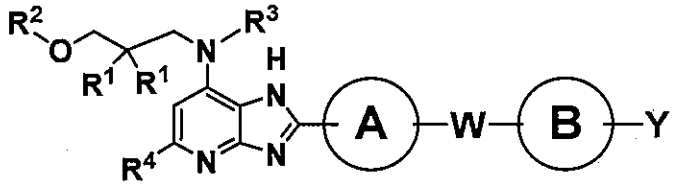
CLAIMS

1. Use of an azabenzimidazole compound, or a pharmaceutically acceptable salt thereof, or a solvate thereof, as an active ingredient, the azabenzimidazole compound being a compound of the formula [1]:

[Chem. 1]



[1]

wherein:

R^1 is a hydrogen atom or alkyl, or the two R^1s combine with the adjacent carbon atom to form a 3- to 7-membered cycloalkyl or an oxygen-containing non-aromatic heterocycle;

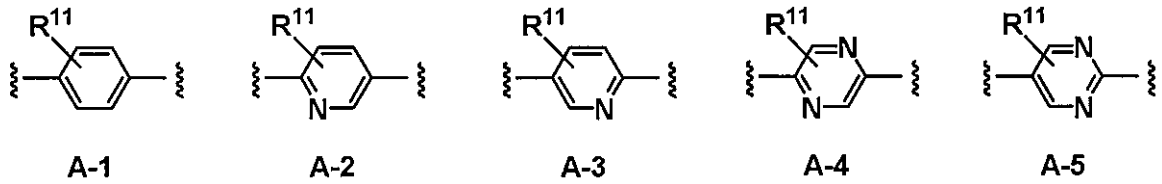
R^2 is a hydrogen atom, alkyl, cycloalkyl, alkyl substituted with cycloalkyl, or alkoxyalkyl;

R^3 is a hydrogen atom, alkyl, or alkoxyalkyl;

R^4 is pyridyl optionally substituted with one or two groups selected from the group consisting of alkyl, trihaloalkyl, alkoxy, cyano, and cycloalkyl, or phenyl optionally substituted with 1 to 3 groups selected from the group consisting of trihaloalkyl, halogen, alkoxy, and cycloalkyl;

A is a group of the formula A-1, A-2, A-3, A-4, or A-5:

[Chem. 2]

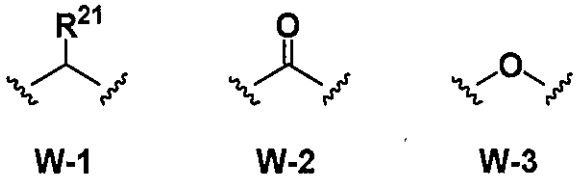


A-1 A-2 A-3 A-4 A-5

wherein the bond on the left side of each group is attached to the 2-position of the azabenzimidazole in the formula [1], the bond on the right side is attached to W in the formula [1], and R^{11} is a group selected from a hydrogen atom, halogen, alkyl, alkoxy, and nitro; W is a

bond or a group of the formula W-1, W-2, or W-3:

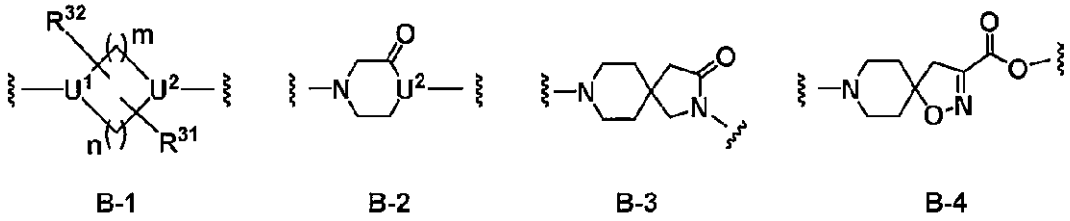
[Chem. 3]



wherein R^{21} is a hydrogen atom or alkyl;

B is a group of the formula B-1, B-2, B-3, or B-4:

