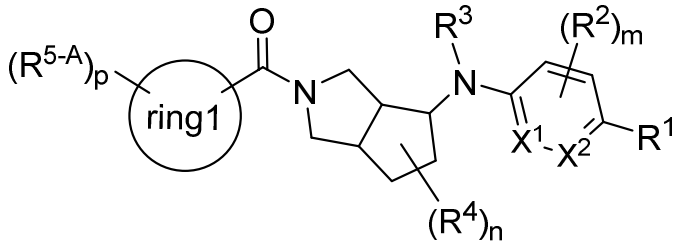
CLAIMS

[Claim 1]

A compound represented by general formula (I-A) or a pharmaceutically acceptable salt thereof:



(I-A)

wherein

X^1 and X^2 each independently represent (1) CH, (2) CR^X, or (3) N, provided that at least one of X^1 and X^2 represents N,

R^1 represents a halogen atom,

R^X represents (1) a halogen atom, (2) a C1-6 alkyl group, (3) a C2-6 alkenyl group, (4) a C2-6 alkynyl group, (5) a C1-6 alkoxy group, (6) a C1-6 haloalkyl group, (7) a C2-6 haloalkenyl group, (8) a C2-6 haloalkynyl group, (9) a C1-6 haloalkoxy group, or (10) a cyano group,

R^2 represents (1) a halogen atom, (2) a C1-6 alkyl group, (3) a C2-6 alkenyl group, (4) a C2-6 alkynyl group, (5) a C1-6 alkoxy group, (6) a C1-6 haloalkyl group, (7) a C2-6 haloalkenyl group, (8) a C2-6 haloalkynyl group, (9) a C1-6 haloalkoxy group, or (10) a cyano group,

when m is 2 or more, a plurality of R^2s may be the same or different,

R^3 represents (1) a hydrogen atom, (2) a C1-6 alkyl group, (3) a C1-6 haloalkyl group, (4) a 3- to 10-membered cyclic group, (5) -(C1-6 alkylene)-(3- to 10-membered cyclic group), (6) -(C1-6 haloalkylene)-(3- to 10-membered cyclic group), wherein one to two carbon atoms in the C1-6 alkyl group, the C1-6 haloalkyl group, the C1-6 alkylene, and the C1-6 haloalkylene may be replaced with an oxygen atom or an optionally oxidized sulfur atom,

the 3- to 10-membered cyclic group in R^3 may be substituted with one to five R^{301}s,

R^{301} represents (1) a halogen atom, (2) a C1-4 alkyl group, (3) a C1-4 alkoxy group, (4) a C1-4 haloalkyl group, (5) a C1-4 haloalkoxy group, (6) $COOR^{302}$, (7) $CONR^{303}R^{304}$, (8) a C3-6 cycloalkyl group, (9) a hydroxyl group, (10) a nitro group, (11) a cyano group, (12) -$NR^{305}R^{306}$, (13) -SR^{307}, (14) -SOR^{308}, (15) -SO_2R^{309}, or (16) an oxo group,

when two or more R^{301}s are substituted, a plurality of R^{301}s may be the same or different,

R^{302}, R^{303}, R^{304}, R^{305}, R^{306}, R^{307}, R^{308}, or R^{309} each independently represent (1) a hydrogen atom or (2) a C1-4 alkyl group,

when R^2 represents (2) to (9) in R^2, and R^3 represents a C1-6 alkyl group, R^2 and R^3, together with an atom to which R^2 and R^3 are bonded, may form a 5- to 6-membered cyclic group,

