

Case 25091

DIHYDROPYRIDONE AMIDES AS P2X₇ MODULATORS

This invention pertains to compounds useful for treatment of diseases associated with P2X purinergic receptors, and more particularly to P2X₇ modulators usable for treatment of autoimmune and inflammatory diseases.

P2X purinergic receptors are ATP-activated ionotropic receptors having seven subtypes.

- 5 The P2X₇ receptor subtype (also known as the P2Z receptor) is a ligand-gated ion channel found on mast cells, peripheral macrophages, lymphocytes, erythrocytes, fibroblasts and epidermal langerhans cells. Activation of P2X₇ receptor on such immune system cells results in release of interleukin-1beta. (Solle et al., *J. Biol. Chemistry* **276**,125-132, (2001)). The P2X₇ receptor is also found on microglia, Schwann cells and astrocytes within the
- 10 central nervous system (Donnelly-Roberts et al., *Br. J. Pharmacol.* **151**, 571-579 (2007)). Antagonists of P2X₇ have been shown to block P2X₇-mediated IL-1beta release and P2X₇-mediated cation flux (Stokes et al., *Br. J. Pharmacol.* **149**, 880-887 (2006)). Mice lacking the P2X₇ receptor show a lack of inflammatory and neuropathic hypersensitivity to mechanical and thermal stimuli (Chessell et al., *Pain* **114**, 386-396 (2005)). P2X₇ is thus
- 15 believed to have a role in inflammatory responses (Ferrari et al., *J. Immunol.* **176**, 3877-3883 (2006)) and in the onset and persistence of chronic pain (Honore et al., *J. Pharmacol. Ex. Ther.* **319**, 1376-1385 (2006b)).

Modulators of the P2X₇ receptor thus may have utility in the treatment of disease states such as rheumatoid arthritis, osteoarthritis, psoriasis, allergic dermatitis, asthma, chronic

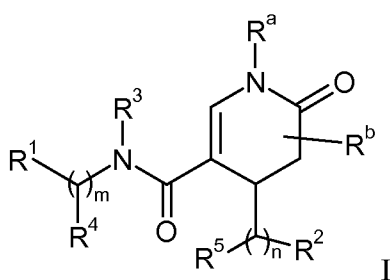
- 20 obstructive pulmonary disease, airways hyper-responsiveness, septic shock, glomerulonephritis, irritable bowel disease, diabetes and Crohn's disease. P2X₇ modulators may also be useful for treatment of pain, including chronic pain, neuropathic pain, and pain associated inflammatory processes and degenerative conditions.

There is accordingly a need for compounds that act as modulators of P2X receptors,

- 25 including antagonists of P2X₇ receptor, as well as a need for methods of treating diseases, conditions and disorders mediated by P2X₇. The present invention satisfies these needs as well as others.

The invention provides compounds of the formula I:

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or pharmaceutically acceptable salts thereof,

wherein:

m is 0 or 1;

5 n is 0 or 1;

R¹ is optionally substituted aryl;

R² is:

optionally substituted aryl;

optionally substituted heteroaryl;

10 C₃₋₆cycloalkyl; or

C₁₋₆ alkyl;

R³ is:

hydrogen;

C₁₋₆alkyl;

15 alkylcarbonylalkyl; or

alkoxycarbonylalkyl;

R⁴ and R⁵ each independently is:

hydrogen; or

C₁₋₆alkyl;

20 R^a is:

hydrogen;

C₁₋₆alkyl;

hydroxy-C₁₋₆alkyl; or

C₁₋₆alkoxy-C₁₋₆alkyl; or

25 hydroxy C₁₋₆alkoxy- C₁₋₆alkyl; and

R^b is:

hydrogen; or

C₁₋₆alkyl.

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The invention also provides and pharmaceutical compositions comprising the compounds, methods of using the compounds, and methods of preparing the compounds.

Definitions

Unless otherwise stated, the following terms used in this Application, including the

5 specification and claims, have the definitions given below. It must be noted that, as used in the specification and the appended claims, the singular forms “a”, “an,” and “the” include plural referents unless the context clearly dictates otherwise.

“Alkyl” means the monovalent linear or branched saturated hydrocarbon moiety, consisting solely of carbon and hydrogen atoms, having from one to twelve carbon atoms. “Lower
10 alkyl” refers to an alkyl group of one to six carbon atoms, i.e. C₁-C₆alkyl. Examples of alkyl groups include, but are not limited to, methyl, ethyl, propyl, isopropyl, isobutyl, sec-butyl, tert-butyl, pentyl, n-hexyl, octyl, dodecyl, and the like.

“Alkenyl” means a linear monovalent hydrocarbon radical of two to six carbon atoms or a branched monovalent hydrocarbon radical of three to six carbon atoms, containing at least
15 one double bond, *e.g.*, ethenyl, propenyl, and the like.

“Alkynyl” means a linear monovalent hydrocarbon radical of two to six carbon atoms or a branched monovalent hydrocarbon radical of three to six carbon atoms, containing at least one triple bond, *e.g.*, ethynyl, propynyl, and the like.

“Alkylene” means a linear saturated divalent hydrocarbon radical of one to six carbon atoms
20 or a branched saturated divalent hydrocarbon radical of three to six carbon atoms, *e.g.*, methylene, ethylene, 2,2-dimethylethylene, propylene, 2-methylpropylene, butylene, pentylene, and the like.

“Alkoxy” and “alkyloxy”, which may be used interchangeably, mean a moiety of the formula –OR, wherein R is an alkyl moiety as defined herein. Examples of alkoxy moieties include,
25 but are not limited to, methoxy, ethoxy, isopropoxy, and the like.

“Alkoxyalkyl” means a moiety of the formula R^a–O–R^b–, where R^a is alkyl and R^b is alkylene as defined herein. Exemplary alkoxyalkyl groups include, by way of example, 2-methoxyethyl, 3-methoxypropyl, 1-methyl-2-methoxyethyl, 1-(2-methoxyethyl)-3-methoxypropyl, and 1-(2-methoxyethyl)-3-methoxypropyl.

30 “Alkoxyalkoxy” means a group of the formula –O–R–R’ wherein R is alkylene and R’ is alkoxy as defined herein.

“Alkylcarbonyl” means a moiety of the formula –C(O)–R, wherein R is alkyl as defined herein.

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"Alkoxy carbonyl" means a group of the formula $-C(O)-R$ wherein R is alkoxy as defined herein.

"Alkyl carbonyl alkyl" means a group of the formula $-R-C(O)-R'$ wherein R is alkylene and R' is alkyl as defined herein.

- 5 "Alkoxy carbonyl alkyl" means a group of the formula $-R-C(O)-R$ wherein R is alkylene and R' is alkoxy as defined herein.

"Alkoxy carbonyl alkoxy" means a group of the formula $-O-R-C(O)-R'$ wherein R is alkylene and R' is alkoxy as defined herein.

- 10 "Alkyl carbonyl alkoxy" means a group of the formula $-O-R-C(O)-R'$ wherein R is alkylene and R' is alkyl as defined herein.

"Hydroxy carbonyl alkoxy" means a group of the formula $-O-R-C(O)-OH$ wherein R is alkylene as defined herein.

"Alkyl aminocarbonyl alkoxy" means a group of the formula $-O-R-C(O)-NHR'$ wherein R is alkylene and R' is alkyl as defined herein.

- 15 "Dialkyl aminocarbonyl alkoxy" means a group of the formula $-O-R-C(O)-NR'R''$ wherein R is alkylene and R' and R'' are alkyl as defined herein.

"Alkyl amino alkoxy" means a group of the formula $-O-R-NHR'$ wherein R is alkylene and R' is alkyl as defined herein.

- 20 "Dialkyl amino alkoxy" means a group of the formula $-O-R-NR'R''$ wherein R is alkylene and R' and R'' are alkyl as defined herein.

"Alkyl sulfonyl" means a moiety of the formula $-SO_2-R$, wherein R is alkyl as defined herein.

"Alkyl sulfonyl alkyl" means a moiety of the formula $-R'-SO_2-R''$ where R' is alkylene and R'' is alkyl as defined herein.

- 25 "Alkyl sulfonyl alkoxy" means a group of the formula $-O-R-SO_2-R'$ wherein R is alkylene and R' is alkyl as defined herein.

"Amino" means a moiety of the formula $-NRR'$ wherein R and R' each independently is hydrogen or alkyl as defined herein. "Amino" thus includes "alkylamino" (where one of R and R' is alkyl and the other is hydrogen) and "dialkylamino" (where R and R' are both alkyl).

- 30 "Amino carbonyl" means a group of the formula $-C(O)-R$ wherein R is amino as defined herein.

"Alkoxy amino" means a moiety of the formula $-NR-OR'$ wherein R is hydrogen or alkyl and R' is alkyl as defined herein.

"Alkyl sulfanyl" means a moiety of the formula $-SR$ wherein R is alkyl as defined herein.

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"Aminoalkyl" means a group -R-R' wherein R' is amino and R is alkylene as defined herein.

"Aminoalkyl" includes aminomethyl, aminoethyl, 1-aminopropyl, 2-aminopropyl, and the like. The amino moiety of "aminoalkyl" may be substituted once or twice with alkyl to provide "alkylaminoalkyl" and "dialkylaminoalkyl" respectively. "Alkylaminoalkyl"

5 includes methylaminomethyl, methylaminoethyl, methylaminopropyl, ethylaminoethyl and the like. "Dialkylaminoalkyl" includes dimethylaminomethyl, dimethylaminoethyl, dimethylaminopropyl, N-methyl-N-ethylaminoethyl, and the like.

"Aminoalkoxy" means a group -OR-R' wherein R' is amino and R is alkylene as defined herein.

10 "Alkylsulfonylamido" means a moiety of the formula -NR'SO₂-R wherein R is alkyl and R' is hydrogen or alkyl.

"Aminocarbonyloxyalkyl" or "carbamylalkyl" means a group of the formula -R-O-C(O)-NR'R" wherein R is alkylene and R', R" each independently is hydrogen or alkyl as defined herein.

15 "aminocarbonylalkoxy" means a group of the formula -O-R-C(O)-NR'R" wherein R is alkylene and R', R" each independently is hydrogen or alkyl as defined herein.

"Alkynylalkoxy" means a group of the formula -O-R-R' wherein R is alkylene and R' is alkynyl as defined herein.

"Aryl" means a monovalent cyclic aromatic hydrocarbon moiety consisting of a mono-, bi- or

20 tricyclic aromatic ring. The aryl group can be optionally substituted as defined herein.

Examples of aryl moieties include, but are not limited to, phenyl, naphthyl, phenanthryl, fluorenyl, indenyl, pentalenyl, azulenyl, oxydiphenyl, biphenyl, methylenediphenyl, aminodiphenyl, diphenylsulfidyl, diphenylsulfonyl, diphenylisopropylidenyl, benzodioxanyl, benzofuranyl, benzodioxyl, benzopyranyl, benzoxazinyl, benzoxazinonyl, benzopiperadiny, benzopiperazinyl, benzopyrrolidinyl, benzomorpholinyl, methylenedioxyphenyl,

25 ethylenedioxyphenyl, and the like, including partially hydrogenated derivatives thereof, each being optionally substituted.

"Arylalkyl" and "Aralkyl", which may be used interchangeably, mean a radical-R^aR^b where R^a is an alkylene group and R^b is an aryl group as defined herein; *e.g.*, phenylalkyls such as

30 benzyl, phenylethyl, 3-(3-chlorophenyl)-2-methylpentyl, and the like are examples of arylalkyl.

"Arylsulfonyl" means a group of the formula -SO₂-R wherein R is aryl as defined herein.

"Aryloxy" means a group of the formula -O-R wherein R is aryl as defined herein.

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"Aralkyloxy" means a group of the formula -O-R-R' wherein R is alkylene and R' is aryl as defined herein.

"Carboxy" or "hydroxycarbonyl", which may be used interchangeably, means a group of the formula -C(O)-OH.

5 "Cyanoalkyl" means a moiety of the formula -R'-R'', where R' is alkylene as defined herein and R'' is cyano or nitrile.

"Cycloalkyl" means a monovalent saturated carbocyclic moiety consisting of mono- or bicyclic rings. Preferred cycloalkyl are unsubstituted or substituted with alkyl. Cycloalkyl can optionally be substituted with one or more substituents, wherein each substituent is
10 independently hydroxy, alkyl, alkoxy, halo, haloalkyl, amino, monoalkylamino, or dialkylamino, unless otherwise specifically indicated. Examples of cycloalkyl moieties include, but are not limited to, cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, cycloheptyl, and the like, including partially unsaturated (cycloalkenyl) derivatives thereof.

"Cycloalkylalkyl" means a moiety of the formula -R'-R'', where R' is alkylene and R'' is
15 cycloalkyl as defined herein.

"Cycloalkylalkoxy" means a group of the formula -O-R-R' wherein R is alkylene and R' is cycloalkyl as defined herein.

"Heteroalkyl" means an alkyl radical as defined herein wherein one, two or three hydrogen atoms have been replaced with a substituent independently selected from the group consisting
20 of -OR^a, -NR^bR^c, and -S(O)_nR^d (where n is an integer from 0 to 2), with the understanding that the point of attachment of the heteroalkyl radical is through a carbon atom, wherein R^a is hydrogen, acyl, alkyl, cycloalkyl, or cycloalkylalkyl; R^b and R^c are independently of each other hydrogen, acyl, alkyl, cycloalkyl, or cycloalkylalkyl; and when n is 0, R^d is hydrogen, alkyl, cycloalkyl, or cycloalkylalkyl, and when n is 1 or 2, R^d is alkyl, cycloalkyl,
25 cycloalkylalkyl, amino, acylamino, monoalkylamino, or dialkylamino. Representative examples include, but are not limited to, 2-hydroxyethyl, 3-hydroxypropyl, 2-hydroxy-1-hydroxymethylethyl, 2,3-dihydroxypropyl, 1-hydroxymethylethyl, 3-hydroxybutyl, 2,3-dihydroxybutyl, 2-hydroxy-1-methylpropyl, 2-aminoethyl, 3-aminopropyl, 2-methylsulfonylethyl, aminosulfonylmethyl, aminosulfonylethyl, aminosulfonylpropyl,
30 methylaminosulfonylmethyl, methylaminosulfonylethyl, methylaminosulfonylpropyl, and the like.

"Heteroaryl" means a monocyclic or bicyclic radical of 5 to 12 ring atoms having at least one aromatic ring containing one, two, or three ring heteroatoms selected from N, O, or S, the

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remaining ring atoms being C, with the understanding that the attachment point of the heteroaryl radical will be on an aromatic ring. The heteroaryl ring may be optionally substituted as defined herein. Examples of heteroaryl moieties include, but are not limited to, optionally substituted imidazolyl, oxazolyl, isoxazolyl, thiazolyl, isothiazolyl, oxadiazolyl, thiadiazolyl, pyrazinyl, thienyl, benzothienyl, thiophenyl, furanyl, pyranal, pyridyl, pyrrolal, pyrazolal, pyrimidal, quinolinal, isoquinolinal, benzofural, benzothiophenyl, benzothiopyranal, benzimidazolal, benzooxazolal, benzooxadiazolal, benzothiazolal, benzothiadiazolal, benzopyranal, indolal, isoindolal, triazolal, triazinyl, quinoxalinal, purinal, quinazolinal, quinolizinal, naphthyridinal, pteridinal, carbazolal, azepinal, diazepinal, acridinal and the like, including partially hydrogenated derivatives thereof, each optionally substituted.

"Heteroarylalkyl" or "heteroaralkyl" means a group of the formula -R-R' wherein R is alkylene and R' is heteroaryl as defined herein.

"Heteroarylsulfonyl means a group of the formula -SO₂-R wherein R is heteroaryl as defined herein.

"Heteroaryloxy" means a group of the formula -O-R wherein R is heteroaryl as defined herein.

"Heteroaralkyloxy" means a group of the formula -O-R-R' wherein R is alkylene and R' is heteroaryl as defined herein.

The terms "halo", "halogen" and "halide", which may be used interchangeably, refer to a substituent fluoro, chloro, bromo, or iodo.

"Haloalkyl" means alkyl as defined herein in which one or more hydrogen has been replaced with same or different halogen. Exemplary haloalkyls include -CH₂Cl, -CH₂CF₃, -CH₂CCl₃, perfluoroalkyl (e.g., -CF₃), and the like.

"Haloalkoxy" means a moiety of the formula -OR, wherein R is a haloalkyl moiety as defined herein. An exemplary haloalkoxy is difluoromethoxy.

"Heterocycloamino" means a saturated ring wherein at least one ring atom is N, NH or N-alkyl and the remaining ring atoms form an alkylene group.

"Heterocyclal" means a monovalent saturated moiety, consisting of one to three rings, incorporating one, two, or three or four heteroatoms (chosen from nitrogen, oxygen or sulfur). The heterocyclal ring may be optionally substituted as defined herein. Examples of heterocyclal moieties include, but are not limited to, optionally substituted piperidinal, piperazinal, homopiperazinal, azepinal, pyrrolidinal, pyrazolidinal, imidazolinal,

imidazolidinyl, pyridinyl, pyridazinyl, pyrimidinyl, oxazolidinyl, isoxazolidinyl, morpholinyl, thiazolidinyl, isothiazolidinyl, quinuclidinyl, quinolinyl, isoquinolinyl, benzimidazolyl, thiadiazolylidinyl, benzothiazolidinyl, benzoazolylidinyl, dihydrofuryl, tetrahydrofuryl, dihydropyranyl, tetrahydropyranyl, thiamorpholinyl, thiamorpholinylsulfoxide,
5 thiamorpholinylsulfone, dihydroquinolinyl, dihydriisoquinolinyl, tetrahydroquinolinyl, tetrahydriisoquinolinyl, and the like.