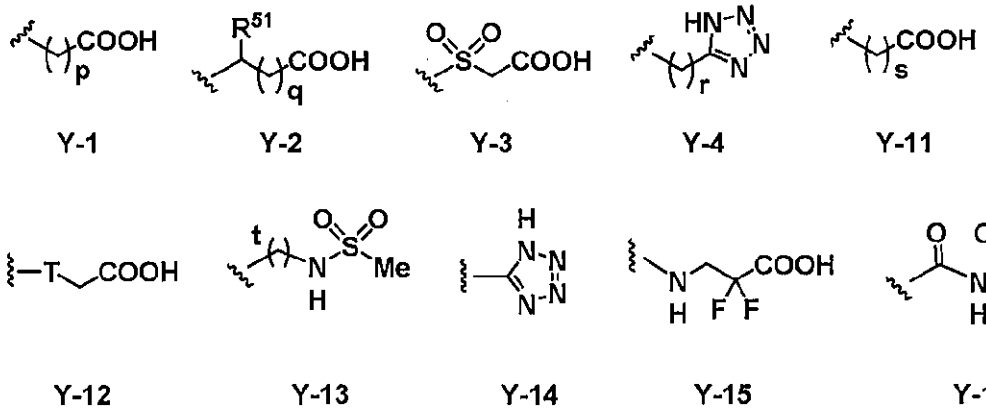
[Chem. 4]



wherein the bond on the left side of each group is attached to W in the formula [1], the bond on the right side is attached to Y in the formula [1], U^1 is a nitrogen atom or CR^{41}, U^2 is a nitrogen atom or CR^{42}, R^{41} and R^{42} are each independently a hydrogen atom, alkyl, halogen, or a hydroxyl group, m and n are each 1, 2, or 3, and R^{31} and R^{32} are each independently a hydrogen atom, alkyl, halogen, or alkoxyalkyl, or R^{31} and R^{32} combine with an adjacent carbon atom to form an alkylene bridge, provided that R^{31} and R^{32} substitute at any substitutable positions other than U^1 and U^2; and

Y is a hydrogen atom or a group of any one of the formulae Y-1 to Y-4, Y-11 to Y-16:

[Chem. 5]



wherein R^{51} is alkyl, p is 1, 2, or 3, q is 0, 1, or 2, r is 1, 2, or 3, T is O, S, SO_2, or NR^{61} wherein R^{61} is a hydrogen atom or alkyl, s is 0, 1, 2, or 3, and t is 0 or 1, with the proviso that one of the following cases (a) to (d) is selected:

(a) when W is a bond,

if B is B-1 or B-2 and U^2 is a nitrogen atom, then Y is Y-1, Y-2, Y-3, or Y-4,

if B is B-1 or B-2 and U^2 is CR^{42} wherein R^{42} is as defined above, then U^1 is a nitrogen atom and Y is Y-11, Y-12, Y-13, Y-14, Y-15, or Y-16, and

if B is B-3 or B-4, then Y is a hydrogen atom;

(b) when W is W-1,

if B is B-1, U^1 is a nitrogen atom, and U^2 is a nitrogen atom, then Y is Y-1, Y-2, Y-3, or Y-4, and

if B is B-1, U^1 is a nitrogen atom, and U^2 is CR^{42} wherein R^{42} is as defined above, then Y is Y-11, Y-12, Y-13, Y-14, Y-15, or Y-16;

(c) when W is W-2,

if B is B-1 or B-2, U^1 is a nitrogen atom, and U^2 is a nitrogen atom, then Y is Y-1, Y-2, Y-3, or Y-4,

if B is B-1 or B-2, U^1 is a nitrogen atom, and U^2 is CR^{42} wherein R^{42} is as defined above, then Y is Y-11, Y-12, Y-13, Y-14, Y-15, or Y-16, and

if B is B-3 or B-4, then Y is a hydrogen atom; and

(d) when W is W-3,

if B is B-1, U^1 is CR^{41} wherein R^{41} is as defined above, and U^2 is a nitrogen atom, then Y is Y-1, Y-2, Y-3, or Y-4, in the preparation of a pharmaceutical composition for treatment or prophylaxis of a functional gastrointestinal disorder.