R^4 represents (1) a halogen atom, (2) a C1-6 alkyl group, (3) a C2-6 alkenyl group, (4) a C2-6 alkynyl group, (5) a C1-6 alkoxy group, (6) a C1-6 haloalkyl group, (7) a C2-6 haloalkenyl group, (8) a C2-6 haloalkynyl group, or (9) a C1-6 haloalkoxy group,

when n is 2 or more, a plurality of R^4s may be the same or different,

when two R^4s present on the same carbon atom represent a C1-6 alkyl group, the two R^4s, together with a carbon atom to which the two R^4s are bonded, may form a C3-6 cycloalkyl group,

ring 1 represents a 3- to 15-membered cyclic group,

$R^{5\text{-}A}$ represents (1) a halogen atom, (2) a C1-6 alkyl group, (3) a C2-6 alkenyl group, (4) a C2-6 alkynyl group, (5) a C1-6 alkoxy group, (6) a C1-6 alkylthio group, (7) a C1-6 alkylsulfinyl group, (8) a C1-6 alkylsulfonyl group, (9) a C2-6 acyl group, (10) a 3- to 6-membered cyclic group, (11) -L^{R5}-(3- to 6-membered cyclic group), (12) a hydroxyl group, (13) a nitro group, (14) a cyano group, (15) an oxo group, (16) -$NR^{501}R^{502}$, (17) -$COOR^{503}$, (18) -$CONR^{504}R^{505}$, or (19) -$SO_2NR^{506}R^{507}$, wherein one to two carbon atoms in the C1-6 alkyl group, the C2-6 alkenyl group, the C2-6 alkynyl group, the C1-6 alkoxy group, the C1-6 alkylthio group, the C1-6 alkylsulfinyl group, the C1-6 alkylsulfonyl group, the C2-6 acyl group may be replaced with an oxygen atom or an optionally oxidized sulfur atom,

when p is 2 or more, a plurality of $R^{5\text{-}A}$s may be the same or different,

the groups (2) to (11) in $R^{5\text{-}A}$ may be substituted with one to nine R^{508}s,

R^{508} represents (1) a halogen atom, (2) a C1-4 alkyl group, (3) a C1-4 alkoxy group, (4) a C2-6 acyl group, (5) a C3-6 cycloalkyl group, (6) a hydroxyl group, or (7) -$NR^{509}R^{510}$,

when two or more R^{508}s are substituted, a plurality of R^{508}s may be the same or different,

L^{R5} represents (1) -O-, (2) -(C1-4 alkylene)-, (3) -O-(C1-4 alkylene)-, (4) -(C1-4 alkylene)-O-, (5) -NR^{511}-, or (6) -$SO_{0\text{-}2}$-,

R^{501}, R^{502}, R^{503}, R^{504}, R^{505}, R^{506}, R^{507}, R^{509}, R^{510}, or R^{511} each independently represent (1) a hydrogen atom, (2) a C1-6 alkyl group, (3) a C2-6 acyl group, or (4) a C1-6

alkylsulfonyl group,

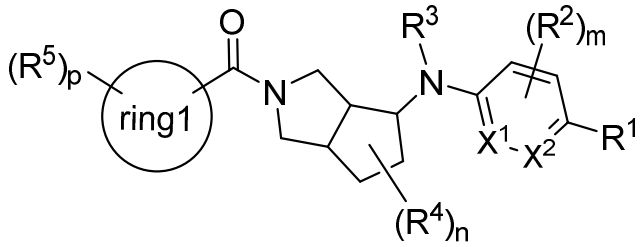
m represents an integer of 0 to 2,

n represents an integer of 0 to 5, and

p represents an integer of 0 to 5.

[Claim 2]

A compound represented by general formula (I) or a pharmaceutically acceptable salt thereof:



(I)

wherein

X^1 and X^2 each independently represent (1) CH, (2) CR^X, or (3) N, provided that at least one of X^1 and X^2 represents N,

R^1 represents a halogen atom,

R^X represents (1) a halogen atom, (2) a C1-6 alkyl group, (3) a C2-6 alkenyl group, (4) a C2-6 alkynyl group, (5) a C1-6 alkoxy group, (6) a C1-6 haloalkyl group, (7) a C2-6 haloalkenyl group, (8) a C2-6 haloalkynyl group, (9) a C1-6 haloalkoxy group, or (10) a cyano group,