"Heterocyclalkyl" means a moiety of the formula -R-R' wherein R is alkylene and R' is heterocycl as defined herein.

10 "Heterocycloxy" means a moiety of the formula -OR wherein R is heterocycl as defined herein.

"Heterocyclalkoxy" means a moiety of the formula -OR-R' wherein R is alkylene and R' is heterocycl as defined herein.

"Hydroxyalkoxy" means a moiety of the formula -OR wherein R is hydroxyalkyl as defined herein.

15 "alkoxy-hydroxyalkoxy" means a moiety of the formula -OR-R' wherein R is hydroxyalkyl and R' is alkoxy as defined herein.

"Hydroxyalkylamino" means a moiety of the formula -NR-R' wherein R is hydrogen or alkyl and R' is hydroxyalkyl as defined herein.

20 "Hydroxyalkylaminoalkyl" means a moiety of the formula -R-NR'-R" wherein R is alkylene, R' is hydrogen or alkyl, and R" is hydroxyalkyl as defined herein.

"Hydroxycarbonylalkyl" or "carboxyalkyl" means a group of the formula -R-(CO)-OH where R is alkylene as defined herein.

"Hydroxycarbonylalkoxy" means a group of the formula -O-R-C(O)-OH wherein R is alkylene as defined herein.

25 "Hydroxyalkyloxycarbonylalkyl" or "hydroxyalkoxycarbonylalkyl" means a group of the formula -R-C(O)-O-R-OH wherein each R is alkylene and may be the same or different.

"Hydroxyalkyl" means an alkyl moiety as defined herein, substituted with one or more, preferably one, two or three hydroxy groups, provided that the same carbon atom does not carry more than one hydroxy group. Representative examples include, but are not limited to,
30 hydroxymethyl, 2-hydroxyethyl, 2-hydroxypropyl, 3-hydroxypropyl, 1-(hydroxymethyl)-2-methylpropyl, 2-hydroxybutyl, 3-hydroxybutyl, 4-hydroxybutyl, 2,3-dihydroxypropyl, 2-hydroxy-1-hydroxymethylethyl, 2,3-dihydroxybutyl, 3,4-dihydroxybutyl and 2-(hydroxymethyl)-3-hydroxypropyl

"Hydroxycycloalkyl" means a cycloalkyl moiety as defined herein wherein one, two or three hydrogen atoms in the cycloalkyl radical have been replaced with a hydroxy substituent. Representative examples include, but are not limited to, 2-, 3-, or 4-hydroxycyclohexyl, and the like.

- 5 "Alkoxy hydroxyalkyl" and "hydroxy alkoxyalkyl", which may be used interchangeably, means an alkyl as defined herein that is substituted at least once with hydroxy and at least once with alkoxy. "Alkoxy hydroxyalkyl" and "hydroxy alkoxyalkyl" thus encompass, for example, 2-hydroxy-3-methoxy-propan-1-yl and the like.

"Urea" or "ureido" means a group of the formula $-NR'-C(O)-NR''R'''$ wherein R' , R'' and R''' each independently is hydrogen or alkyl.

"Carbamate" means a group of the formula $-O-C(O)-NR'R''$ wherein R' and R'' each independently is hydrogen or alkyl.

"Carboxy" means a group of the formula $-O-C(O)-OH$.

"Sulfonamido" means a group of the formula $-SO_2-NR'R''$ wherein R' , R'' and R''' each independently is hydrogen or alkyl.

15 "Optionally substituted", when used in association with "aryl", "phenyl", "heteroaryl", "cycloalkyl" or "heterocyclyl", means an aryl, phenyl, heteroaryl, cycloalkyl or heterocyclyl which is optionally substituted independently with one to four substituents, preferably one or two substituents selected from alkyl, cycloalkyl, cycloalkylalkyl, heteroalkyl, hydroxyalkyl, halo, nitro, cyano, hydroxy, alkoxy, amino, acylamino, mono-alkylamino, di-alkylamino, haloalkyl, haloalkoxy, heteroalkyl, $-COR$, $-SO_2R$ (where R is hydrogen, alkyl, phenyl or phenylalkyl), $-(CR'R'')_n-COOR$ (where n is an integer from 0 to 5, R' and R'' are independently hydrogen or alkyl, and R is hydrogen, alkyl, cycloalkyl, cycloalkylalkyl, phenyl or phenylalkyl), or $-(CR'R'')_n-CONR^aR^b$ (where n is an integer from 0 to 5, R' and R'' are independently hydrogen or alkyl, and R^a and R^b are, independently of each other, hydrogen, alkyl, cycloalkyl, cycloalkylalkyl, phenyl or phenylalkyl). Certain preferred optional substituents for "aryl", "phenyl", "heteroaryl", "cycloalkyl" or "heterocyclyl" include alkyl, halo, haloalkyl, alkoxy, cyano, amino and alkylsulfonyl. More preferred substituents are methyl, fluoro, chloro, trifluoromethyl, methoxy, amino and methanesulfonyl.

30 "Leaving group" means the group with the meaning conventionally associated with it in synthetic organic chemistry, i.e., an atom or group displaceable under substitution reaction conditions. Examples of leaving groups include, but are not limited to, halogen, alkane- or

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arylenesulfonyloxy, such as methanesulfonyloxy, ethanesulfonyloxy, thiomethyl, benzenesulfonyloxy, tosyloxy, and thienyloxy, dihalophosphinoyloxy, optionally substituted benzyloxy, isopropyloxy, acyloxy, and the like.

“Modulator” means a molecule that interacts with a target. The interactions include, but are not limited to, agonist, antagonist, and the like, as defined herein.

“Optional” or “optionally” means that the subsequently described event or circumstance may but need not occur, and that the description includes instances where the event or circumstance occurs and instances in which it does not.

“Disease” and “Disease state” means any disease, condition, symptom, disorder or indication.

“Inert organic solvent” or “inert solvent” means the solvent is inert under the conditions of the reaction being described in conjunction therewith, including for example, benzene, toluene, acetonitrile, tetrahydrofuran, N,N-dimethylformamide, chloroform, methylene chloride or dichloromethane, dichloroethane, diethyl ether, ethyl acetate, acetone, methyl ethyl ketone, methanol, ethanol, propanol, isopropanol, *tert*-butanol, dioxane, pyridine, and the like. Unless specified to the contrary, the solvents used in the reactions of the present invention are inert solvents.

“Pharmaceutically acceptable” means that which is useful in preparing a pharmaceutical composition that is generally safe, non-toxic, and neither biologically nor otherwise undesirable and includes that which is acceptable for veterinary as well as human

pharmaceutical use.

“Pharmaceutically acceptable salts” of a compound means salts that are pharmaceutically acceptable, as defined herein, and that possess the desired pharmacological activity of the parent compound. Such salts include:

acid addition salts formed with inorganic acids such as hydrochloric acid, hydrobromic acid, sulfuric acid, nitric acid, phosphoric acid, and the like; or formed with organic acids such as acetic acid, benzenesulfonic acid, benzoic, camphorsulfonic acid, citric acid, ethanesulfonic acid, fumaric acid, glucoheptonic acid, gluconic acid, glutamic acid, glycolic acid, hydroxynaphtoic acid, 2-hydroxyethanesulfonic acid, lactic acid, maleic acid, malic acid, malonic acid, mandelic acid, methanesulfonic acid, muconic acid, 2-naphthalenesulfonic acid, propionic acid, salicylic acid, succinic acid, tartaric acid, p-toluenesulfonic acid, trimethylacetic acid, and the like; or

salts formed when an acidic proton present in the parent compound either is replaced by a metal ion, e.g., an alkali metal ion, an alkaline earth ion, or an aluminum ion; or

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coordinates with an organic or inorganic base. Acceptable organic bases include diethanolamine, ethanolamine, N-methylglucamine, triethanolamine, tromethamine, and the like. Acceptable inorganic bases include aluminum hydroxide, calcium hydroxide, potassium hydroxide, sodium carbonate and sodium hydroxide.

- 5 The preferred pharmaceutically acceptable salts are the salts formed from acetic acid, hydrochloric acid, sulphuric acid, methanesulfonic acid, maleic acid, phosphoric acid, tartaric acid, citric acid, sodium, potassium, calcium, zinc, and magnesium.

It should be understood that all references to pharmaceutically acceptable salts include solvent addition forms (solvates) or crystal forms (polymorphs) as defined herein, of the
10 same acid addition salt.

“Protective group” or “protecting group” means the group which selectively blocks one reactive site in a multifunctional compound such that a chemical reaction can be carried out selectively at another unprotected reactive site in the meaning conventionally associated with it in synthetic chemistry. Certain processes of this invention rely upon the protective groups
15 to block reactive nitrogen and/or oxygen atoms present in the reactants. For example, the terms “amino-protecting group” and “nitrogen protecting group” are used interchangeably herein and refer to those organic groups intended to protect the nitrogen atom against undesirable reactions during synthetic procedures. Exemplary nitrogen protecting groups include, but are not limited to, trifluoroacetyl, acetamido, benzyl (Bn), benzyloxycarbonyl
20 (carbobenzyloxy, CBZ), p-methoxybenzyloxycarbonyl, p-nitrobenzyloxycarbonyl, *tert*-butoxycarbonyl (BOC), and the like. The artisan in the art will know how to chose a group for the ease of removal and for the ability to withstand the following reactions.

“Solvates” means solvent additions forms that contain either stoichiometric or non stoichiometric amounts of solvent. Some compounds have a tendency to trap a fixed molar
25 ratio of solvent molecules in the crystalline solid state, thus forming a solvate. If the solvent is water the solvate formed is a hydrate, when the solvent is alcohol, the solvate formed is an alcoholate. Hydrates are formed by the combination of one or more molecules of water with one of the substances in which the water retains its molecular state as H₂O, such combination being able to form one or more hydrate.

30 “Subject” means mammals and non-mammals. Mammals means any member of the mammalia class including, but not limited to, humans; non-human primates such as chimpanzees and other apes and monkey species; farm animals such as cattle, horses, sheep, goats, and swine; domestic animals such as rabbits, dogs, and cats; laboratory animals

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including rodents, such as rats, mice, and guinea pigs; and the like. Examples of non-mammals include, but are not limited to, birds, and the like. The term “subject” does not denote a particular age or sex.

“Arthritis” means diseases or conditions damage to joints of the body and pain associated with such joint damage. Arthritis includes rheumatoid arthritis, osteoarthritis, psoriatic arthritis, septic arthritis and gouty arthritis.

“Pain” includes, without limitation, inflammatory pain; surgical pain; visceral pain; dental pain; premenstrual pain; central pain; pain due to burns; migraine or cluster headaches; nerve injury; neuritis; neuralgias; poisoning; ischemic injury; interstitial cystitis; cancer pain; viral, parasitic or bacterial infection; post-traumatic injury; or pain associated with irritable bowel syndrome.

“Therapeutically effective amount” means an amount of a compound that, when administered to a subject for treating a disease state, is sufficient to effect such treatment for the disease state. The “therapeutically effective amount” will vary depending on the compound, disease state being treated, the severity or the disease treated, the age and relative health of the subject, the route and form of administration, the judgment of the attending medical or veterinary practitioner, and other factors.

The terms “those defined above” and “those defined herein” when referring to a variable incorporates by reference the broad definition of the variable as well as preferred, more preferred and most preferred definitions, if any.

“Treating” or “treatment” of a disease state includes:

- (i) preventing the disease state, i.e. causing the clinical symptoms of the disease state not to develop in a subject that may be exposed to or predisposed to the disease state, but does not yet experience or display symptoms of the disease state.
- (ii) inhibiting the disease state, *i.e.*, arresting the development of the disease state or its clinical symptoms, or
- (iii) relieving the disease state, *i.e.*, causing temporary or permanent regression of the disease state or its clinical symptoms.

The terms “treating”, “contacting” and “reacting” when referring to a chemical reaction means adding or mixing two or more reagents under appropriate conditions to produce the indicated and/or the desired product. It should be appreciated that the reaction which produces the indicated and/or the desired product may not necessarily result directly from the

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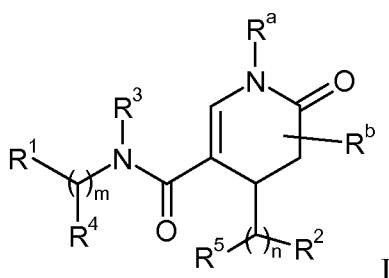
combination of two reagents which were initially added, i.e., there may be one or more intermediates which are produced in the mixture which ultimately leads to the formation of the indicated and/or the desired product.

Nomenclature and Structures

- 5 In general, the nomenclature used in this Application is based on AUTONOMTM v.4.0, a Beilstein Institute computerized system for the generation of IUPAC systematic nomenclature. Chemical structures shown herein were prepared using ISIS[®] version 2.2. Any open valency appearing on a carbon, oxygen sulfur or nitrogen atom in the structures herein indicates the presence of a hydrogen atom unless indicated otherwise. Where a
- 10 nitrogen-containing heteroaryl ring is shown with an open valency on a nitrogen atom, and variables such as R^a, R^b or R^c are shown on the heteroaryl ring, such variables may be bound or joined to the open valency nitrogen. Where a chiral center exists in a structure but no specific stereochemistry is shown for the chiral center, both enantiomers associated with the chiral center are encompassed by the structure. Where a structure shown herein may exist in
- 15 multiple tautomeric forms, all such tautomers are encompassed by the structure. All patents and publications identified herein are incorporated herein by reference in their entirety.

Compounds of the Invention

The invention provides compounds of the formula I:



or pharmaceutically acceptable salts thereof,
wherein:

- m is 0 or 1;
n is 0 or 1;
- 25 R¹ is optionally substituted aryl;
R² is:
optionally substituted aryl;
optionally substituted heteroaryl;

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C₃₋₆cycloalkyl; orC₁₋₆ alkyl;R³ is:

hydrogen;

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C₁₋₆alkyl;

alkylcarbonylalkyl; or

alkoxycarbonylalkyl;

R⁴ and R⁵ each independently is:

hydrogen; or

10

C₁₋₆alkyl;R^a is:

hydrogen;

C₁₋₆alkyl;hydroxy-C₁₋₆alkyl; or

15

C₁₋₆alkoxy-C₁₋₆alkyl; orhydroxy C₁₋₆alkoxy- C₁₋₆alkyl; andR^b is:

hydrogen; or

C₁₋₆alkyl.20 In certain embodiments of formula I, R³, R⁴ and R⁵ are hydrogen.In certain embodiments of formula I, R³, R⁴, R⁵ and R^a are hydrogen.

In certain embodiments of formula I, m is 0.

In certain embodiments of formula I, n is 0.

In certain embodiments of formula I, R³ is hydrogen.25 In certain embodiments of formula I, R⁴ is hydrogen.In certain embodiments of formula I, R⁵ is hydrogen.In certain embodiments of formula I, R^a is hydrogen.In certain embodiments of formula I, R^b is hydrogen.In certain embodiments of formula I, R¹ is optionally substituted phenyl.

30 In certain embodiments of formula I, R¹ is phenyl optionally substituted one, two, three or four times, and preferably substituted one, two or three times, with a substituent or substituents each independently selected from: halo; C₁₋₆alkyl; C₁₋₆alkoxy; halo-C₁₋₆alkyl; halo-C₁₋₆alkoxy; C₁₋₆alkylsulfonyl; C₁₋₆alkylsulfanyl; C₁₋₆alkylsulfinyl; phenylsulfonyl

wherein the phenyl portion is optionally substituted with C₁₋₆alkyl; nitrile; hydroxy; C₁₋₆alkylcarbonyl; aminocarbonyl; C₁₋₆alkoxycarbonyl; C₁₋₆alkoxycarbonyl-C₁₋₆alkoxy; C₁₋₆alkylcarbonyl-C₁₋₆alkoxy; hydroxycarbonyl; hydroxycarbonyl-C₁₋₆alkoxy; C₁₋₆alkylaminocarbonyl-C₁₋₆alkoxy; C₁₋₆alkoxy-C₁₋₆alkoxy; hydroxy-C₁₋₆alkoxy; C₁₋₆alkoxy-hydroxy-C₁₋₆alkoxy; C₁₋₆alkylamino-C₁₋₆alkoxy; C₁₋₆alkylsulfonyl-C₁₋₆alkoxy; sulfonamido; hydroxy-C₁₋₆alkyl; C₃₋₆cycloalkyl-C₁₋₆alkoxy; amino; amino-C₁₋₆alkyl; C₁₋₆alkenyl; C₁₋₆alkynyl; morpholinyl; morpholinyl-C₁₋₆alkyl; piperazinyl; piperidinyl; aminocarbonyl-C₁₋₆alkoxy; hydroxy C₁₋₆alkoxy- C₁₋₆alkyl; C₁₋₆alkoxyamino-C₁₋₆alkyl; hydroxy-C₁₋₆alkylamino-C₁₋₆alkyl; di(hydroxy-C₁₋₆alkyl)amino-C₁₋₆alkyl; C₁₋₆alkoxycarbonylamino-C₁₋₆alkyl; C₁₋₆alkylcarbonylamino-C₁₋₆alkyl; C₁₋₆alkylaminocarbonyl; C₁₋₆alkoxycarbonylC₁₋₆alkyl; C₁₋₆alkylaminocarbonyl-C₁₋₆alkyl; C₁₋₆alkylamino-C₁₋₆alkyl; hydroxycarbonyl-C₁₋₆alkyl; or nitro; or two adjacent substituents may form a C₃₋₄alkylene, C₁₋₂alkylenedioxy or halo-C₁₋₂alkylenedioxy.