2. The use according to claim 1, wherein W is a bond.

3. The use according to claim 1 or 2, wherein
(1) B is B-1 or B-2, U^2 is a nitrogen atom, and Y is Y-1, Y-2, or Y-3,
(2) B is B-1 or B-2, U^2 is CR^{42}, and Y is Y-11, Y-12, or Y-15, or
(3) B is B-4 and Y is a hydrogen atom.

4. The use according to claim 3, wherein R^4 is pyridyl substituted with trihaloalkyl and a group selected from the group consisting of alkyl, trihaloalkyl, alkoxy, cyano, and cycloalkyl.

5. The use according to claim 4, wherein A is A-4.

6. The use according to any one of claims 1 to 5, wherein the azabenzimidazole compound is any one of the following (1) to (15):
(1) [4-(5-{5-[3-fluoro-5-(trifluoromethyl)phenyl]-7-[{[1-(methoxymethyl)cyclobutyl]methyl}(methyl)amino]-1H-imidazo[4,5-b]pyridin-2-yl}pyrazin-2-yl)piperazin-1-yl]acetic acid,
(2) 4-fluoro-1-(5-{5-[3-fluoro-5-(trifluoromethyl)phenyl]-7-[{[1-(methoxymethyl)cyclobutyl]methyl}(methyl)amino]-1H-imidazo[4,5-b]pyridin-2-yl}pyrazin-2-yl)piperidine-4-carboxylic acid,
(3) 1-(5-{5-[6-ethoxy-5-(trifluoromethyl)pyridin-3-yl]-7-[{[1-(methoxymethyl)cyclobutyl]methyl}(methyl)amino]-1H-imidazo[4,5-b]pyridin-2-yl}pyrazin-2-yl)piperidine-4-carboxylic acid,
(4) 1-(5-{5-[2-ethoxy-6-(trifluoromethyl)pyridin-4-yl]-7-[{[1-(methoxymethyl)cyclobutyl]methyl}(methyl)amino]-1H-imidazo[4,5-b]pyridin-2-yl}pyrazin-2-yl)piperidine-4-carboxylic acid,
(5) {[1-(5-{5-[2-cyclopropyl-6-(trifluoromethyl)pyridin-4-yl]-7-[{[1-(methoxymethyl)cyclopentyl]methyl}(methyl)amino]-1H-imidazo[4,5-b]pyridin-2-yl}pyrazin-2-yl)piperidin-4-yl]oxy}acetic acid,
(6) 1-(4-{5-[6-ethoxy-5-(trifluoromethyl)pyridin-3-yl]-7-[{[1-(methoxymethyl)cyclopentyl]methyl}(methyl)amino]-1H-imidazo[4,5-b]pyridin-2-yl}-3-fluorophenyl)piperidine-4-carboxylic acid,
(7) 1-(5-{5-[2-ethoxy-6-(trifluoromethyl)pyridin-4-yl]-7-[(3-methoxy-2,2-dimethylpropyl)(methyl)amino]-1H-imidazo[4,5-b]pyridin-2-yl}pyrazin-2-yl)piperidine-4-