R^2 represents (1) a halogen atom, (2) a C1-6 alkyl group, (3) a C2-6 alkenyl group, (4) a C2-6 alkynyl group, (5) a C1-6 alkoxy group, (6) a C1-6 haloalkyl group, (7) a C2-6 haloalkenyl group, (8) a C2-6 haloalkynyl group, (9) a C1-6 haloalkoxy group, or (10) a cyano group,

when m is 2 or more, a plurality of R^2s may be the same or different,

R^3 represents (1) a hydrogen atom, (2) a C1-6 alkyl group, (3) a C1-6 haloalkyl group, (4) a 3- to 10-membered cyclic group, (5) -(C1-6 alkylene)-(3- to 10-membered cyclic group), (6) -(C1-6 haloalkylene)-(3- to 10-membered cyclic group), wherein one to two carbon atoms in the C1-6 alkyl group, the C1-6 haloalkyl group, the C1-6 alkylene, and the C1-6 haloalkylene may be replaced with an oxygen atom or an optionally oxidized sulfur atom,

the 3- to 10-membered cyclic group in R^3 may be substituted with one to five R^{301}s,

R^{301} represents (1) a halogen atom, (2) a C1-4 alkyl group, (3) a C1-4 alkoxy group,

(4) a C1-4 haloalkyl group, (5) a C1-4 haloalkoxy group, (6) $COOR^{302}$, (7) $CONR^{303}R^{304}$, (8) a C3-6 cycloalkyl group, (9) a hydroxyl group, (10) a nitro group, (11) a cyano group, (12) $-NR^{305}R^{306}$, (13) $-SR^{307}$, (14) $-SOR^{308}$, (15) $-SO_2R^{309}$, or (16) an oxo group,

when two or more R^{301}s are substituted, a plurality of R^{301}s may be the same or different,

R^{302}, R^{303}, R^{304}, R^{305}, R^{306}, R^{307}, R^{308}, or R^{309} each independently represent (1) a hydrogen atom or (2) a C1-4 alkyl group,

when R^2 represents (2) to (9) in R^2 and R^3 represents a C1-6 alkyl group, R^2 and R^3, together with an atom to which R^2 and R^3 are bonded, may form a 5- to 6-membered cyclic group,

R^4 represents (1) a halogen atom, (2) a C1-6 alkyl group, (3) a C2-6 alkenyl group, (4) a C2-6 alkynyl group, (5) a C1-6 alkoxy group, (6) a C1-6 haloalkyl group, (7) a C2-6 haloalkenyl group, (8) a C2-6 haloalkynyl group, or (9) a C1-6 haloalkoxy group,

when n is 2 or more, a plurality of R^4s may be the same or different,

when two R^4s present on the same carbon atom represent a C1-6 alkyl group, the two R^4s, together with a carbon atom to which the two R^4s are bonded, may form a C3-6 cycloalkyl group,

ring 1 represents a 3- to 15-membered cyclic group,

R^5 represents (1) a halogen atom, (2) a C1-6 alkyl group, (3) a C2-6 alkenyl group, (4) a C2-6 alkynyl group, (5) a C1-6 alkoxy group, (6) a C1-6 alkylthio group, (7) a C1-6 alkylsulfinyl group, (8) a C1-6 alkylsulfonyl group, (9) a C2-6 acyl group, (10) a 3- to 6-membered cyclic group, (11) $-L^{R5}$-(3- to 6-membered cyclic group), (12) a hydroxyl group, (13) a nitro group, (14) a cyano group, (15) an oxo group, (16) $-NR^{501}R^{502}$, (17) $-COOR^{503}$, (18) $-CONR^{504}R^{505}$, or (19) $-SO_2NR^{506}R^{507}$,

when p is 2 or more, a plurality of R^5s may be the same or different,

the groups (2) to (11) in R^5 may be substituted with one to nine R^{508}s,

R^{508} represents (1) a halogen atom, (2) a C1-4 alkyl group, (3) a C1-4 alkoxy group, (4) a C2-6 acyl group, (5) a C3-6 cycloalkyl group, (6) a hydroxyl group, or (7) $-NR^{509}R^{510}$,

when two or more R^{508}s are substituted, a plurality of R^{508}s may be the same or different,