In certain embodiments of formula I, R¹ is phenyl optionally substituted one, two, three or four times, and preferably substituted one, two or three times, with a substituent or substituents each independently selected from: halo; C₁₋₆alkyl; C₁₋₆alkoxy; halo-C₁₋₆alkyl; halo-C₁₋₆alkoxy; C₁₋₆alkylsulfonyl; C₁₋₆alkylsulfanyl; C₁₋₆alkylsulfinyl; phenylsulfonyl wherein the phenyl portion is optionally substituted with C₁₋₆alkyl; nitrile; hydroxy; C₁₋₆alkylcarbonyl; aminocarbonyl; C₁₋₆alkoxycarbonyl; C₁₋₆alkoxycarbonyl-C₁₋₆alkoxy; hydroxycarbonyl; hydroxycarbonyl-C₁₋₆alkoxy; C₁₋₆alkylaminocarbonyl-C₁₋₆alkoxy; C₁₋₆alkoxy-C₁₋₆alkoxy; hydroxy-C₁₋₆alkoxy; C₁₋₆alkylamino-C₁₋₆alkoxy; C₁₋₆alkylsulfonyl-C₁₋₆alkoxy; hydroxy-C₁₋₆alkyl; C₃₋₆cycloalkyl-C₁₋₆alkoxy; amino; amino-C₁₋₆alkyl; C₁₋₆alkenyl; C₁₋₆alkynyl; morpholinyl; morpholinyl-C₁₋₆alkyl; piperazinyl; piperidinyl; aminocarbonyl-C₁₋₆alkoxy; hydroxy C₁₋₆alkoxy- C₁₋₆alkyl; C₁₋₆alkoxyamino-C₁₋₆alkyl; hydroxy-C₁₋₆alkylamino-C₁₋₆alkyl; C₁₋₆alkoxycarbonylamino-C₁₋₆alkyl; C₁₋₆alkylcarbonylamino-C₁₋₆alkyl; C₁₋₆alkylaminocarbonyl; C₁₋₆alkoxycarbonylC₁₋₆alkyl; C₁₋₆alkylaminocarbonyl-C₁₋₆alkyl; C₁₋₆alkylamino-C₁₋₆alkyl; hydroxycarbonyl-C₁₋₆alkyl; or nitro; or two adjacent substituents may form a C₁₋₂alkylenedioxy or halo-C₁₋₂alkylenedioxy.

In certain embodiments of formula I, R¹ is phenyl substituted one, two, three or four times, and preferably substituted one, two or three times, with a substituent or substituents each independently selected from: fluoro; chloro; bromo; iodo; methyl; ethyl; methoxy; ethoxy; trifluoromethyl; difluoromethoxy; trifluoromethoxy; methanesulfonyl; methanesulfanyl; methanesulfinyl; toluenesulfonyl; nitrile; acetyl; aminocarbonyl; methoxycarbonyl;

methoxycarbonylmethoxy; carboxy; hydroxycarbonylmethoxy;
 methylaminocarbonylmethoxy; methoxyethoxy; hydroxyethoxy; methylaminoethoxy;
 methanesulfonylpropyloxy; hydroxymethyl; hydroxyethyl; cyclopropylmethoxy; amino; or
 nitro; morpholinyl; N,N-dimethylaminocarbonylmethoxy; boc-piperazinyl; N-(2-
 5 methoxyethyl)-N-methylaminomethyl; N,N-dimethylaminomethyl; aminomethyl; boc-
 aminomethyl; methylcarbonylaminomethyl; N,N-di-(2-hydroxyethyl)-aminomethyl;
 morpholinylmethyl; 2-hydroxy-1-hydroxymethyl-ethyl; methylaminocarbonyl;
 piperidinyloxy; tert-butoxycarbonylmethyl; N,N-dimethylaminocarbonylmethyl; n-propyl;
 isopropyl; hydroxycarbonylmethyl; hydroxypropoxy; or two adjacent substituents may form
 10 methylenedioxy, ethylenedioxy or difluoromethylenedioxy.

In certain embodiments of formula I, R¹ is phenyl substituted one, two, three or four times,
 and preferably substituted one, two or three times, with a substituent or substituents each
 independently selected from: halo; C₁₋₆alkyl; C₁₋₆alkoxy; halo-C₁₋₆alkyl; halo-C₁₋₆alkoxy; C₁₋₆
 15 alkylsulfonyl; nitrile; C₁₋₆alkoxy-C₁₋₆alkoxy; hydroxy-C₁₋₆alkoxy; C₁₋₆alkylsulfonyl-C₁₋₆
 alkoxy; hydroxy-C₁₋₆alkyl; hydroxy-C₁₋₆alkylamino; C₁₋₂alkylenedioxy; or C₃₋₆cycloalkyl-
 C₁₋₆alkoxy.

In certain embodiments of formula I, R¹ is phenyl substituted one, two, three or four times,
 and preferably substituted one, two or three times, with a substituent or substituents each
 independently selected from: fluoro; chloro; bromo; iodo; methyl; ethyl; methoxy; ethoxy;
 20 trifluoromethyl; difluoromethoxy; methanesulfonyl; nitrile; methoxyethoxy; hydroxyethoxy;
 hydroxymethyl; hydroxyethyl; hydroxypropoxy; methylenedioxy; or ethylenedioxy.

In certain embodiments of formula I, R¹ is phenyl substituted at the two position with halo or
 C₁₋₆alkyl, and substituted one or two additional times with a substituent or substituents each
 independently selected from: halo; C₁₋₆alkyl; C₁₋₆alkoxy; halo-C₁₋₆alkyl; halo-C₁₋₆alkoxy; C₁₋₆
 25 alkylsulfonyl; nitrile; C₁₋₆alkoxy-C₁₋₆alkoxy; hydroxy-C₁₋₆alkoxy; C₁₋₆alkylsulfonyl-C₁₋₆
 alkoxy; hydroxy-C₁₋₆alkyl; hydroxy-C₁₋₆alkylamino; C₁₋₂alkylenedioxy; or C₃₋₆cycloalkyl-
 C₁₋₆alkoxy.

In certain embodiments of formula I, R¹ is phenyl substituted at the two position C₁₋₆alkyl,
 and substituted one or two additional times with a substituent or substituents each
 30 independently selected from: halo; C₁₋₆alkyl; C₁₋₆alkoxy; halo-C₁₋₆alkyl; halo-C₁₋₆alkoxy; C₁₋₆
 alkylsulfonyl; nitrile; C₁₋₆alkoxy-C₁₋₆alkoxy; hydroxy-C₁₋₆alkoxy; C₁₋₆alkylsulfonyl-C₁₋₆
 alkoxy; hydroxy-C₁₋₆alkyl; hydroxy-C₁₋₆alkylamino; C₁₋₂alkylenedioxy; or C₃₋₆cycloalkyl-
 C₁₋₆alkoxy.

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In certain embodiments of formula I, R¹ is phenyl substituted two or three times with substituents each independently selected from: fluoro; chloro; bromo; methyl; ethyl; methoxy; ethoxy; difluoromethoxy; methoxyethoxy; hydroxyethoxy; hydroxymethyl; hydroxyethyl; hydroxypropoxy; methylenedioxy; or ethylenedioxy.

- 5 In certain embodiments of formula I, R¹ is phenyl substituted two or three times with substituents each independently selected from: fluoro; chloro; bromo; methyl; and methoxy. In certain embodiments of formula I, R¹ is phenyl optionally substituted one, two or three times with a substituent or substituents each independently selected from: fluoro; chloro; bromo; methyl; ethyl; methoxy; ethoxy; trifluoromethyl; difluoromethoxy; nitrile;
- 10 methoxyethoxy; hydroxyethoxy; hydroxymethyl; hydroxyethyl; or cyclopropylmethoxy. In certain embodiments of formula I, R¹ is phenyl substituted at the two position with methyl or halo, and additionally substituted one or two times times with a substituent or substituents each independently selected from: fluoro; chloro; bromo; methyl; ethyl; methoxy; ethoxy; difluoromethoxy; methoxyethoxy; hydroxyethoxy; hydroxymethyl; hydroxyethyl;
- 15 hydroxypropoxy; methylenedioxy; or ethylenedioxy. In certain embodiments of formula I, R¹ is phenyl substituted at the two position with methyl, and additionally substituted one or two times times with a substituent or substituents each independently selected from: fluoro; chloro; bromo; methyl; ethyl; methoxy; ethoxy; difluoromethoxy; methoxyethoxy; hydroxyethoxy; hydroxymethyl; hydroxyethyl;
- 20 hydroxypropoxy; methylenedioxy; or ethylenedioxy. In certain embodiments of formula I, R¹ is: 2-bromo-4,5-dimethoxy-phenyl; 2-bromo-4-chloro-5-methoxy-phenyl; 2-bromo-4-fluoro-5-methoxy-phenyl; 2,4-dichloro-5-methoxy-phenyl; 2-bromo-5-methoxy-4-trifluoromethyl-phenyl; 2-bromo-4,5-dichloro-phenyl; 2-bromo-4-chloro-5-iodo-phenyl; 2-bromo-4-chloro-5-trifluoromethyl-phenyl; 2-bromo-5-
- 25 methoxy-4-methyl-phenyl; 2-isopropyl-4,5-dimethoxy-phenyl; 2-bromo-4-chloro-5-methanesulfanyl-phenyl; 2-bromo-4-chloro-5-methanesulfonyl-phenyl; 2-bromo-4-chloro-5-methanesulfinyl-phenyl; 2-bromo-4-chloro-5-fluoro-phenyl; 2-bromo-5-methoxy-phenyl; 2-bromo-5-methoxy-4-methoxycarbonyl-phenyl; 2-bromo-4-chloro-5-hydroxy-phenyl; 2-bromo-4-chloro-5-(methylamino-carbonyl-methoxy)-phenyl; 2-methyl-4,5-dimethoxy-
- 30 phenyl; 2-bromo-4-chloro-5-methoxycarbonyl-phenyl; 2-bromo-4-methanesulfonyl-5-methoxy-phenyl; 2-bromo-4-methyl-5-methoxy-phenyl; 2-bromo-4-chloro-5-(methoxycarbonyl-methoxy)-phenyl; 2-bromo-4-chloro-5-(hydroxycarbonyl-methoxy)-phenyl; 2-bromo-4-chloro-5-(2-methoxyethoxy)-phenyl;

- 4,5-dimethoxy-phenyl; 2-fluoro-4-chloro-5-methoxy-phenyl; 2-bromo-4-methoxycarbonyl-5-methoxy-phenyl; 6-bromo-benzo[1,3]dioxol-5-yl; 2-bromo-4-chloro-5-(2-hydroxyethoxy)-phenyl; 2-bromo-4-difluoromethoxy-5-methoxy-phenyl;
- 5-methoxy-4-methyl-phenyl; 2-bromo-4-chloro-5-(2-methylamino-ethoxy)-phenyl; 2-bromo-4-cyano-5-methyl-phenyl; 2-fluoro-4-methyl-5-methoxy-phenyl; 2-bromo-4-chloro-5-acetyl-phenyl; 5-methoxy-2-methyl-phenyl; 2-bromo-4-chloro-5-(3-methanesulfonyl-propoxy)-phenyl; 2-bromo-5-methoxy-4-(tert-butoxycarbonyl)-phenyl;
- 5-methanesulfonyl-2-methoxy-phenyl; 2-bromo-4-chloro-5-(1-hydroxyethyl)-phenyl; 2-fluoro-5-(2-hydroxyethoxy)-4-methyl-phenyl; 2-bromo-5-methoxy-4-aminocarbonyl-phenyl;
- 10 6-bromo-2,2-difluoro-benzo[1,3]dioxol-5-yl; 2,6-difluoro-phenyl; 2-bromo-4-cyano-5-methoxy-phenyl; 2,5-dimethoxy-phenyl; 3-methoxycarbonyl-2-methyl-phenyl; 3-methoxy-phenyl; 4-methoxy-phenyl; 2,4-dimethoxy-phenyl; 4-chloro-5-methoxy-phenyl; 4-fluoro-5-methoxy-phenyl; 2-bromo-4-methyl-5-(tert-butoxycarbonyl)-phenyl; 3,4,5-trimethoxy-phenyl; 2-bromo-4,6-difluoro-phenyl; 2-ethyl-4,5-dimethoxy-phenyl; 2-bromo-4-methoxy-phenyl;
- 15 4-chloro-5-(2-hydroxyethoxy)-2-methyl-phenyl; 3-methoxycarbonyl-2-methyl-phenyl; 2,5-dimethyl-phenyl; 2-bromo-5-methoxy-phenyl; 2,3-dimethyl-phenyl; 2-bromo-4-chloro-5-hydroxymethyl-phenyl; 2-bromo-3,5-dimethyl-phenyl; 4-methoxy-2-methyl-phenyl; 2,4-dimethyl-phenyl; 2-iodo-4,5-dimethoxy-phenyl; 2-chloro-4,5-dimethoxy-phenyl; 7-bromo-2,3-dihydrobenzo[1,4]dioxin-6-yl; 4,5-dimethoxy-2-trifluoromethyl-phenyl; 2-bromo-
- 20 5-ethoxy-4-methoxy-phenyl; 2-bromo-4-ethoxy-5-methoxy-phenyl; 2-bromo-5-cyclopropylmethoxy-4-methoxy-phenyl; 2-bromo-4-cyclopropylmethoxy-5-methoxy-phenyl; 2-cyano-4,5-dimethoxyphenyl; 2-bromo-5-difluoromethoxy-4-methoxy-phenyl; 2-bromo-4,5-bis-difluoromethoxy-phenyl; 2-bromo-4-fluoro-5-(2-methoxyethoxy)-phenyl; 2-bromo-4-fluoro-5-(2-hydroxyethoxy)-phenyl; 4-fluoro-4,5-dimethoxy-phenyl; 2,4-dimethylphenyl;
- 25 3,5-dimethylphenyl; 4,5-dimethoxy-2-morpholin-4-yl-phenyl; 3-methoxy-2-methyl-phenyl; 2,3-dimethoxy-phenyl; 4-fluoro-5-(2-hydroxy-ethoxy)-2-methyl-phenyl; 4-chloro-4-(3-hydroxy-propyl)-2-methyl-phenyl; 2-dimethylamino-4,5-dimethoxy-phenyl; 4-chloro-5-hydroxymethyl-2-methyl-phenyl; 2-bromo-4-trifluoromethoxy-phenyl; 2-bromo-4-chloro-5-dimethylaminocarbonylmethoxy-phenyl; 4-chloro-5-[(2-methoxy-ethyl)-methyl-amino]-methyl}-2-methyl-phenyl; 5-(tert-butoxycarbonylaminomethyl)-2-methyl-4-chloro-phenyl;
- 30 5-aminomethyl-4-chloro-2-methyl-phenyl; 4-chloro-2-methyl-5-(methylcarbonylaminomethyl)-phenyl; 5-[[bis-(2-hydroxy-ethyl)-amino]-methyl]-4-chloro-2-methyl-phenyl; 4-chloro-2-methyl-5-morpholin-4-ylmethyl-phenyl; 3-methyl-phenyl; 4-

chloro-5-(2-hydroxy-ethyl)-2-methyl-phenyl; 2-bromo-3,4-ethylenedioxy-phenyl (7-bromo-2,3-dihydro-benzo[1,4]dioxin-6-yl)); 3-chloro-2-methyl-phenyl; 3-hydroxymethyl-2-methyl-phenyl; 2-methyl-3-methylaminocarbonyl-phenyl; 4-chloro-2-methyl-5-(piperidin-4-yloxy)-phenyl; 2-methyl-3-(tert-butoxycarbonylmethyl)-phenyl; 3-(2-hydroxy-ethyl)-2-methyl-phenyl; 4,5-difluoro-2-methyl-phenyl; 2-bromo-4,5-difluoro-phenyl; 3,4-dimethyl-phenyl; 2-chloro-3-methyl-phenyl; 2-bromo-4-(2-hydroxy-ethyl)-phenyl; 2-bromo-4-isopropyl-phenyl; 3-fluoro-2-methyl-phenyl; 2-bromo-5-(2-hydroxy-ethoxy)-4-methyl-phenyl; 2-(2-hydroxy-ethyl)-4,5-dimethoxy-phenyl; 4-chloro-5-dimethylaminomethyl-2-methyl-phenyl; 2-ethyl-phenyl; 2-propyl-phenyl; 5-methoxy-2,3-dimethyl-phenyl; and 3-(hydroxycarbonylmethyl)-2-methyl-phenyl.