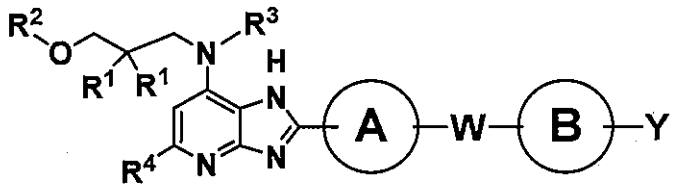
carboxylic acid,
(8) 1-(5-{5-[6-cyclopropyl-5-(trifluoromethyl)pyridin-3-yl]-7-[{[1-(ethoxymethyl)cyclopentyl]methyl}(methyl)amino]-1H-imidazo[4,5-b]pyridin-2-yl}pyrazin-2-yl)piperidine-4-carboxylic acid,
(9) 1-(5-{5-[2-ethoxy-6-(trifluoromethyl)pyridin-4-yl]-7-[{[1-(methoxymethyl)cyclopentyl]methyl}(methyl)amino]-1H-imidazo[4,5-b]pyridin-2-yl}pyrazin-2-yl)piperidine-4-carboxylic acid,
(10) 3-[4-(5-{5-[6-cyclopropyl-5-(trifluoromethyl)pyridin-3-yl]-7-[{[1-(methoxymethyl)cyclohexyl]methyl}(methyl)amino]-1H-imidazo[4,5-b]pyridin-2-yl}pyrazin-2-yl)piperazin-1-yl]propanoic acid,
(11) [4-(4-{5-[6-cyclopropyl-5-(trifluoromethyl)pyridin-3-yl]-7-[{[1-(methoxymethyl)cyclopentyl]methyl}(methyl)amino]-1H-imidazo[4,5-b]pyridin-2-yl}-3-fluorophenoxy)piperidin-1-yl]acetic acid,
(12) 3-[(2S)-4-(5-{5-[6-cyclopropyl-5-(trifluoromethyl)pyridin-3-yl]-7-[{[1-(methoxymethyl)cyclohexyl]methyl}(methyl)amino]-1H-imidazo[4,5-b]pyridin-2-yl}pyrazin-2-yl)-2-(methoxymethyl)piperazin-1-yl]propanoic acid,
(13) 3-[(3R)-4-(5-{5-[6-cyclopropyl-5-(trifluoromethyl)pyridin-3-yl]-7-[{[1-(ethoxymethyl)cyclopentyl]methyl}(methyl)amino]-1H-imidazo[4,5-b]pyridin-2-yl}pyrazin-2-yl)-3-methylpiperazin-1-yl]propanoic acid,
(14) 3-[(3R)-4-(5-{5-[2-cyclopropyl-6-(trifluoromethyl)pyridin-4-yl]-7-[{[1-(methoxymethyl)cyclohexyl]methyl}(methyl)amino]-1H-imidazo[4,5-b]pyridin-2-yl}pyrazin-2-yl)-3-methylpiperazin-1-yl]propanoic acid, and
(15) 3-[(3R)-4-(5-{5-[6-cyclopropyl-5-(trifluoromethyl)pyridin-3-yl]-7-[{[1-(methoxymethyl)cyclopentyl]methyl}(methyl)amino]-1H-imidazo[4,5-b]pyridin-2-yl}pyrazin-2-yl)-3-methylpiperazin-1-yl]propanoic acid.

7. The use according to any one of claims 1 to 6, wherein the functional gastrointestinal disorder is irritable bowel syndrome (IBS).

8. The use according to any one of claims 1 to 6, wherein the functional gastrointestinal disorder is functional constipation.

9. Use of an azabenzimidazole compound, or a pharmaceutically acceptable salt thereof, or a solvate thereof, as an active ingredient, the azabenzimidazole compound being a compound of the formula [1]:

[Chem. 6]



[1]

wherein:

R^1 is a hydrogen atom or alkyl, or the two R^1s combine with the adjacent carbon atom to form a 3- to 7-membered cycloalkyl or an oxygen-containing non-aromatic heterocycle;

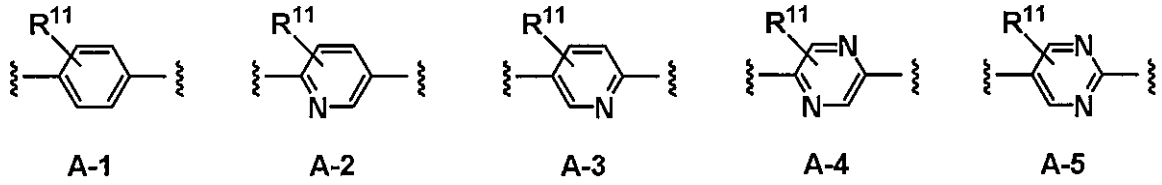
R^2 is a hydrogen atom, alkyl, cycloalkyl, alkyl substituted with cycloalkyl, or alkoxyalkyl;