L^{R5} represents (1) -O-, (2) -(C1-4 alkylene)-, (3) -O-(C1-4 alkylene)-, (4) -(C1-4 alkylene)-O-, (5) $-NR^{511}$-, or (6) $-SO_{0-2}$-,

R^{501}, R^{502}, R^{503}, R^{504}, R^{505}, R^{506}, R^{507}, R^{509}, R^{510}, or R^{511} each independently represent (1) a hydrogen atom, (2) a C1-6 alkyl group, (3) a C2-6 acyl group, or (4) a C1-6

alkylsulfonyl group,

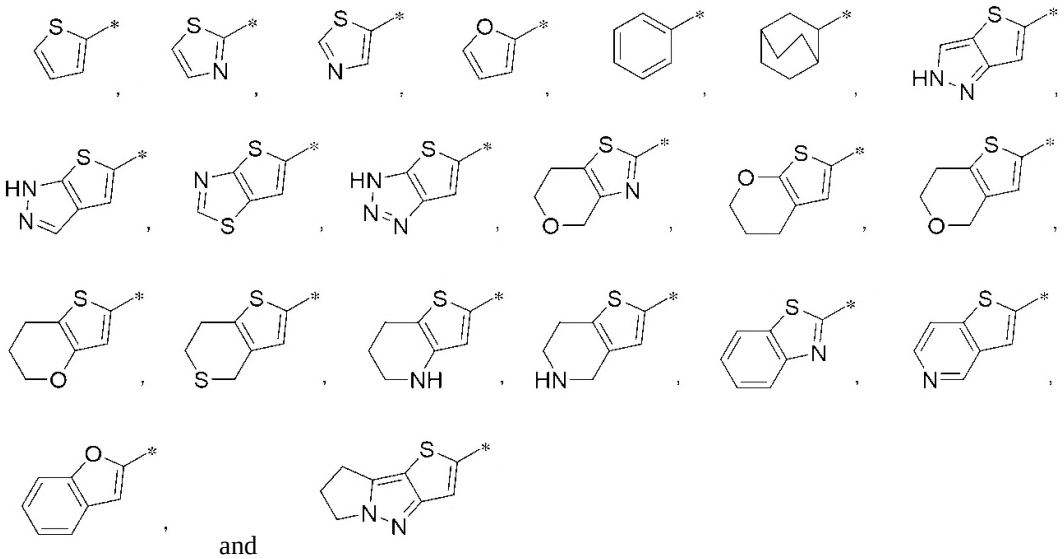
m represents an integer of 0 to 2,

n represents an integer of 0 to 5, and

p represents an integer of 0 to 5.

[Claim 3]

The compound or the pharmaceutically acceptable salt thereof according to claim 1, wherein ring 1 represents a ring structure selected from the group consisting of the following ring structures;