In certain embodiments of formula I, R¹ is: 2-bromo-4,5-dimethoxy-phenyl; 2-bromo-4-chloro-5-methoxy-phenyl; 2-bromo-4-fluoro-5-methoxy-phenyl; 2,4-dichloro-5-methoxy-phenyl; 2-bromo-5-methoxy-4-trifluoromethyl-phenyl; 2-bromo-4,5-dichloro-phenyl; 2-bromo-4-chloro-5-iodo-phenyl; 2-bromo-4-chloro-5-trifluoromethyl-phenyl; 2-bromo-5-methoxy-4-methyl-phenyl; 2-isopropyl-4,5-dimethoxy-phenyl; 2-bromo-4-chloro-5-methanesulfanyl-phenyl; 2-bromo-4-chloro-5-methanesulfonyl-phenyl; 2-bromo-4-chloro-5-methanesulfinyl-phenyl; 2-bromo-4-chloro-5-fluoro-phenyl; 2-bromo-5-methoxy-phenyl; 2-bromo-5-methoxy-4-methoxycarbonyl-phenyl; 2-bromo-4-chloro-5-hydroxy-phenyl; 2-bromo-4-chloro-5-(methylamino-carbonyl-methoxy)-phenyl; 2-methyl-4,5-dimethoxy-phenyl; 2-bromo-4-chloro-5-methoxycarbonyl-phenyl; 2-bromo-4-methanesulfonyl-5-methoxy-phenyl; 2-bromo-4-methyl-5-methoxy-phenyl; 2-bromo-4-chloro-5-(methoxycarbonyl-methoxy)-phenyl; 2-bromo-4-chloro-5-(hydroxycarbonyl-methoxy)-phenyl; 2-bromo-4-chloro-5-(2-methoxyethoxy)-phenyl; 4,5-dimethoxy-phenyl; 2-fluoro-4-chloro-5-methoxy-phenyl; 2-bromo-4-methoxycarbonyl-5-methoxy-phenyl; 6-bromo-benzo[1,3]dioxol-5-yl; 2-bromo-4-chloro-5-(2-hydroxyethoxy)-phenyl; 2-bromo-4-difluoromethoxy-5-methoxy-phenyl; 5-methoxy-4-methyl-phenyl; 2-bromo-4-chloro-5-(2-methylamino-ethoxy)-phenyl; 2-bromo-4-cyano-5-methyl-phenyl; 2-fluoro-4-methyl-5-methoxy-phenyl; 2-bromo-4-chloro-5-acetyl-phenyl; 5-methoxy-2-methyl-phenyl; 2-bromo-4-chloro-5-(3-methanesulfonyl-propoxy)-phenyl; 2-bromo-5-methoxy-4-(tert-butoxycarbonyl)-phenyl; 5-methanesulfonyl-2-methoxy-phenyl; 2-bromo-4-chloro-5-(1-hydroxyethyl)-phenyl; 2-fluoro-5-(2-hydroxyethoxy)-4-methyl-phenyl; 2-bromo-5-methoxy-4-aminocarbonyl-phenyl; 6-bromo-2,2-difluoro-benzo[1,3]dioxol-5-yl; 2,6-difluoro-phenyl; 2-bromo-4-cyano-5-methoxy-phenyl; 2,5-dimethoxy-phenyl; 3-methoxycarbonyl-2-methyl-

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phenyl; 3-methoxy-phenyl; 4-methoxy-phenyl; 2,4-dimethoxy-phenyl; 4-chloro-5-methoxy-phenyl; 4-fluoro-5-methoxy-phenyl; 2-bromo-4-methyl-5-(tert-butoxycarbonyl)-phenyl; 3,4,5-trimethoxy-phenyl; 2-bromo-4,6-difluoro-phenyl; 2-ethyl-4,5-dimethoxy-phenyl; 2-bromo-4-methoxy-phenyl; 4-chloro-5-(2-hydroxyethoxy)-2-methyl-phenyl; 3-

5 methoxycarbonyl-2-methyl-phenyl; 2,5-dimethyl-phenyl; 2-bromo-5-methoxy-phenyl; 2,3-dimethyl-phenyl; 2-bromo-4-chloro-5-hydroxymethyl-phenyl; 2-bromo-3,5-dimethyl-phenyl; 4-methoxy-2-methyl-phenyl; or 2,4-dimethyl-phenyl.

In certain embodiments of formula I, R¹ is: 2-bromo-4,5-dimethoxy-phenyl; 2-bromo-4-chloro-5-methoxy-phenyl; 2-bromo-4-fluoro-5-methoxy-phenyl; 2-bromo-5-methoxy-4-methyl-phenyl; 2-methyl-4,5-dimethoxy-phenyl; 2-bromo-4-chloro-5-(2-methoxy-ethyl-phenyl; 2-bromo-4-chloro-5-(2-hydroxy-ethyl-phenyl; 2-bromo-4-difluoromethoxy-5-methoxy-phenyl; 2,5-dimethoxy-phenyl; 2-ethyl-4,5-dimethoxy-phenyl; 2-methyl-5-(2-hydroxy-ethoxy)-4-chloro-phenyl; 2,5-dimethyl-phenyl; 2-bromo-5-methoxy-phenyl; or 2-bromo-4,5-dimethyl-phenyl.

15 In certain embodiments of formula I, R¹ is: 2-bromo-4,5-dimethoxy-phenyl; 2-bromo-4-chloro-5-methoxy-phenyl; 2-bromo-4-fluoro-5-methoxy-phenyl; 2-bromo-5-methoxy-4-methyl-phenyl; 4,5-dimethoxy-2-methyl-phenyl; 2-bromo-4,5-methylenedioxy-phenyl (6-bromo-benzo[1,3]dioxol-5-yl); 2-bromo-4-chloro-5-(2-hydroxy-ethoxy)-phenyl; 2-bromo-4-difluoromethoxy-5-methoxy-phenyl; 5-methoxy-2-methyl-phenyl; 2-bromo-4-chloro-5-(1-hydroxy-ethyl)-phenyl; 2-bromo-4-chloro-5-((S)-1-hydroxy-ethyl)-phenyl; 2-ethyl-4,5-dimethoxy-phenyl; 2-bromo-4-methoxy-phenyl; 4-chloro-5-(2-hydroxy-ethoxy)-2-methyl-phenyl; 2,5-dimethyl-phenyl; 2-bromo-5-methoxy-phenyl; 2,3-dimethyl-phenyl; 2-bromo-4-chloro-5-hydroxymethyl-phenyl; 2-bromo-3,5-dimethyl-phenyl; 2,4-dimethyl-phenyl; 3-methoxy-2-methyl-phenyl; 4-fluoro-5-(2-hydroxy-ethoxy)-2-methyl-phenyl; 4-chloro-5-(3-hydroxy-propoxy)-2-methyl-phenyl; 4-chloro-5-hydroxymethyl-2-methyl-phenyl; 5-{{[bis-(2-hydroxy-ethyl)-amino]-methyl}-4-chloro-2-methyl-phenyl; 4-chloro-5-(2-hydroxy-ethyl)-2-methyl-phenyl; 2-bromo-4,5-ethylenedioxy-phenyl (7-bromo-2,3-dihydro-benzo[1,4]dioxin-6-yl) ; 3-chloro-2-methyl-phenyl; 3-hydroxymethyl-2-methyl-phenyl; or 3-(2-hydroxy-ethyl)-2-methyl-phenyl;

30 In certain embodiments of formula I, R¹ is 2-bromo-4,5-dimethoxy-phenyl.

In certain embodiments of formula I, R¹ is 2-bromo-4-chloro-5-methoxy-phenyl.

In certain embodiments of formula I, R¹ is 2-bromo-4-fluoro-5-methoxy-phenyl.

In certain embodiments of formula I, R¹ is 2-bromo-5-methoxy-4-methyl-phenyl.

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- In certain embodiments of formula I, R¹ is 2-methyl-4,5-dimethoxy-phenyl.
- In certain embodiments of formula I, R¹ is 2-bromo-4-chloro-5-(2-methoxy-ethyl-phenyl).
- In certain embodiments of formula I, R¹ is 2-bromo-4-chloro-5-(2-hydroxy-ethyl-phenyl).
- In certain embodiments of formula I, R¹ is 2-bromo-4-difluoromethoxy-5-methoxy-phenyl.
- 5 In certain embodiments of formula I, R¹ is 2,5-dimethoxy-phenyl.
- In certain embodiments of formula I, R¹ is 2-ethyl-4,5-dimethoxy-phenyl.
- In certain embodiments of formula I, R¹ is 2-methyl-5-(2-hydroxy-ethoxy)-4-chloro-phenyl.
- In certain embodiments of formula I, R¹ is 2,5-dimethyl-phenyl.
- In certain embodiments of formula I, R¹ is 2-bromo-5-methoxy-phenyl.
- 10 In certain embodiments of formula I, R¹ is 2-bromo-4,5-dimethyl-phenyl.
- In certain embodiments of formula I, R² is C₁₋₆alkyl. In specific embodiments R² may be C₃₋₆ branched alkyl.
- In certain embodiments of formula I, R² is optionally substituted aryl.
- In certain embodiments of formula I, R² is optionally substituted phenyl.
- 15 In certain embodiments of formula I, R² is phenyl optionally substituted one, two, three or four times with a substituent or substituents each independently selected from: halo; C₁₋₆alkyl; C₁₋₆alkoxy; halo-C₁₋₆alkyl; halo-C₁₋₆alkoxy; C₁₋₆alkylsulfonyl; C₁₋₆alkylsulfanyl; C₁₋₆alkylsulfinyl; phenylsulfonyl wherein the phenyl portion is optionally substituted with C₁₋₆alkyl; nitrile; hydroxy; C₁₋₆alkylcarbonyl; aminocarbonyl; C₁₋₆alkoxycarbonyl; C₁₋₆alkoxycarbonyl-C₁₋₆alkoxy; hydroxycarbonyl; hydroxycarbonyl-C₁₋₆alkoxy; C₁₋₆alkylaminocarbonyl-C₁₋₆alkoxy; C₁₋₆alkoxy-C₁₋₆alkoxy; hydroxy-C₁₋₆alkoxy; C₁₋₆alkylamino-C₁₋₆alkoxy; C₁₋₆alkylsulfonyl-C₁₋₆alkoxy; hydroxy-C₁₋₆alkyl; C₃₋₆cycloalkyl-C₁₋₆alkoxy; amino; amino-C₁₋₆alkyl; C₁₋₆alkenyl; C₁₋₆alkynyl; morpholiny; morpholiny-C₁₋₆alkyl; piperaziny; piperidinyloxy; aminocarbonyl-C₁₋₆alkoxy; C₁₋₆alkoxyamino-C₁₋₆alkyl;
- 20 hydroxy-C₁₋₆alkylamino-C₁₋₆alkyl; C₁₋₆alkoxycarbonylamino-C₁₋₆alkyl; C₁₋₆alkylcarbonylamino-C₁₋₆alkyl; C₁₋₆alkylaminocarbonyl; C₁₋₆alkoxycarbonylC₁₋₆alkyl; C₁₋₆alkylaminocarbonyl-C₁₋₆alkyl; C₁₋₆alkylamino-C₁₋₆alkyl; hydroxycarbonyl-C₁₋₆alkyl; or nitro; or two adjacent substituents may form a C₁₋₂alkylenedioxy or halo-C₁₋₂alkylenedioxy.
- In certain embodiments of formula I, R² is phenyl optionally substituted once or twice with a
- 25 substituent or substituents each independently selected from: fluoro; chloro; bromo; iodo; methyl; ethyl; methoxy; ethoxy; trifluoromethyl; difluoromethoxy; methanesulfonyl; methanesulfanyl; methanesulfinyl; toluenesulfonyl; nitrile; acetyl; aminocarbonyl; methoxycarbonyl; methoxycarbonylmethoxy; carboxy; hydroxycarbonylmethoxy;
- 30

methylaminocarbonylmethoxy; methoxyethoxy; hydroxyethoxy; methylaminoethoxy; methanesulfonylpropyloxy; hydroxymethyl; hydroxyethyl; cyclopropylmethoxy; amino; or nitro; or two adjacent substituents may form methylenedioxy, ethylenedioxy or difluoromethylenedioxy.

- 5 In certain embodiments of formula I, R^2 is phenyl optionally substituted once or twice with a substituent or substituents each independently selected from: halo; C_{1-6} alkyl; C_{1-6} alkoxy; halo- C_{1-6} alkyl; halo- C_{1-6} alkoxy; C_{1-6} alkylsulfonyl; nitrile; alkoxyalkoxy; hydroxyalkoxy; alkylsulfonylalkoxy; hydroxyalkyl; or C_{3-6} cycloalkyl- C_{1-6} alkoxy.

- 10 In certain embodiments of formula I, R^2 is phenyl optionally substituted once or twice with a substituent or substituents each independently selected from: fluoro; chloro; bromo; iodo; methyl; ethyl; methoxy; ethoxy; trifluoromethyl; difluoromethoxy; methanesulfonyl; nitrile; methoxyethoxy; hydroxyethoxy; hydroxymethyl; hydroxyethyl; or cyclopropylmethoxy.

- In certain embodiments of formula I, R^2 is phenyl optionally substituted once or twice with a substituent or substituents each independently selected from: fluoro; chloro; bromo; methyl; 15 ethyl; methoxy; ethoxy; trifluoromethyl; difluoromethoxy; nitrile; methoxyethoxy; hydroxyethoxy; hydroxymethyl; hydroxyethyl; or cyclopropylmethoxy.

In certain embodiments of formula I, R^2 is phenyl substituted once or twice with a substituent or substituents each independently selected from: halo; methyl; methoxy; trifluoromethyl; difluoromethoxy; nitrile; or methanesulfonyl.

- 20 In certain embodiments of formula I, R^2 is phenyl substituted once or twice with a substituent or substituents each independently selected from: fluoro; chloro; methyl; methoxy; or nitrile.

In certain embodiments of formula I, R^2 is phenyl substituted once or twice with fluoro.

- In certain embodiments of formula I, R^2 is: phenyl; 4-fluoro-phenyl; 3-fluoro-phenyl; 2-fluoro-phenyl; 2-chloro-phenyl; 3,4-difluoro-phenyl; 3,5-difluoro-phenyl; 3-methyl-phenyl; 25 4-methyl-phenyl; or 3-cyano-phenyl.

In certain embodiments of formula I, R^2 is: phenyl; 4-fluoro-phenyl; 3-fluoro-phenyl; 2-fluoro-phenyl; 2-chloro-phenyl; 3,4-difluoro-phenyl; or 3,5-difluoro-phenyl.

In certain embodiments of formula I, R^2 is 4-fluoro-phenyl.

In certain embodiments of formula I, R^2 is 3-fluoro-phenyl.

- 30 In certain embodiments of formula I, R^2 is 3,4-difluoro-phenyl.

In certain embodiments of formula I, R^a is hydrogen.

In certain embodiments of formula I, R^a is C_{1-6} alkyl.

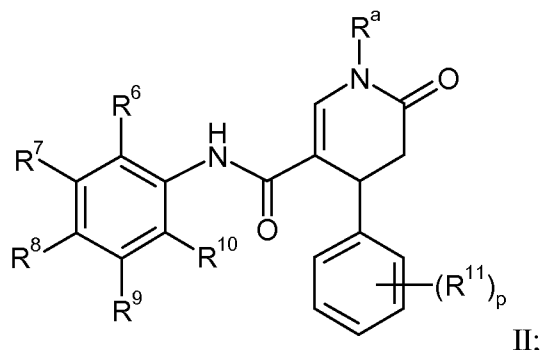
In certain embodiments of formula I, R^a is methyl.

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In certain embodiments of formula I, R^a is hydroxy-C₁₋₆alkyl.

In certain embodiments of formula I, R^a is C₁₋₆alkoxy-C₁₋₆alkyl.