R^3 is a hydrogen atom, alkyl, or alkoxyalkyl;

R^4 is pyridyl optionally substituted with one or two groups selected from the group consisting of alkyl, trihaloalkyl, alkoxy, cyano, and cycloalkyl, or phenyl optionally substituted with 1 to 3 groups selected from the group consisting of trihaloalkyl, halogen, alkoxy, and cycloalkyl;

A is a group of the formula A-1, A-2, A-3, A-4, or A-5:

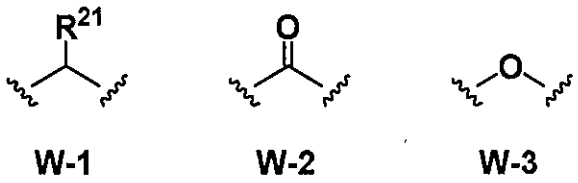
[Chem. 7]



A-1 A-2 A-3 A-4 A-5

wherein the bond on the left side of each group is attached to the 2-position of the azabenzimidazole in the formula [1], the bond on the right side is attached to W in the formula [1], and R^{11} is a group selected from a hydrogen atom, halogen, alkyl, alkoxy, and nitro; W is a bond or a group of the formula W-1, W-2, or W-3:

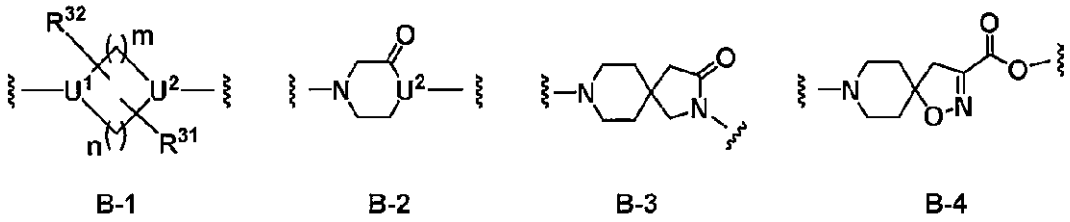
[Chem. 8]



wherein R^{21} is a hydrogen atom or alkyl;

B is a group of the formula B-1, B-2, B-3, or B-4:

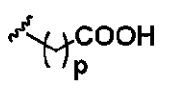
[Chem. 9]



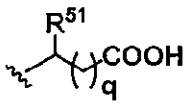
wherein the bond on the left side of each group is attached to W in the formula [1], the bond on the right side is attached to Y in the formula [1], U^1 is a nitrogen atom or CR^{41}, U^2 is a nitrogen atom or CR^{42}, R^{41} and R^{42} are each independently a hydrogen atom, alkyl, halogen, or a hydroxyl group, m and n are each 1, 2, or 3, and R^{31} and R^{32} are each independently a hydrogen atom, alkyl, halogen, or alkoxyalkyl, or R^{31} and R^{32} combine with an adjacent carbon atom to form an alkylene bridge, provided that R^{31} and R^{32} substitute at any substitutable positions other than U^1 and U^2; and

Y is a hydrogen atom or a group of any one of the formulae Y-1 to Y-4, Y-11 to Y-16:

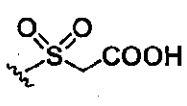
[Chem. 10]



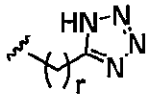
Y-1



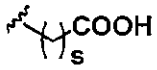
Y-2



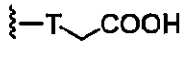
Y-3



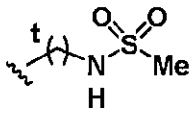
Y-4



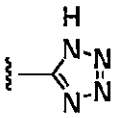
Y-11



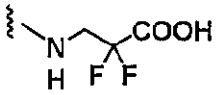
Y-12



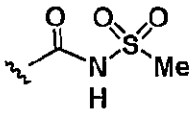
Y-13



Y-14



Y-15



Y-16

wherein R^{51} is alkyl, p is 1, 2, or 3, q is 0, 1, or 2, r is 1, 2, or 3, T is O, S, SO_2, or NR^{61} wherein R^{61} is a hydrogen atom or alkyl, s is 0, 1, 2, or 3, and t is 0 or 1, with the proviso that one of the following cases (a) to (d) is selected:

