceptable salt is a sodium salt.

4. A pharmaceutical composition comprising a compound according to any one of Claims 1 to 3, or a pharmaceutically acceptable salt, or solvate thereof.

5. A pharmaceutical composition according to claim 4, which is an anti-HIV agent.

6. A pharmaceutical composition according to claim 4 wherein said composition comprises at least one additional therapeutic agent selected from reverse transcriptase inhibitors and protease inhibitors.

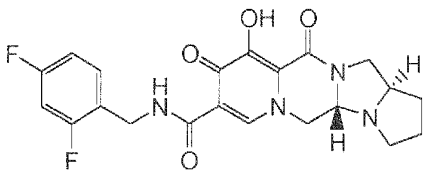
7. A compound as defined in any one of claims 1 to 3 for use in medical therapy.

8. A compound as defined in any one of claim 1 to 3 for use in the treatment or prophylaxis of an HIV infection.

9. Use of a compound as defined in any one of claims 1 to 3 in the manufacture of a medicament for the treatment or prophylaxis of an HIV infection.

Patentansprüche

1. Verbindung (4a*S*,13a*R*)-*N*-[(2,4-Difluorphenyl)methyl]-10-hydroxy-9,11-dioxo-2,3,4a,5,9,11,13,13a-octahydro-1*H*-pyrido[1,2-*a*]pyrrolo[1',2':3,4]imidazo[1,2-d]pyrazin-8-carboxamid:



oder ein pharmazeutisch verträgliches Salz oder Solvat davon.

2. Verbindung nach Anspruch 1, welche (4a*S*,13a*R*)-*N*-[(2,4-Difluorphenyl)methyl]-10-hydroxy-9,11-dioxo-2,3,4a,5,9,11,13,13a-octahydro-1*H*-pyrido[1,2-a]pyrrolo[1',2':3,4]imidazo[1,2-*d*]pyrazin-8-carboxamid ist oder ein pharmazeutisch verträgliches Salz davon.

3. Verbindung nach Anspruch 1 oder 2, wobei das pharmazeutisch verträgliche Salz ein Natriumsalz ist.

4. Pharmazeutische Zusammensetzung, umfassend eine Verbindung nach einem der Ansprüche 1 bis 3, oder ein pharmazeutisch verträgliches Salz oder Solvat davon.

5. Pharmazeutische Zusammensetzung nach Anspruch 4, welche ein Anti-HIV-Mittel ist.

6. Pharmazeutische Zusammensetzung nach Anspruch 4, wobei die Zusammensetzung mindestens ein weiteres therapeutisches Mittel umfasst, ausgewählt aus reverse Transkriptase-Inhibitoren und Protease-Inhibitoren.

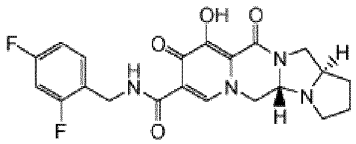
7. Verbindung, wie in einem der Ansprüche 1 bis 3 definiert, zur Verwendung in der medizinischen Therapie.

8. Verbindung, wie in einem der Ansprüche 1 bis 3 definiert, zur Verwendung bei der Behandlung oder Prophylaxe einer HIV-Infektion.

9. Verwendung einer Verbindung, wie in einem der Ansprüche 1 bis 3 definiert, bei der Herstellung eines Medikaments zur Behandlung oder Prophylaxe einer HIV-Infektion.

Revendications

1. Composé qui est le (4a*S*,13a*R*)-N-[(2,4-difluorophényl)méthyl]-10-hydroxy-9,11-dioxo-2,3,4a,5,9,11,13,13a-octahydro-1*H*-pyrido[1,2-a]pyrrolo[1,2':3,4]imidazo[1,2-*d*]pyrazine-8-carboxamide :



ou sel ou solvate pharmaceutiquement acceptable de celui-ci.

2. Composé selon la revendication 1, lequel est le (4a*S*,13a*R*)-N-[(2,4-difluorophényl)méthyl]-10-hydroxy-9,11-dioxo-2,3,4a,5,9,11,13,13a-octahydro-1*H*-pyrido[1,2-a]pyrrolo[1',2':3,4]imidazo-[1,2-*d*]pyrazine-8-carboxamide ou un sel pharmaceutiquement acceptable de celui-ci.

3. Composé selon la revendication 1 ou la revendication 2, dans lequel le sel pharmaceutiquement acceptable est un sel de sodium.

4. Composition pharmaceutique comprenant un composé selon l'une quelconque des revendications 1 à 3, ou un sel ou solvate pharmaceutiquement acceptable de celui-ci.

5. Composition pharmaceutique selon la revendication 4, laquelle est un agent anti-VIH.

6. Composition pharmaceutique selon la revendication 4, dans laquelle ladite composition comprend au moins un agent thérapeutique supplémentaire choisi parmi des inhibiteurs de transcriptase inverse et des inhibiteurs de protéase.

7. Composé selon l'une quelconque des revendications 1 à 3 pour une utilisation dans une thérapie médicale.

8. Composé selon l'une quelconque des revendications 1 à 3 pour une utilisation dans le traitement ou la prophylaxie d'une infection par le VIH.

9. Utilisation d'un composé selon l'une quelconque des revendications 1 à 3 dans la fabrication d'un médicament pour le traitement ou la prophylaxie d'une infection par le VIH.

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 030166275 A **[0005]**
- WO 2004024693 A **[0005]**
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