In certain embodiments, the compounds of formula I may be more specifically of formula II:



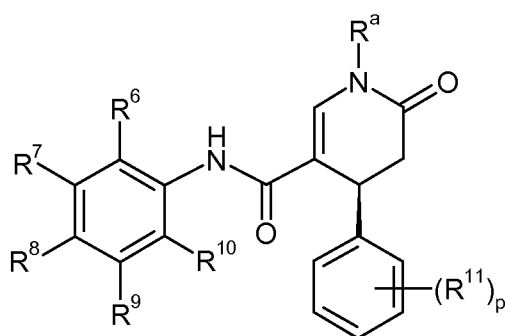
5 wherein:

p is from 0 to 3;

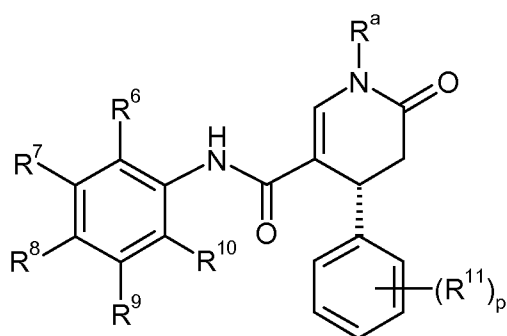
- R⁶, R⁷, R⁸, R⁹ and R¹⁰ each independently is: hydrogen; halo; C₁₋₆alkyl; C₁₋₆alkoxy; halo-C₁₋₆alkyl; halo-C₁₋₆alkoxy; C₁₋₆alkylsulfonyl; C₁₋₆alkylsulfanyl; C₁₋₆alkylsulfinyl; phenylsulfonyl wherein the phenyl portion is optionally substituted with C₁₋₆alkyl; nitrile; hydroxy; C₁₋₆alkylcarbonyl; aminocarbonyl; C₁₋₆alkoxycarbonyl; C₁₋₆alkoxycarbonyl-C₁₋₆alkoxy; hydroxycarbonyl; hydroxycarbonyl-C₁₋₆alkoxy; C₁₋₆alkylaminocarbonyl-C₁₋₆alkoxy; C₁₋₆alkoxy-C₁₋₆alkoxy; hydroxy-C₁₋₆alkoxy; C₁₋₆alkylamino-C₁₋₆alkoxy; C₁₋₆alkylsulfony-C₁₋₆alkoxy; hydroxy-C₁₋₆alkyl; C₃₋₆cycloalkyl-C₁₋₆alkoxy; amino; amino-C₁₋₆alkyl; C₁₋₆alkenyl; C₁₋₆alkynyl; morpholinyl; morpholinyl-C₁₋₆alkyl; piperazinyl; piperidinyl; aminocarbonyl-C₁₋₆alkoxy; C₁₋₆alkoxyamino-C₁₋₆alkyl; hydroxy-C₁₋₆alkylamino-C₁₋₆alkyl; C₁₋₆alkoxycarbonylamino-C₁₋₆alkyl; C₁₋₆alkylcarbonylamino-C₁₋₆alkyl; C₁₋₆alkylaminocarbonyl; C₁₋₆alkoxycarbonyl-C₁₋₆alkyl; C₁₋₆alkylaminocarbonyl-C₁₋₆alkyl; C₁₋₆alkylamino-C₁₋₆alkyl; hydroxycarbonyl-C₁₋₆alkyl; or nitro; or two adjacent substituents may form a C₁₋₂alkylenedioxy or halo-C₁₋₂alkylenedioxy;
- 15 each R¹¹ independently is: halo; C₁₋₆alkyl; C₁₋₆alkoxy; halo-C₁₋₆alkyl; halo-C₁₋₆alkoxy; C₁₋₆alkylsulfonyl; or nitrile; and

R^a is as defined herein.

In certain embodiments of formula II, the subject compounds may be more specifically of formula IIa or formula IIb;



IIa;



IIb;

wherein p , R^6 , R^7 , R^8 , R^9 , R^{10} , R^{11} and are as defined herein.

In certain embodiments, the subject compounds are of formula IIa.

In certain embodiments, the subject compounds are of formula IIb.

- 5 In certain embodiments of any of formulas II, IIa and IIb, at least two of R^6 , R^7 , R^8 , R^9 and R^{10} are not hydrogen.

In certain embodiments of any of formulas II, IIa and IIb, at least three of R^6 , R^7 , R^8 , R^9 and R^{10} are not hydrogen.

- In certain embodiments of any of formulas II, IIa and IIb, R^6 , R^7 , R^8 , R^9 and R^{10} each
 10 independently is: hydrogen; fluoro; chloro; bromo; iodo; methyl; ethyl; methoxy; ethoxy; trifluoromethyl; difluoromethoxy; trifluoromethoxy; methanesulfonyl; methanesulfanyl; methanesulfinyl; toluenesulfonyl; nitrile; acetyl; aminocarbonyl; methoxycarbonyl; methoxycarbonylmethoxy; carboxy; hydroxycarbonylmethoxy; methylaminocarbonylmethoxy; methoxyethoxy; hydroxyethoxy; methylaminoethoxy;
 15 methanesulfonylpropyloxy; hydroxymethyl; hydroxyethyl; cyclopropylmethoxy; amino; or nitro; morpholinyl; N,N-dimethylaminocarbonylmethoxy; boc-piperazinyl; N-(2-methoxyethyl)-N-methylaminomethyl; N,N-dimethylaminomethyl; aminomethyl; boc-aminomethyl; methylcarbonylaminomethyl; N,N-di-(2-hydroxyethyl)-aminomethyl; morpholinylmethyl; 2-hydroxy-1-hydroxymethyl-ethyl; methylaminocarbonyl;
 20 piperidinyloxy; tert-butoxycarbonylmethyl; N,N-dimethylaminocarbonylmethyl; n-propyl; isopropyl; hydroxycarbonylmethyl; hydroxypropoxy; or two adjacent substituents may form methylenedioxy, ethylenedioxy or difluoromethylenedioxy.

In certain embodiments of any of formulas II, IIa and IIb, two of R^6 , R^7 , R^8 , R^9 and R^{10} are hydrogen, and the remaining ones of R^6 , R^7 , R^8 , R^9 and R^{10} of each independently is:

- 25 hydrogen; fluoro; chloro; bromo; iodo; methyl; ethyl; methoxy; ethoxy; trifluoromethyl; difluoromethoxy; methanesulfonyl; nitrile; methoxyethoxy; hydroxyethoxy; hydroxymethyl; hydroxyethyl; hydroxypropoxy; methylenedioxy; or ethylenedioxy.

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In certain embodiments of any of formulas II, IIa and IIb, two of R^6 , R^7 , R^8 , R^9 and R^{10} are hydrogen, and the remaining ones of R^6 , R^7 , R^8 , R^9 and R^{10} of each independently is: hydrogen; fluoro; chloro; bromo; methyl; ethyl; methoxy; ethoxy; difluoromethoxy; methoxyethoxy; hydroxyethoxy; hydroxymethyl; hydroxyethyl; hydroxypropoxy;

5 methylenedioxy; or ethylenedioxy.

In certain embodiments of any of formulas II, IIa and IIb, two of R^6 , R^7 , R^8 , R^9 and R^{10} are hydrogen, and the remaining ones of R^6 , R^7 , R^8 , R^9 and R^{10} of each independently is: hydrogen; fluoro; chloro; bromo; methyl; and methoxy.

In certain embodiments of any of formulas II, IIa and IIb, R^6 is halo or methyl, R^{10} is
10 hydrogen, one of R^7 , R^8 and R^9 is hydrogen and the others of R^7 , R^8 and R^9 are each independently selected from: fluoro; chloro; bromo; iodo; methyl; ethyl; methoxy; ethoxy; trifluoromethyl; difluoromethoxy; methanesulfonyl; nitrile; methoxyethoxy; hydroxyethoxy; hydroxymethyl; hydroxyethyl; and hydroxypropoxy.

In certain embodiments of any of formulas II, IIa and IIb, R^6 is halo or methyl, R^{10} is
15 hydrogen, two of R^7 , R^8 and R^9 is hydrogen and the other of R^7 , R^8 and R^9 is selected from: fluoro; chloro; bromo; iodo; methyl; ethyl; methoxy; ethoxy; trifluoromethyl; difluoromethoxy; methanesulfonyl; nitrile; methoxyethoxy; hydroxyethoxy; hydroxymethyl; hydroxyethyl; and hydroxypropoxy.

In certain embodiments of any of formulas II, IIa and IIb, R^6 , R^7 , R^8 , R^9 and R^{10} each
20 independently is: hydrogen; halo; C_{1-6} alkyl; C_{1-6} alkoxy; halo- C_{1-6} alkyl; halo- C_{1-6} alkoxy; C_{1-6} alkylsulfonyl; nitrile; alkoxyalkoxy; hydroxyalkoxy; alkylsulfonylalkoxy; hydroxyalkyl; or C_{3-6} cycloalkyl- C_{1-6} alkoxy.

In certain embodiments of any of formulas II, IIa and IIb, R^6 , R^7 , R^8 , R^9 and R^{10} each
independently is: hydrogen; fluoro; chloro; bromo; iodo; methyl; ethyl; methoxy; ethoxy;
25 trifluoromethyl; difluoromethoxy; methanesulfonyl; nitrile; methoxyethoxy; hydroxyethoxy; hydroxymethyl; or hydroxyethyl.

In certain embodiments of any of formulas II, IIa and IIb, R^6 , R^7 , R^8 , R^9 and R^{10} each
independently is: hydrogen; fluoro; chloro; bromo; methyl; ethyl; methoxy; ethoxy;
trifluoromethyl; difluoromethoxy; nitrile; methoxyethoxy; hydroxyethoxy; hydroxymethyl;
30 hydroxyethyl; or cyclopropylmethoxy.

In certain embodiments of any of formulas II, IIa and IIb, R^7 and R^{10} are hydrogen.

In certain embodiments of any of formulas II, IIa and IIb, R^6 is: hydrogen; halo; or methyl.

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In certain embodiments of any of formulas II, IIa and IIb, R⁸ is: hydrogen; methoxy; halo; methyl; or difluoromethoxy.

In certain embodiments of any of formulas II, IIa and IIb, R⁹ is: methoxy; hydrogen; 2-hydroxy-ethoxy; 2-methoxy-ethoxy; 1-hydroxy-ethyl; or cyclopropylmethyl.

5 In certain embodiments of any of formulas II, IIa and IIb, p is 0, 1 or 2.

In certain embodiments of any of formulas II, IIa and IIb, p is 1 or 2.

In certain embodiments of any of formulas II, IIa and IIb, p is 1.

In certain embodiments of any of formulas II, IIa and IIb, each R¹¹ independently is: halo; C₁₋₆alkyl; or C₁₋₆alkoxy.

10 In certain embodiments of any of formulas II, IIa and IIb, each R¹¹ independently is fluoro or methyl.

In certain embodiments of any of formulas II, IIa and IIb, R¹¹ is halo.

In certain embodiments of any of formulas II, IIa and IIb, R¹¹ is fluoro.

In certain embodiments of any of formulas II, IIa and IIb p is 1 and R¹¹ is halo.

15 In certain embodiments of any of formulas II, IIa and IIb p is 1 and R¹¹ is 3-halo or 4-halo.

In certain embodiments of any of formulas II, IIa and IIb p is 1 and R¹¹ is fluoro.

In certain embodiments of any of formulas II, IIa and IIb p is 1 and R¹¹ is 3-fluoro or 4-fluoro.

In certain embodiments of any of formulas II, IIa and IIb p is 1 and R¹¹ is 4-fluoro.

In certain embodiments of any of formula II, IIa and IIb, R^a is hydrogen.

20 In certain embodiments of any of formulas II, IIa and IIb:

R⁶ is: hydrogen; halo; methyl; or ethyl;

R⁷ is hydrogen; methyl; methoxy; or methoxycarbonyl;

R⁸ is: hydrogen; methoxy; halo; methyl; or difluoromethoxy;

R⁹ is: hydrogen; methoxy; hydrogen; 2-hydroxy-ethoxy; 2-methoxy-ethoxy; or 1-

25 hydroxy-ethyl; and

R¹⁰ is hydrogen; or halo.

In certain embodiments of any of formulas II, IIa and IIb:

R⁶ is: halo; or methyl;

R⁷ is hydrogen;

30 R⁸ is: methoxy; halo; methyl; or difluoromethoxy;

R⁹ is: methoxy; 2-hydroxy-ethoxy; 2-methoxy-ethoxy; or 1-hydroxy-ethyl; and

R¹⁰ is hydrogen; or halo.

In certain embodiments of any of formulas II, IIa and IIb:

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R^6 is: bromo; or methyl;

R^7 is hydrogen;

R^8 is: methoxy; chloro; fluoro; methyl; or difluoromethoxy;

R^9 is: methoxy; 2-hydroxy-ethoxy; 2-methoxy-ethoxy; or 1-hydroxy-ethyl; and

5 R^{10} is hydrogen.

In certain embodiments of any of formulas II, IIa and IIb:

R^6 is methyl;

R^7 is hydrogen;

R^8 is: methoxy; chloro; fluoro; methyl; or difluoromethoxy;

10 R^9 is: methoxy; 2-hydroxy-ethoxy; 2-methoxy-ethoxy; or 1-hydroxy-ethyl; and

R^{10} is hydrogen.

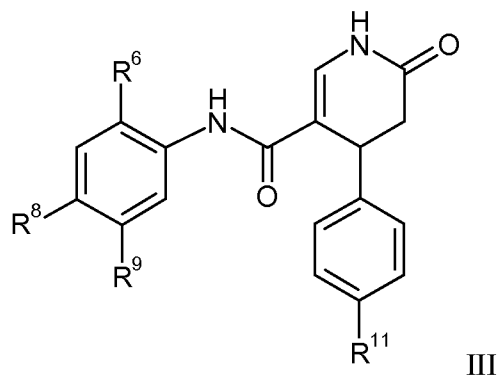
In certain embodiments of any of formulas II, IIa and IIb, p is 1 or 2 and R^{11} is halo.

In certain embodiments of any of formulas II, IIa and IIb, p is 1 or 2 and R^{11} is fluoro.

In certain embodiments of any of formulas II, IIa and IIb, p is 1 and R^{11} is fluoro.

15 In certain embodiments of any of formulas II, IIa and IIb, p is 1 and R^{11} is fluoro at the 4-position.

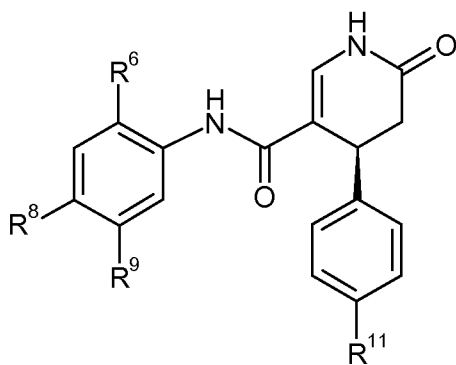
In certain embodiments, the compounds of formula I may be more specifically of formula III:



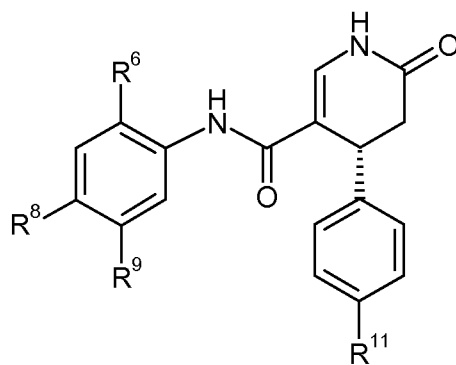
wherein R^6 , R^8 , R^9 and R^{11} are as defined herein.

20 In certain embodiments of formula III, the subject compounds may be more specifically of formula IIIa or formula IIIb;

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IIIa;



IIIb;

wherein R⁶, R⁸, R⁹ and R¹¹ are as defined herein.

In certain embodiments, the subject compounds are of formula IIIa.

In certain embodiments, the subject compounds are of formula IIIb.

5 In certain embodiments of any of formulas III, IIIa and IIIb, R⁶ is: halo; methyl; or ethyl.

In certain embodiments of any of formulas III, IIIa and IIIb, R⁶ is methyl.

In certain embodiments of any of formulas III, IIIa and IIIb, R⁶ is ethyl.

In certain embodiments of any of formulas III, IIIa and IIIb, R⁸ and R⁹ each independently is: fluoro; chloro; bromo; iodo; methyl; ethyl; methoxy; ethoxy; trifluoromethyl;

10 difluoromethoxy; methanesulfonyl; nitrile; methoxyethoxy; hydroxyethoxy; hydroxymethyl; hydroxyethyl; hydroxypropoxy;

In certain embodiments of any of formulas III, IIIa and IIIb, R⁸ is: methoxy; halo; methyl; or difluoromethoxy.

In certain embodiments of any of formulas III, IIIa and IIIb, R⁹ is: methoxy; 2-hydroxy-

15 ethoxy; 2-methoxy-ethoxy; or 1-hydroxy-ethyl.

In certain embodiments of any of formulas III, IIIa and IIIb, R⁶ is: bromo; or methyl;

In certain embodiments of any of formulas III, IIIa and IIIb, R⁸ is: methoxy; chloro; fluoro; methyl; or difluoromethoxy.

In certain embodiments of any of formulas III, IIIa and IIIb, R⁹ is: methoxy; 2-hydroxy-

20 ethoxy; 2-methoxy-ethoxy; or 1-hydroxy-ethyl.

In certain embodiments of any of formulas III, IIIa and IIIb, R¹¹ is halo.

In certain embodiments of any of formulas III, IIIa and IIIb, R¹¹ is fluoro.

Where any of R¹, R², R³, R⁴, R⁵, R⁶, R⁷, R⁸, R⁹, R¹⁰ or R¹¹ is alkyl or contains an alkyl moiety, such alkyl is preferably lower alkyl, i.e. C₁-C₆alkyl, and in many embodiments is C₁-C₄alkyl.

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The invention also provides methods for treating a disease or condition mediated by or otherwise associated with a P2X₇ receptor, the method comprising administering to a subject in need thereof an effective amount of a compound of the invention.

The invention also provides methods for treating an inflammatory, respiratory or diabetes
 5 condition, the method comprising administering to a subject in need thereof an effective amount of a compound of the invention together with an effective amount of a P2X₃ inhibitor. The disease may be an inflammatory disease such as arthritis, and more particularly
 rheumatoid arthritis, osteoarthritis, psoriasis, allergic dermatitis, asthma, chronic obstructive
 pulmonary disease, airways hyper-responsiveness, septic shock, glomerulonephritis, irritable
 10 bowel disease, and Crohn's disease.

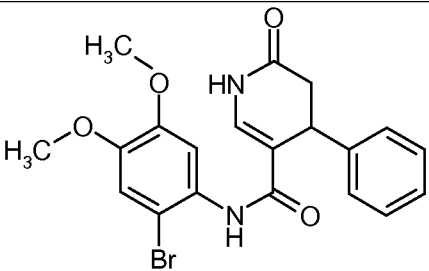
The disease may be a pain condition, such as inflammatory pain; surgical pain; visceral pain;
 dental pain; premenstrual pain; central pain; pain due to burns; migraine or cluster headaches;
 nerve injury; neuritis; neuralgias; poisoning; ischemic injury; interstitial cystitis; cancer pain;
 viral, parasitic or bacterial infection; post-traumatic injury; or pain associated with irritable
 15 bowel syndrome.