(a) when W is a bond,

if B is B-1 or B-2 and U^2 is a nitrogen atom, then Y is Y-1, Y-2, Y-3, or Y-4,

if B is B-1 or B-2 and U^2 is CR^{42} wherein R^{42} is as defined above, then U^1 is a nitrogen atom and Y is Y-11, Y-12, Y-13, Y-14, Y-15, or Y-16, and

if B is B-3 or B-4, then Y is a hydrogen atom;

(b) when W is W-1,

if B is B-1, U^1 is a nitrogen atom, and U^2 is a nitrogen atom, then Y is Y-1, Y-2, Y-3, or Y-4, and

if B is B-1, U^1 is a nitrogen atom, and U^2 is CR^{42} wherein R^{42} is as defined above, then Y is Y-11, Y-12, Y-13, Y-14, Y-15, or Y-16;

(c) when W is W-2,

if B is B-1 or B-2, U^1 is a nitrogen atom, and U^2 is a nitrogen atom, then Y is Y-1, Y-2, Y-3, or Y-4,

if B is B-1 or B-2, U^1 is a nitrogen atom, and U^2 is CR^{42} wherein R^{42} is as defined above, then Y is Y-11, Y-12, Y-13, Y-14, Y-15, or Y-16, and

if B is B-3 or B-4, then Y is a hydrogen atom; and

(d) when W is W-3,

if B is B-1, U^1 is CR^{41} wherein R^{41} is as defined above, and U^2 is a nitrogen atom, then Y is Y-1, Y-2, Y-3, or Y-4, in the preparation of a pharmaceutical composition for treatment or prophylaxis of xerostomia.

10. The use according to claim 9, wherein W is a bond.

11. The use according to claim 9 or 10, wherein
(1) B is B-1 or B-2, U^2 is a nitrogen atom, and Y is Y-1, Y-2, or Y-3,
(2) B is B-1 or B-2, U^2 is CR^{42}, and Y is Y-11, Y-12, or Y-15, or
(3) B is B-4 and Y is a hydrogen atom.

12. The use according to claim 11, wherein R^4 is pyridyl substituted with trihaloalkyl and a group selected from the group consisting of alkyl, trihaloalkyl, alkoxy, cyano, and cycloalkyl.

13. The use according to claim 12, wherein A is A-4.

14. The use according to any one of claims 9 to 13, wherein the azabenzimidazole compound is any one of the following (1) to (15):
(1) [4-(5-{5-[3-fluoro-5-(trifluoromethyl)phenyl]-7-[{[1-(methoxymethyl)cyclobutyl]methyl}(methyl)amino]-1H-imidazo[4,5-b]pyridin-2-yl}pyrazin-2-yl)piperazin-1-yl]acetic acid,
(2) 4-fluoro-1-(5-{5-[3-fluoro-5-(trifluoromethyl)phenyl]-7-[{[1-(methoxymethyl)cyclobutyl]methyl}(methyl)amino]-1H-imidazo[4,5-b]pyridin-2-yl}pyrazin-2-yl)piperidine-4-carboxylic acid,
(3) 1-(5-{5-[6-ethoxy-5-(trifluoromethyl)pyridin-3-yl]-7-[{[1-(methoxymethyl)cyclobutyl]methyl}(methyl)amino]-1H-imidazo[4,5-b]pyridin-2-yl}pyrazin-2-yl)piperidine-4-carboxylic acid,
(4) 1-(5-{5-[2-ethoxy-6-(trifluoromethyl)pyridin-4-yl]-7-[{[1-(methoxymethyl)cyclobutyl]methyl}(methyl)amino]-1H-imidazo[4,5-b]pyridin-2-yl}pyrazin-2-yl)piperidine-4-carboxylic acid,
(5) {[1-(5-{5-[2-cyclopropyl-6-(trifluoromethyl)pyridin-4-yl]-7-[{[1-(methoxymethyl)cyclopentyl]methyl}(methyl)amino]-1H-imidazo[4,5-b]pyridin-2-yl}pyrazin-2-yl)piperidin-4-yl]oxy}acetic acid,
(6) 1-(4-{5-[6-ethoxy-5-(trifluoromethyl)pyridin-3-yl]-7-[{[1-(methoxymethyl)cyclopentyl]methyl}(methyl)amino]-1H-imidazo[4,5-b]pyridin-2-yl}-3-fluorophenyl)piperidine-4-carboxylic acid,
(7) 1-(5-{5-[2-ethoxy-6-(trifluoromethyl)pyridin-4-yl]-7-[(3-methoxy-2,2-dimethylpropyl)(methyl)amino]-1H-imidazo[4,5-b]pyridin-2-yl}pyrazin-2-yl)piperidine-4-