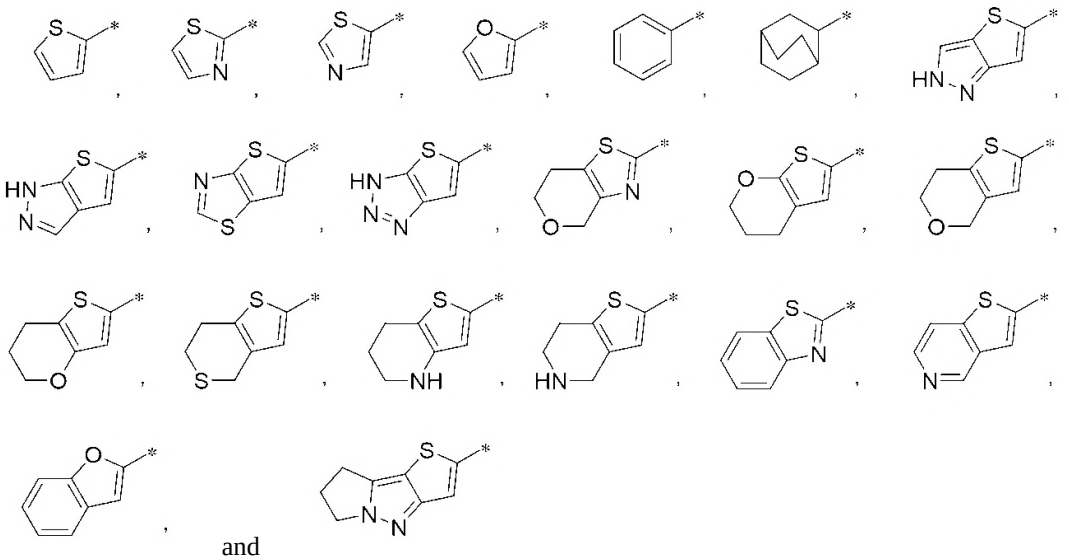


and

wherein the * mark represents a bonding position with a carbonyl group, and a hydrogen atom represented by NH may be replaced with $R^{5\text{-}A}$.

[Claim 4]

The compound or the pharmaceutically acceptable salt thereof according to claim 2, wherein ring 1 represents a ring structure selected from the group consisting of the following ring structures;



and

wherein the * mark represents a bonding position with a carbonyl group, and a hydrogen atom represented by NH may be replaced with R^5.

[Claim 5]

The compound or the pharmaceutically acceptable salt thereof according to claim 1 or 3, wherein R^{5-A} is (1) a C1-6 alkyl group, (2) a C1-6 alkoxy group, (3) a C1-6 haloalkyl group, (4) a C1-6 haloalkoxy group, (5) a cyclopropyl group, (6) a furan ring, (7) an N-methylpyrazole ring, (8) an oxo group, (9) a dimethylamino group, or (10) $-COOCH_3$.

[Claim 6]

The compound or the pharmaceutically acceptable salt thereof according to claim 2 or 4, wherein R^5 is (1) a C1-6 alkyl group, (2) a C1-6 alkoxy group, (3) a C1-6 haloalkyl group, (4) a C1-6 haloalkoxy group, (5) a cyclopropyl group, (6) a furan ring, (7) an N-methylpyrazole ring, (8) an oxo group, (9) a dimethylamino group, or (10) $-COOCH_3$.

[Claim 7]

The compound or the pharmaceutically acceptable salt thereof according to any one of claims 1 to 6, wherein R^3 is (1) a hydrogen atom, (2) a C1-6 alkyl group, (3) a C1-6 haloalkyl group, (4) a cyclopropyl group, or (5) $-CH_2$-Q, and

Q is (1) benzene, (2) pyridine, or (3) imidazo[2,1-b]thiazole.

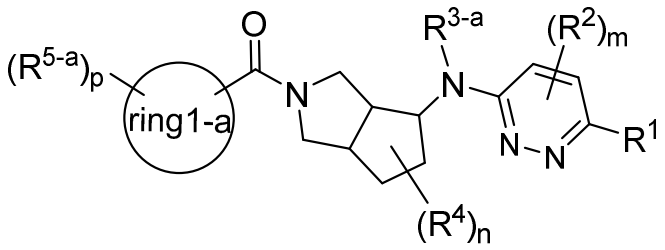
[Claim 8]

The compound or the pharmaceutically acceptable salt thereof according to any one of claims 1 to 7, wherein X^1 and X^2 are both N.

[Claim 9]

The compound or the pharmaceutically acceptable salt thereof according to any one of claims 1 to 8, wherein the compound represented by general formula (I-A) or general