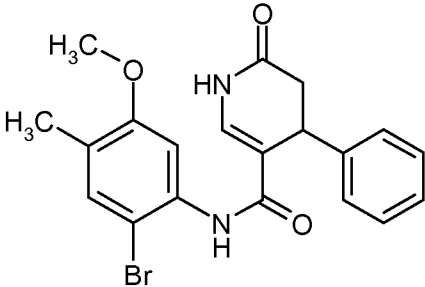
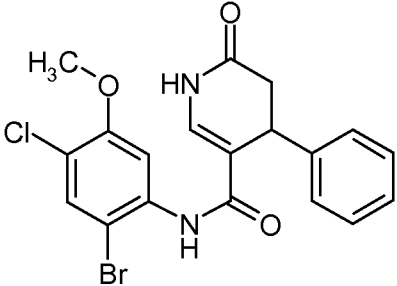
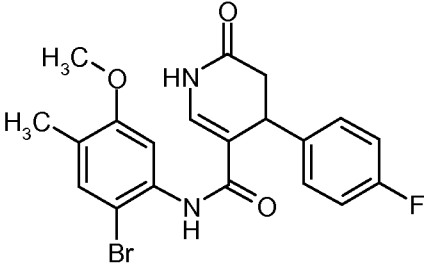
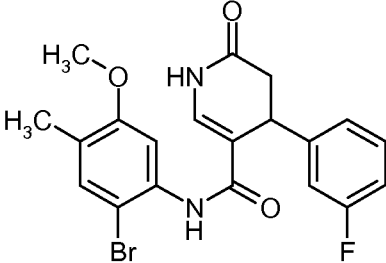
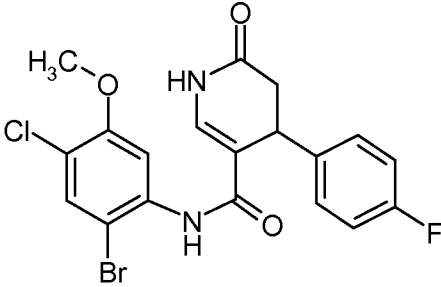
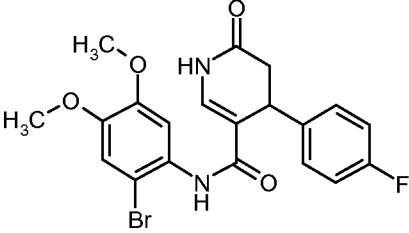
The disease may be a respiratory disorder, such as chronic obstructive pulmonary disorder (COPD), asthma, or bronchospasm, or a gastrointestinal (GI) disorder such as Irritable Bowel Syndrome (IBS), Inflammatory Bowel Disease (IBD), biliary colic and other biliary disorders, renal colic, diarrhea-dominant IBS, pain associated with GI distension.

20 The disease may be diabetes.

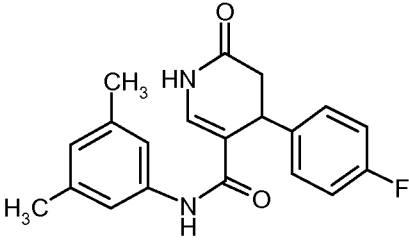
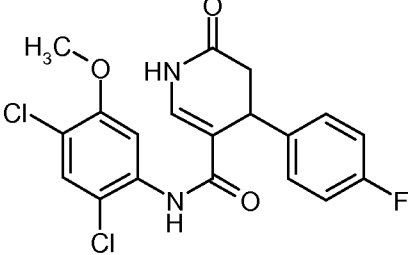
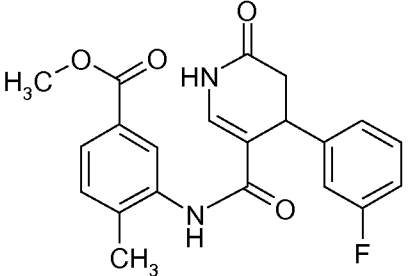
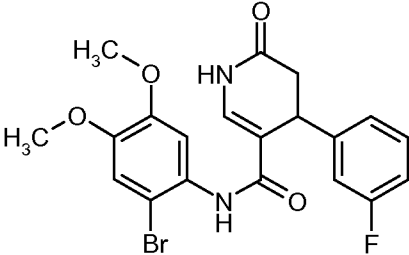
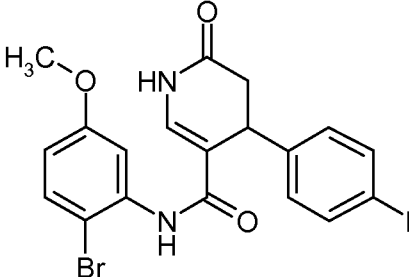
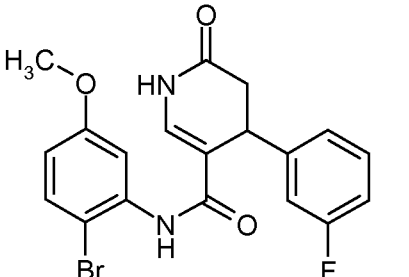
Representative compounds in accordance with the methods of the invention are shown in Table 1.

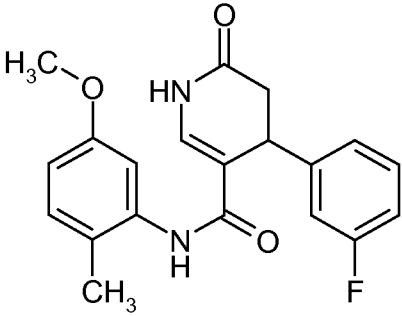
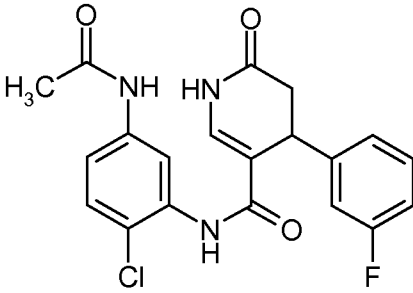
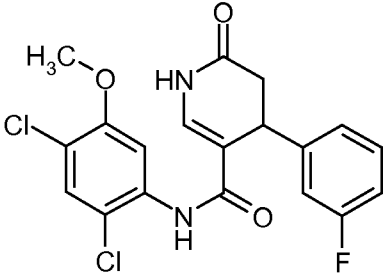
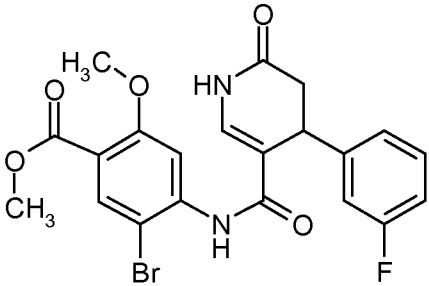
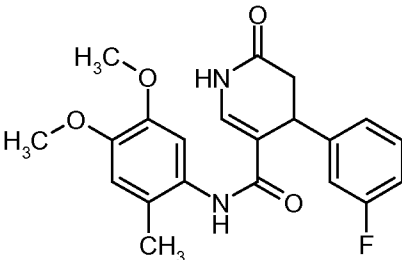
TABLE 1

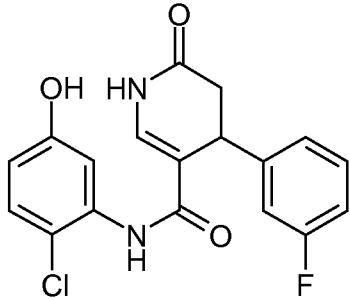
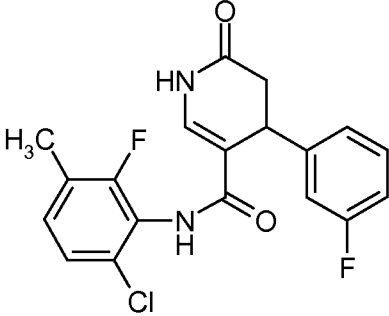
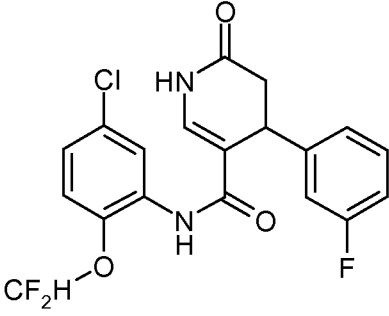
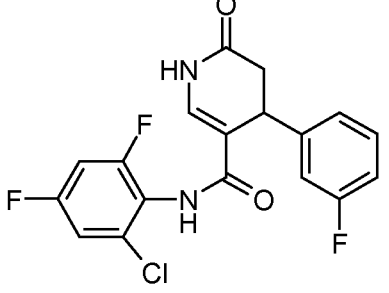
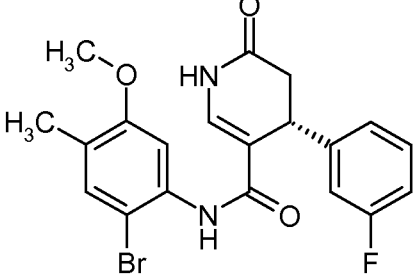
#	Structure	Name	pKi
1		6-Oxo-4-phenyl-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-bromo-4,5-dimethoxy-phenyl)-amide	7.4925

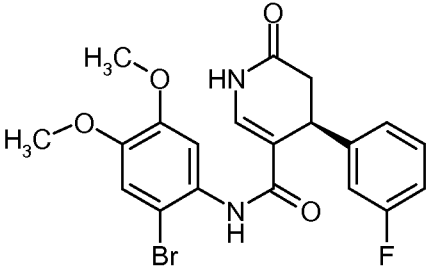
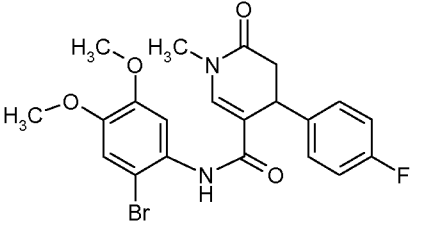
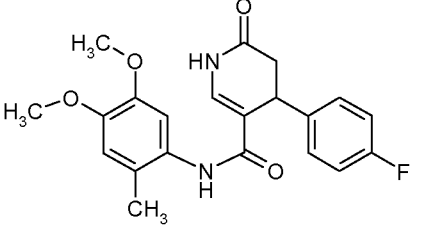
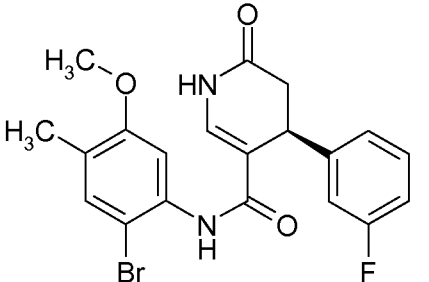
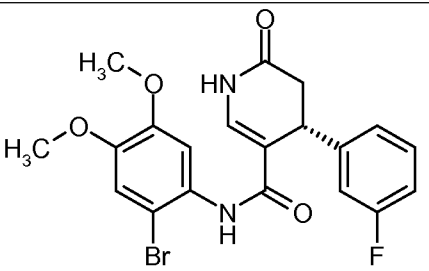
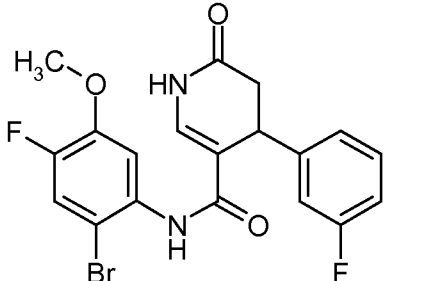
2		6-Oxo-4-phenyl-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-bromo-5-methoxy-4-methyl-phenyl)-amide	6.595
3		6-Oxo-4-phenyl-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-bromo-4-chloro-5-methoxy-phenyl)-amide	5.95
4		4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-bromo-5-methoxy-4-methyl-phenyl)-amide	6.6
5		4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-bromo-5-methoxy-4-methyl-phenyl)-amide	6.726
6		4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-bromo-4-chloro-5-methoxy-phenyl)-amide	6.166
7		4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-bromo-4,5-dimethoxy-phenyl)-amide	7.463

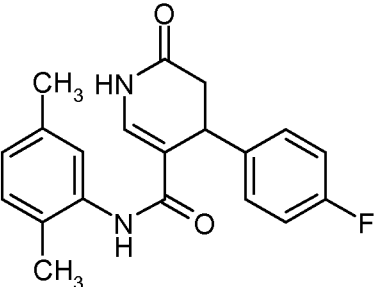
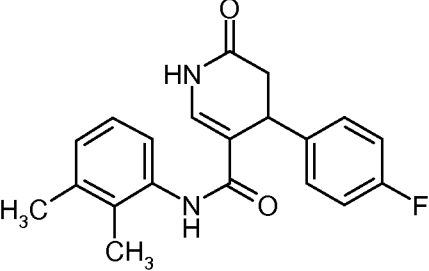
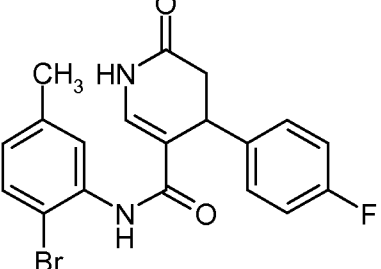
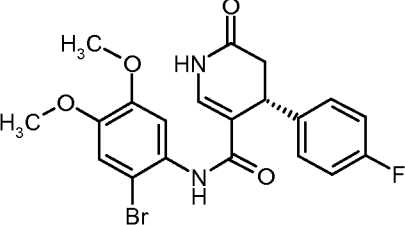
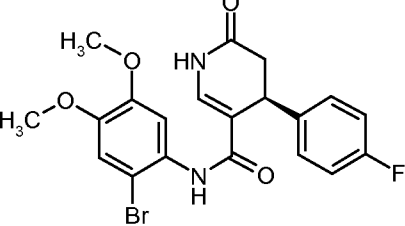
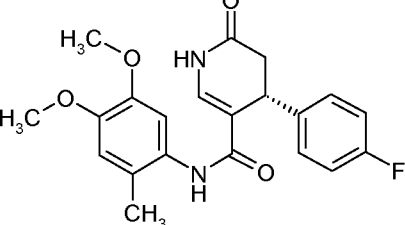
8		4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (3,4-dimethoxy-phenyl)-amide	5.465
9		4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-bromo-4-chloro-5-methoxy-phenyl)-amide	6.766
10		4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (4-chloro-3-methoxy-phenyl)-amide	5.543
11		4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (3-methoxy-4-methyl-phenyl)-amide	6.03
12		(R)-6-Oxo-4-phenyl-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-bromo-4,5-dimethoxy-phenyl)-amide	6.155
13		(S)-6-Oxo-4-phenyl-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-bromo-4,5-dimethoxy-phenyl)-amide	7.455

14		4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (3,5-dimethyl-phenyl)-amide	6.535
15		4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2,4-dichloro-5-methoxy-phenyl)-amide	6.22
16		3-{[4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carbonyl]-amino}-4-methyl-benzoic acid methyl ester	6.43
17		4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-bromo-4,5-dimethoxy-phenyl)-amide	6.77
18		4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-bromo-5-methoxy-phenyl)-amide	6.08
19		4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-bromo-5-methoxy-phenyl)-amide	6.19

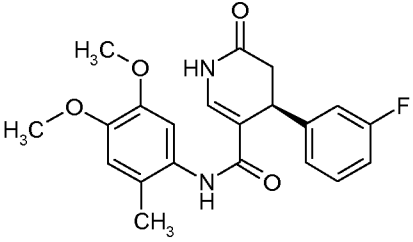
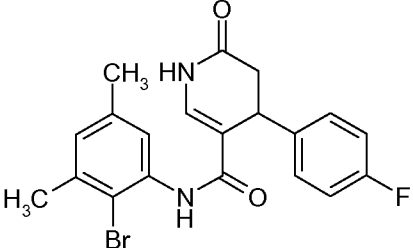
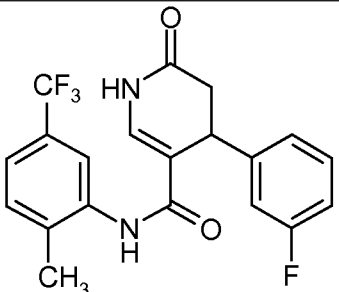
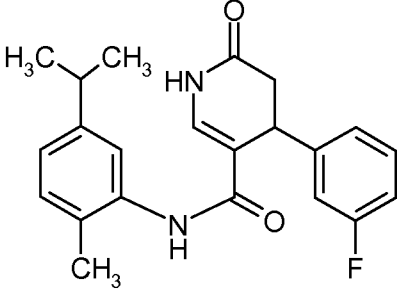
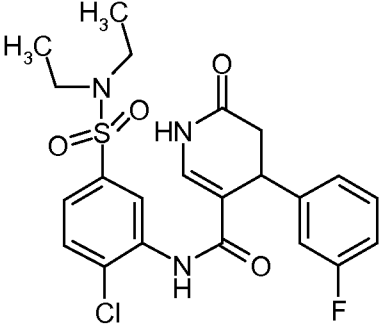
20		4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (5-methoxy-2-methyl-phenyl)-amide	6.815
21		4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (5-acetylamino-2-chloro-phenyl)-amide	6.02
22		4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2,4-dichloro-5-methoxy-phenyl)-amide	6.12
23		5-Bromo-4- {[4-(3-fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carbonyl]-amino} -2-methoxybenzoic acid methyl ester	5.92
24		4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (4,5-dimethoxy-2-methyl-phenyl)-amide	7.69