carboxylic acid,
(8) 1-(5-{5-[6-cyclopropyl-5-(trifluoromethyl)pyridin-3-yl]-7-[{[1-(ethoxymethyl)cyclopentyl]methyl}(methyl)amino]-1H-imidazo[4,5-b]pyridin-2-yl}pyrazin-2-yl)piperidine-4-carboxylic acid,
(9) 1-(5-{5-[2-ethoxy-6-(trifluoromethyl)pyridin-4-yl]-7-[{[1-(methoxymethyl)cyclopentyl]methyl}(methyl)amino]-1H-imidazo[4,5-b]pyridin-2-yl}pyrazin-2-yl)piperidine-4-carboxylic acid,
(10) 3-[4-(5-{5-[6-cyclopropyl-5-(trifluoromethyl)pyridin-3-yl]-7-[{[1-(methoxymethyl)cyclohexyl]methyl}(methyl)amino]-1H-imidazo[4,5-b]pyridin-2-yl}pyrazin-2-yl)piperazin-1-yl]propanoic acid,
(11) [4-(4-{5-[6-cyclopropyl-5-(trifluoromethyl)pyridin-3-yl]-7-[{[1-(methoxymethyl)cyclopentyl]methyl}(methyl)amino]-1H-imidazo[4,5-b]pyridin-2-yl}-3-fluorophenoxy)piperidin-1-yl]acetic acid,
(12) 3-[(2S)-4-(5-{5-[6-cyclopropyl-5-(trifluoromethyl)pyridin-3-yl]-7-[{[1-(methoxymethyl)cyclohexyl]methyl}(methyl)amino]-1H-imidazo[4,5-b]pyridin-2-yl}pyrazin-2-yl)-2-(methoxymethyl)piperazin-1-yl]propanoic acid,
(13) 3-[(3R)-4-(5-{5-[6-cyclopropyl-5-(trifluoromethyl)pyridin-3-yl]-7-[{[1-(ethoxymethyl)cyclopentyl]methyl}(methyl)amino]-1H-imidazo[4,5-b]pyridin-2-yl}pyrazin-2-yl)-3-methylpiperazin-1-yl]propanoic acid,
(14) 3-[(3R)-4-(5-{5-[2-cyclopropyl-6-(trifluoromethyl)pyridin-4-yl]-7-[{[1-(methoxymethyl)cyclohexyl]methyl}(methyl)amino]-1H-imidazo[4,5-b]pyridin-2-yl}pyrazin-2-yl)-3-methylpiperazin-1-yl]propanoic acid, and
(15) 3-[(3R)-4-(5-{5-[6-cyclopropyl-5-(trifluoromethyl)pyridin-3-yl]-7-[{[1-(methoxymethyl)cyclopentyl]methyl}(methyl)amino]-1H-imidazo[4,5-b]pyridin-2-yl}pyrazin-2-yl)-3-methylpiperazin-1-yl]propanoic acid.