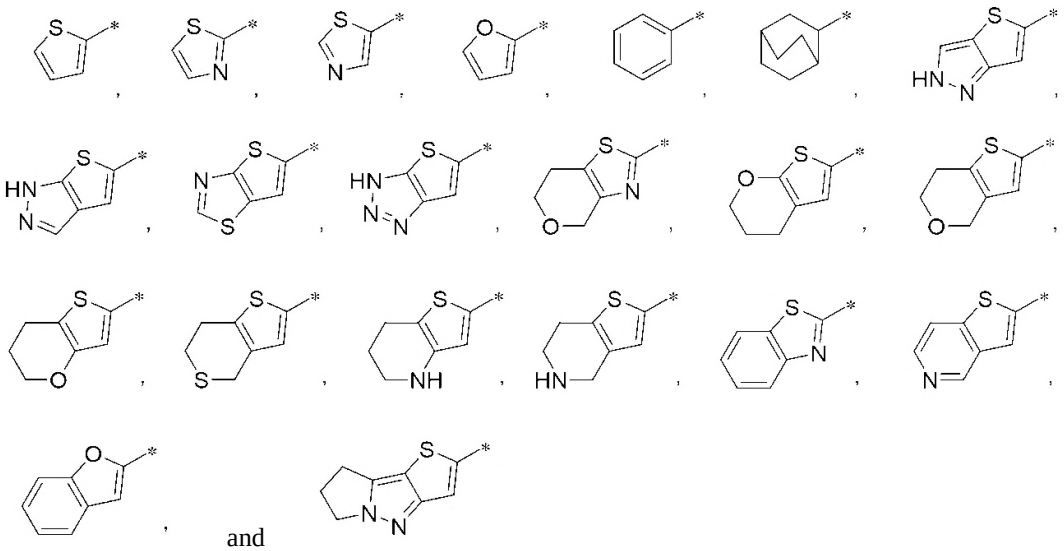
formula (I) is a compound represented by general formula (I-1):



(I-1)

wherein R^{3-a} represents (1) a hydrogen atom, (2) a C1-6 alkyl group, (3) a C1-6 haloalkyl group, (4) a cyclopropyl group, or (5) $-CH_2-Q$,

ring 1-a represents a ring structure selected from the group consisting of the following ring structures;



and

wherein the * mark represents a bonding position with a carbonyl group, and a hydrogen atom represented by NH may be replaced with R^{5-a},

R^{5-a} represents (1) a C1-6 alkyl group, (2) a C1-6 alkoxy group, (3) a C1-6 haloalkyl group, (4) a C1-6 haloalkoxy group, (5) a cyclopropyl group, (6) a furan ring, (7) an N-methylpyrazole ring, (8) an oxo group, (9) a dimethylamino group, or (10) $-COOCH_3$, and

other symbols represent the same meaning as the symbols described in claim 1, 2 or 7.

[Claim 10]

The compound or the pharmaceutically acceptable salt thereof according to claim 1 or 2, wherein the compound represented by general formula (I-A) or general formula (I) is a compound selected from the group consisting of:

(1) {(3aS,4R,6aR)-4-[(6-chloro-3-pyridazinyl)amino]hexahydrocyclopenta[c]pyrrol-2(1H)-yl}[5-(difluoromethyl)-2-

thienyl]methanone,

(2) {(3aS,4R,6aR)-4-[(6-chloro-3-pyridazinyl)amino]hexahydrocyclopenta[c]pyrrol-2(1H)-yl}(5-methyl-2-thienyl)methanone,

(3) [(3aS,4R,6aR)-4-[(6-chloro-3-pyridazinyl)amino]hexahydrocyclopenta[c]pyrrol-2(1H)-yl](6,7-dihydro-4H-thieno[3,2-c]pyran-2-yl)methanone,

(4) [(3aS,4R,6aR)-4-[(6-bromo-3-pyridazinyl)amino]hexahydrocyclopenta[c]pyrrol-2(1H)-yl](5-methyl-2-thienyl)methanone,

(5) [(3aS,4R,6aR)-4-[(6-bromo-3-pyridazinyl)amino]hexahydrocyclopenta[c]pyrrol-2(1H)-yl](6,7-dihydro-4H-thieno[3,2-c]pyran-2-yl)methanone,

(6) [(3aS,4R,6aR)-4-[(6-bromo-3-pyridazinyl)amino]hexahydrocyclopenta[c]pyrrol-2(1H)-yl](2-methyl-2H-thieno[3,2-c]pyrazol-5-yl)methanone,