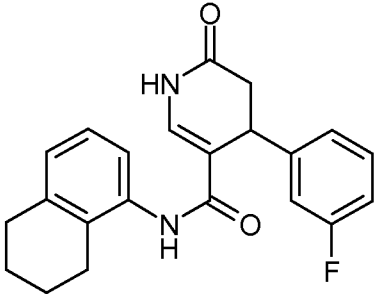
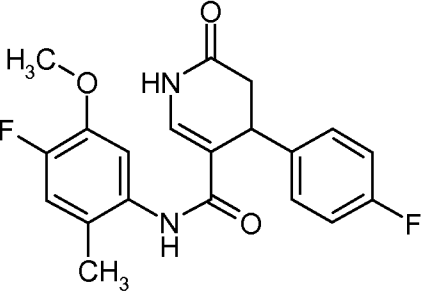
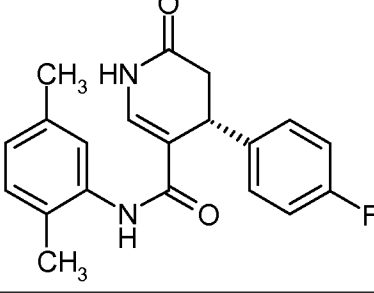
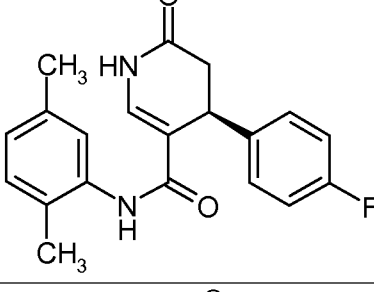
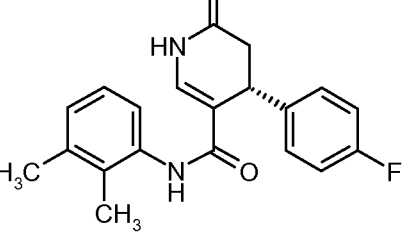
25		4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-chloro-5-hydroxy-phenyl)-amide	5.395
26		4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (6-chloro-2-fluoro-3-methyl-phenyl)-amide	5.73
27		4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (5-chloro-2-difluoromethoxy-phenyl)-amide	5.18
28		4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-chloro-4,6-difluoro-phenyl)-amide	5.215
29		(R)-4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-bromo-5-methoxy-4-methyl-phenyl)-amide	6.405

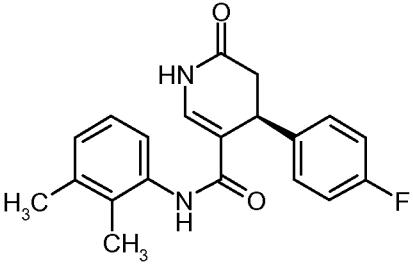
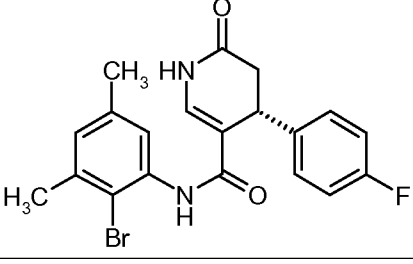
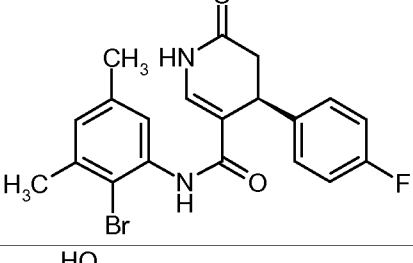
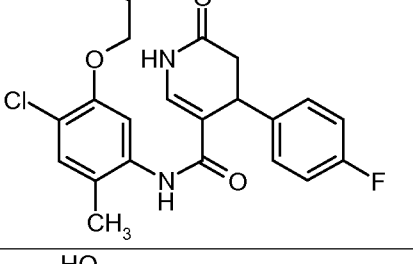
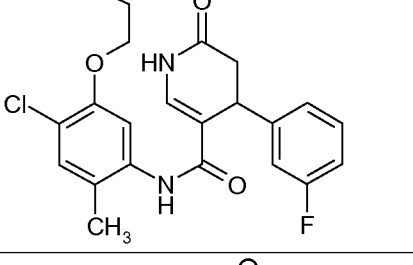
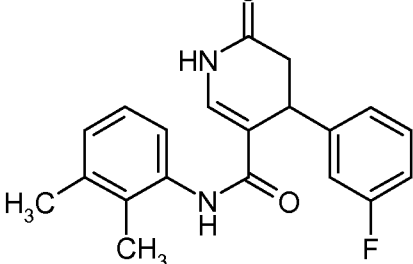
30		(S)-4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-bromo-4,5-dimethoxy-phenyl)-amide	8.045
31		4-(4-Fluoro-phenyl)-1-methyl-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-bromo-4,5-dimethoxy-phenyl)-amide	6.525
32		4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (4,5-dimethoxy-2-methyl-phenyl)-amide	7.98
33		(S)-4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-bromo-5-methoxy-4-methyl-phenyl)-amide	7.195
34		(R)-4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-bromo-4,5-dimethoxy-phenyl)-amide	6.9783
35		4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-bromo-4-fluoro-5-methoxy-phenyl)-amide	6.65

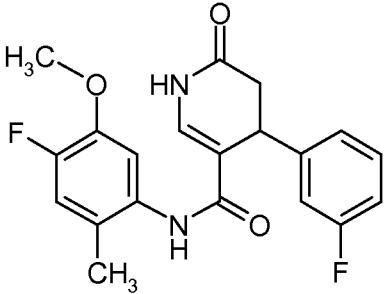
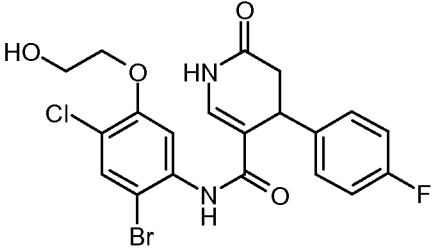
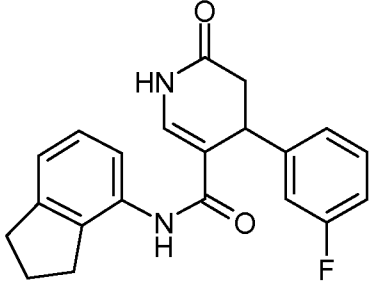
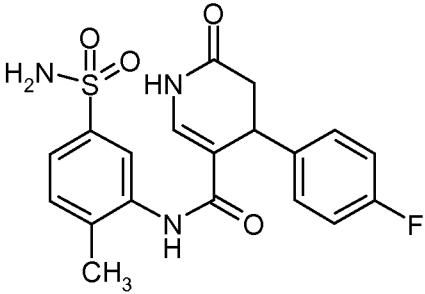
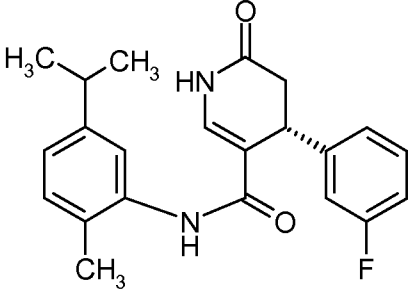
36		4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2,5-dimethyl-phenyl)-amide	6.93
37		4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2,3-dimethyl-phenyl)-amide	7.12
38		4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-bromo-5-methyl-phenyl)-amide	6.87
39		(R)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-bromo-4,5-dimethoxy-phenyl)-amide	6.99
40		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-bromo-4,5-dimethoxy-phenyl)-amide	7.895
41		(R)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (4,5-dimethoxy-2-methyl-phenyl)-amide	7.225

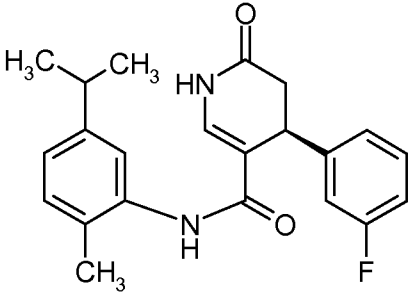
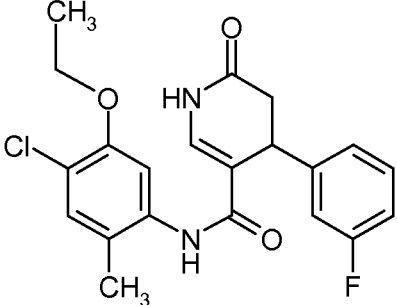
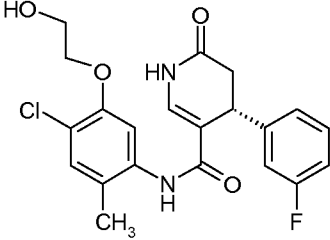
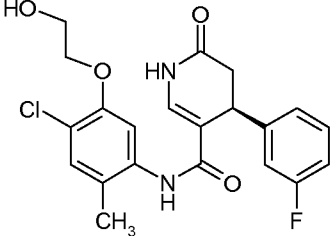
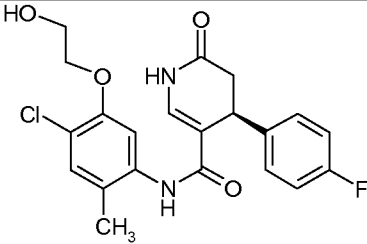
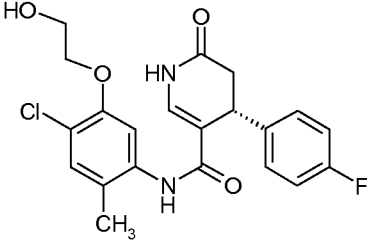
42		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (4,5-dimethoxy-2-methyl-phenyl)-amide	7.993
43		(R)-4-(4-Fluoro-phenyl)-1-methyl-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-bromo-4,5-dimethoxy-phenyl)-amide	7.12
44		(S)-4-(4-Fluoro-phenyl)-1-methyl-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-bromo-4,5-dimethoxy-phenyl)-amide	5.875
45		(R)-4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (5-methoxy-2-methyl-phenyl)-amide	6.765
46		(S)-4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (5-methoxy-2-methyl-phenyl)-amide	7.695
47		(R)-4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (4,5-dimethoxy-2-methyl-phenyl)-amide	6.803

48		(S)-4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (4,5-dimethoxy-2-methyl-phenyl)-amide	7.7225
49		4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-bromo-3,5-dimethyl-phenyl)-amide	7.48
50		4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-methyl-5-trifluoromethyl-phenyl)-amide	6.89
51		4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (5-isopropyl-2-methyl-phenyl)-amide	7.445
52		4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-chloro-5-diethylsulfamoyl-phenyl)-amide	6.02

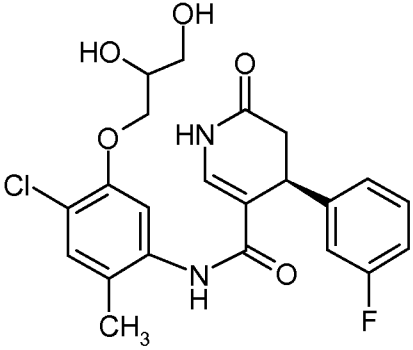
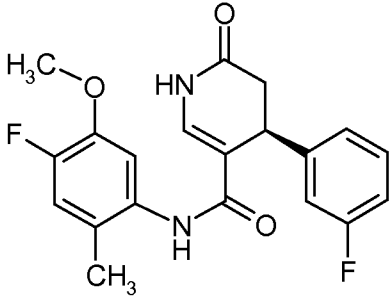
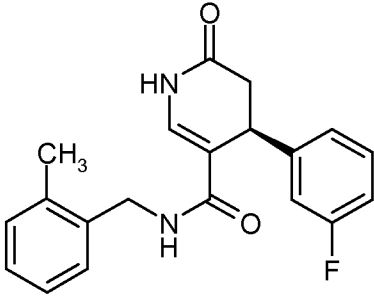
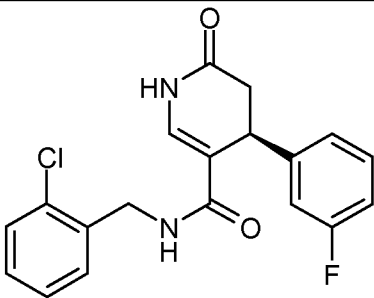
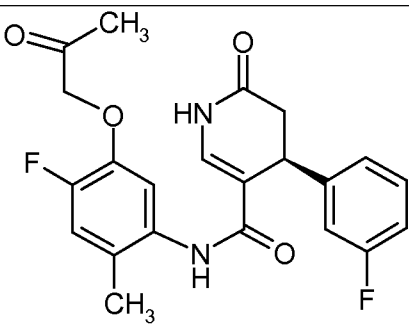
53		4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (5,6,7,8-tetrahydro-naphthalen-1-yl)-amide	6.83
54		4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (4-fluoro-5-methoxy-2-methyl-phenyl)-amide	7.02
55		(R)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2,5-dimethyl-phenyl)-amide	7.535
56		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2,5-dimethyl-phenyl)-amide	6.56
57		(R)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2,3-dimethyl-phenyl)-amide	7.405

58		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2,3-dimethyl-phenyl)-amide	6.785
59		(R)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-bromo-3,5-dimethyl-phenyl)-amide	7.57
60		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-bromo-3,5-dimethyl-phenyl)-amide	6.86
61		4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [4-chloro-5-(2-hydroxy-ethoxy)-2-methyl-phenyl]-amide	7.755
62		4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [4-chloro-5-(2-hydroxy-ethoxy)-2-methyl-phenyl]-amide	7.595
63		4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2,3-dimethyl-phenyl)-amide	7.405

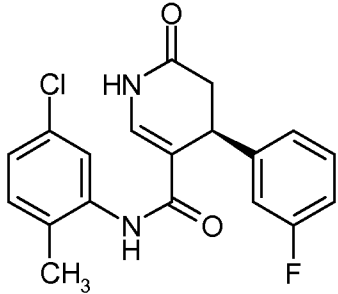
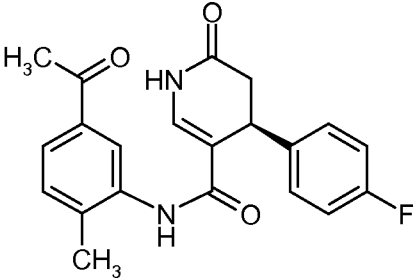
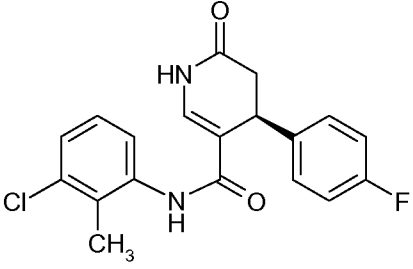
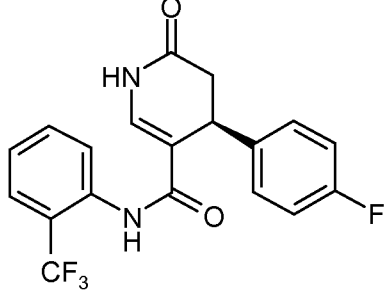
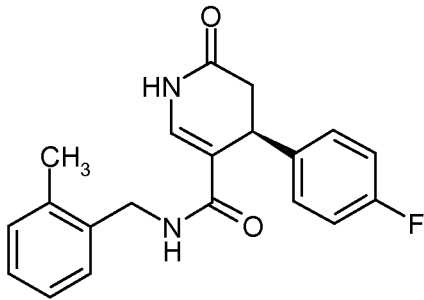
64		4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (4-fluoro-5-methoxy-2-methyl-phenyl)-amide	8.17
65		4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [2-bromo-4-chloro-5-(2-hydroxy-ethoxy)-phenyl]-amide	6.7
66		4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid indan-4-ylamide	6.915
67		4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-methyl-5-sulfamoyl-phenyl)-amide	5.515
68		(R)-4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (5-isopropyl-2-methyl-phenyl)-amide	7.505

69		(S)-4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (5-isopropyl-2-methyl-phenyl)-amide	7.01
70		4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (4-chloro-5-ethoxy-2-methyl-phenyl)-amide	7.425
71		(R)-4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [4-chloro-5-(2-hydroxy-ethoxy)-2-methyl-phenyl]-amide	6.815
72		(S)-4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [4-chloro-5-(2-hydroxy-ethoxy)-2-methyl-phenyl]-amide	7.8375
73		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [4-chloro-5-(2-hydroxy-ethoxy)-2-methyl-phenyl]-amide	7.63
74		(R)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [4-chloro-5-(2-hydroxy-ethoxy)-2-methyl-phenyl]-amide	6.63