(7) [(3aS,4R,6aR)-4-[benzyl(6-bromo-3-pyridazinyl)amino]hexahydrocyclopenta[c]pyrrol-2(1H)-yl](5-methyl-2-thienyl)methanone,

(8) rel-6-chloro-3-({(3aS,4R,6aR)-2-[(5-methyl-2-thienyl)carbonyl]octahydrocyclopenta[c]pyrrol-4-yl}amino)-4-pyridazinecarbonitrile,

(9) {(3aR,4R,6aS)-4-[(6-chloro-3-pyridazinyl)amino]-3a-fluorohexahydrocyclopenta[c]pyrrol-2(1H)-yl}(6,7-dihydro-4H-thieno[3,2-c]pyran-2-yl)methanone, and

(10) [(3aR,6R,6aS)-6-[(6-bromo-3-pyridazinyl)amino]-4,4-difluorohexahydrocyclopenta[c]pyrrol-2(1H)-yl](6,7-dihydro-4H-thieno[3,2-c]pyran-2-yl)methanone.

[Claim 11]

A pharmaceutical composition comprising the compound or the pharmaceutically acceptable salt thereof according to any one of claims 1 to 10 as an active ingredient, and a pharmaceutically acceptable carrier.

[Claim 12]

The pharmaceutical composition according to claim 11, which is an ABHD6 inhibitor.

[Claim 13]

The pharmaceutical composition according to claim 11 or 12 for use as an agent for treating and/or preventing a disease associated with ABHD6.

[Claim 14]

Use of the compound or the pharmaceutically acceptable salt thereof according to any one of claims 1 to 10, or the pharmaceutical composition according to claim 11 or 12 in the manufacture of an agent for preventing and/or treating a disease associated with ABHD6.

[Claim 15]

The use according to claim 14, wherein the disease associated with ABHD6 is pain, a neurological disease, an inflammatory disease, an autoimmune disease, a metabolic disease, or a malignant tumor.

[Claim 16]

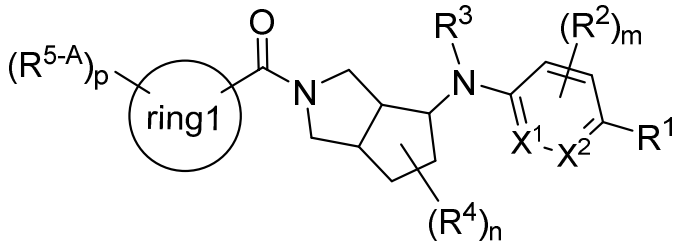
The use according to claim 14 or 15, wherein the disease associated with ABHD6 is pain, and the pain is pain associated with osteoarthritis, cancer pain, pain associated with chemotherapy, chronic low back pain, low back pain associated with osteoporosis, fracture pain, pain associated with rheumatoid arthritis, neuropathic pain, post-herpetic pain, pain associated with diabetic neuropathy, pain associated with fibromyalgia, pain associated with pancreatitis, pain associated with interstitial cystitis or bladder pain syndrome, pain associated with endometriosis, pain associated with irritable bowel syndrome, migraine, or pain associated with pulpitis.

[Claim 17]

The use according to any one of claims 14 to 16, wherein the pharmaceutical composition is to be administered in combination with one or more drugs selected from the group consisting of acetaminophen, non-steroidal anti-inflammatory drugs, opioid drugs, antidepressant drugs, antiepileptic drugs, N-methyl-D-aspartate antagonists, muscle relaxants, antiarrhythmic drugs, steroid drugs, and bisphosphonate drugs.

[Claim 18]

A compound represented by general formula (I-A) or pharmaceutically acceptable salt thereof:



(I-A)

wherein the compound is [3aS,4R,6aR)-4-[(6-bromo-3-pyridazinyl)amino]hexahydrocyclopenta[c]pyrrol-2(1H)-yl](5-methyl-2-thienyl)methanone.