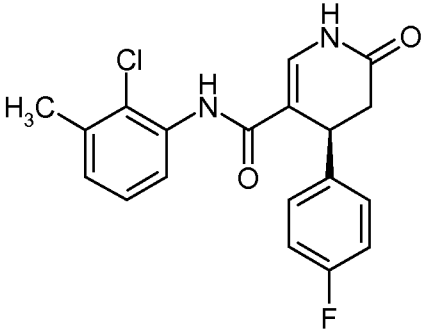
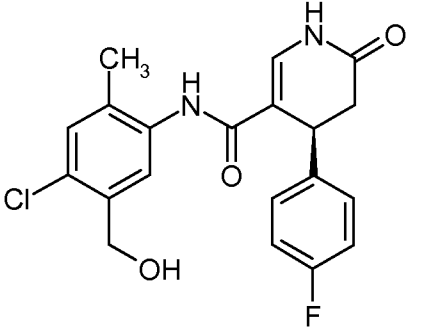
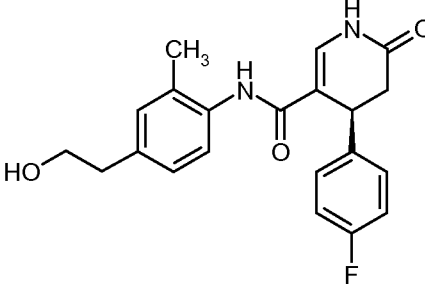
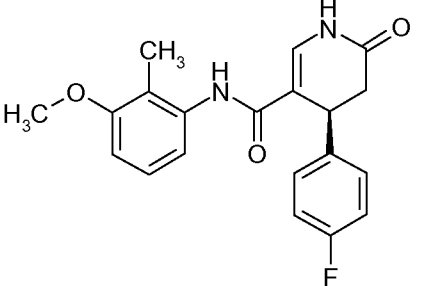
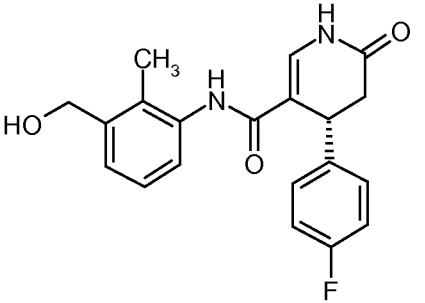
75		(R)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [2-bromo-4-chloro-5-(2-hydroxyethoxy)-phenyl]-amide	6.245
76		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [2-bromo-4-chloro-5-(2-hydroxyethoxy)-phenyl]-amide	7.063
77		4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [4-chloro-5-(2-hydroxypropoxy)-2-methylphenyl]-amide	7.375
78		(S)-4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [2-bromo-4-chloro-5-(2-hydroxyethoxy)-phenyl]-amide	7.695
79		4-(4-Fluoro-phenyl)-1-(2-hydroxy-ethyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (4,5-dimethoxy-2-methyl-phenyl)-amide	7.42
80		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [5-(1-hydroxy-ethyl)-2-methyl-phenyl]-amide	7.59

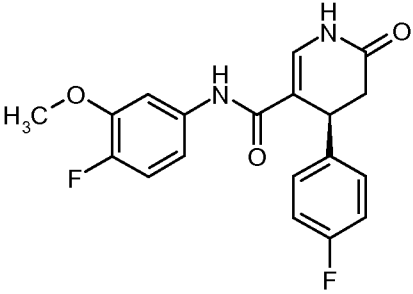
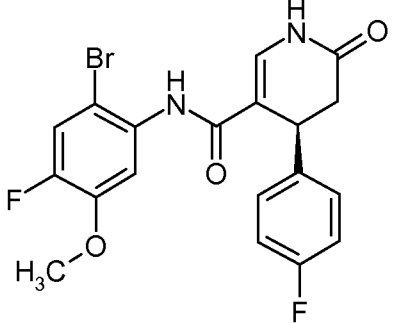
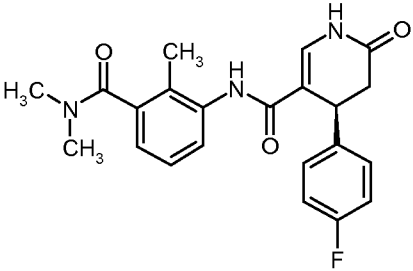
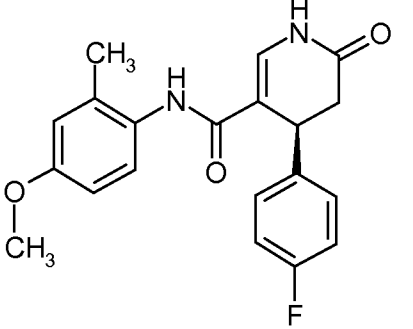
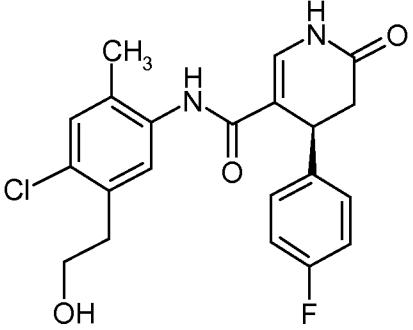
81		(S)-4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydropyridine-3-carboxylic acid [4-chloro-5-(2,3-dihydroxypropoxy)-2-methyl-phenyl]-amide	5.76
82		(S)-4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydropyridine-3-carboxylic acid (4-fluoro-5-methoxy-2-methyl-phenyl)-amide	7.975
83		(S)-4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydropyridine-3-carboxylic acid 2-methyl-benzylamide	6.17
84		(S)-4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydropyridine-3-carboxylic acid 2-chloro-benzylamide	6.365
85		(S)-4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydropyridine-3-carboxylic acid [4-fluoro-2-methyl-5-(2-oxo-propoxy)-phenyl]-amide	6.705

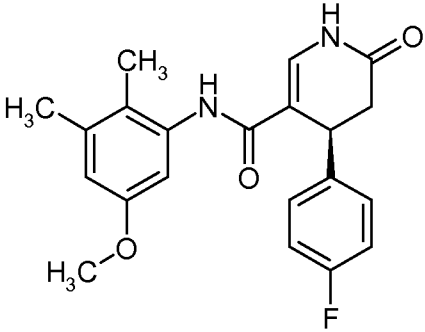
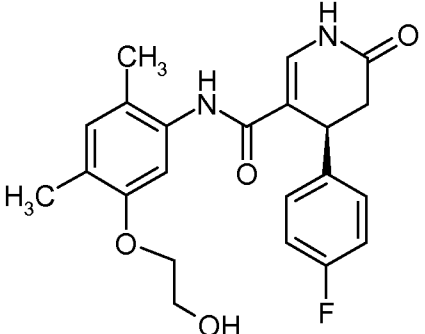
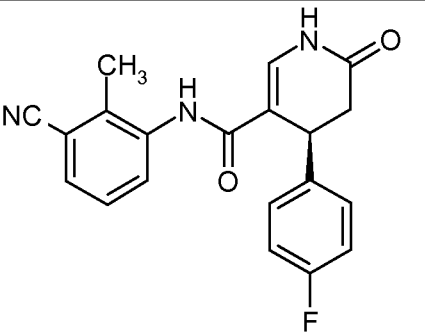
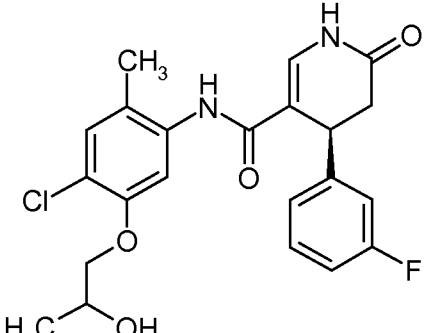
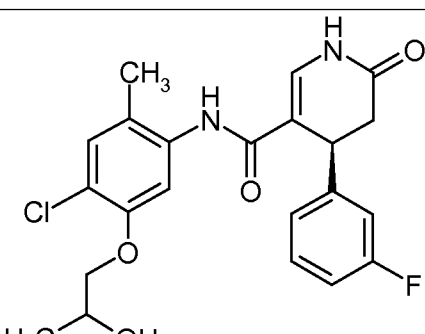
86		(S)-4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [4-fluoro-5-(2-hydroxy-propoxy)-2-methyl-phenyl]-amide	7.27
87		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (3-fluoro-2-methyl-phenyl)-amide	6.63
88		(S)-4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (3-chloro-2-methyl-phenyl)-amide	7.915
89		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [5-((R)-1-hydroxy-ethyl)-2-methyl-phenyl]-amide	7.443
90		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [5-((S)-1-hydroxy-ethyl)-2-methyl-phenyl]-amide	7.19
91		4-(4-Fluoro-phenyl)-1,5-dimethyl-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (4,5-dimethoxy-2-methyl-phenyl)-amide	5.65

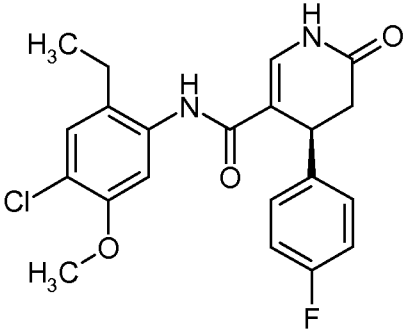
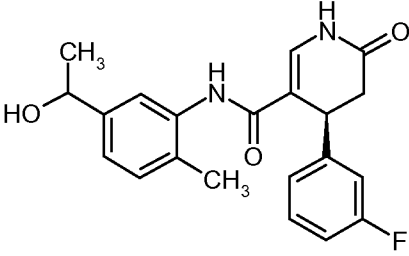
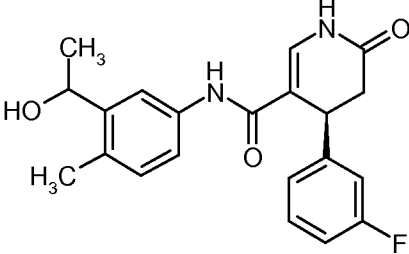
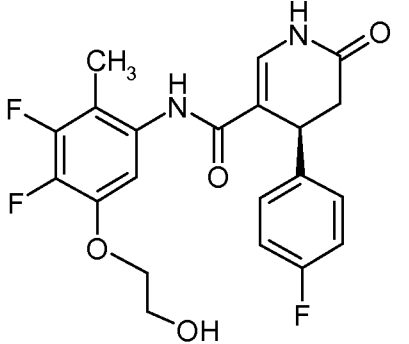
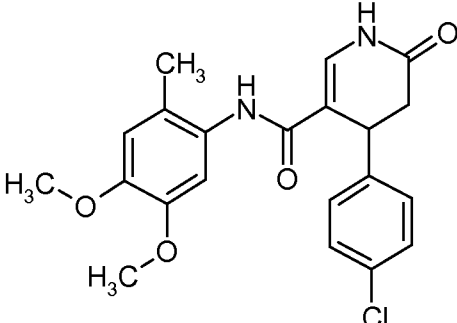
92		(S)-4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (5-chloro-2-methyl-phenyl)-amide	6.995
93		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (5-acetyl-2-methyl-phenyl)-amide	6.86
94		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (3-chloro-2-methyl-phenyl)-amide	7.83
95		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-trifluoromethyl-phenyl)-amide	6.26
96		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid 2-methyl-benzylamide	5.975

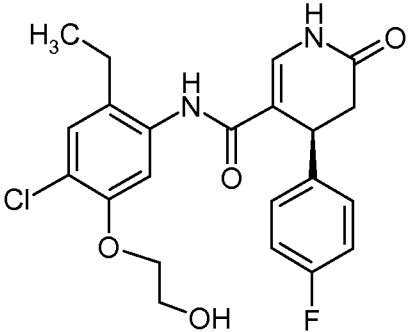
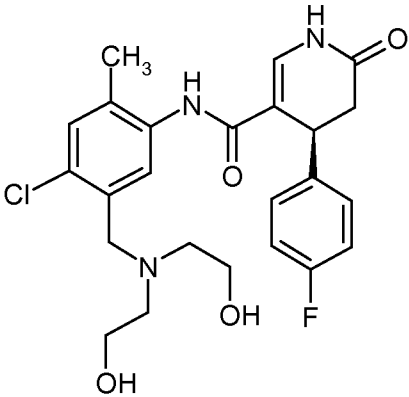
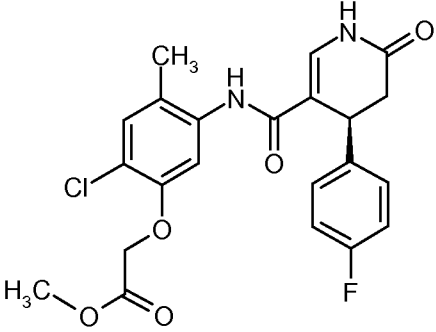
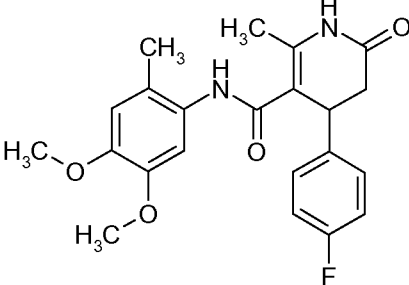
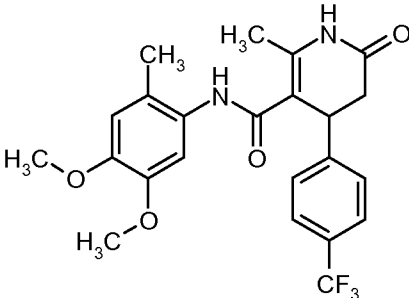
97		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid 2-chloro-benzylamide	6.16
98		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (3-hydroxymethyl-2-methyl-phenyl)-amide	6.93
99		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-methyl-5-trifluoromethoxy-phenyl)-amide	6.755
100		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [3-(2-hydroxy-ethyl)-2-methyl-phenyl]-amide	6.803
101		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid o-tolylamide	6.415
102		4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-ethyl-3-methoxy-phenyl)-amide	7.316

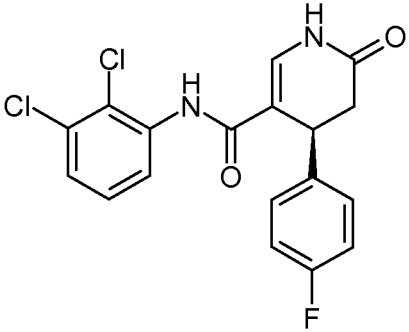
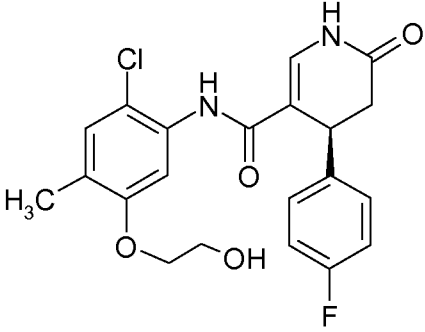
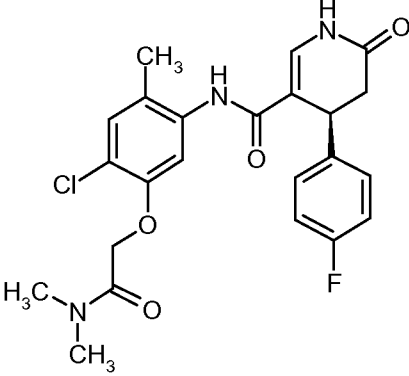
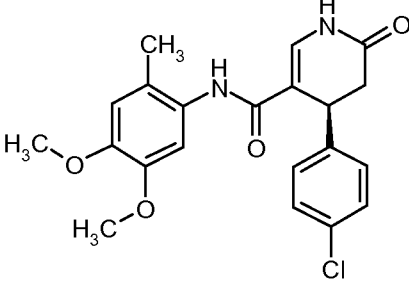
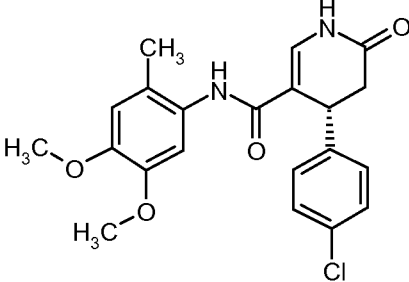
103		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-chloro-3-methyl-phenyl)-amide	7.44
104		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (4-chloro-5-hydroxymethyl-2-methyl-phenyl)-amide	7.21
105		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [4-(2-hydroxy-ethyl)-2-methyl-phenyl]-amide	6.77
106		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (3-methoxy-2-methyl-phenyl)-amide	7.375
107		(R)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (3-hydroxymethyl-2-methyl-phenyl)-amide	5.36

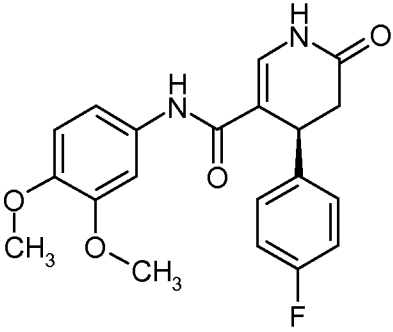
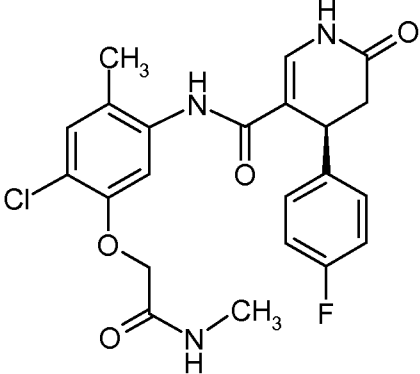
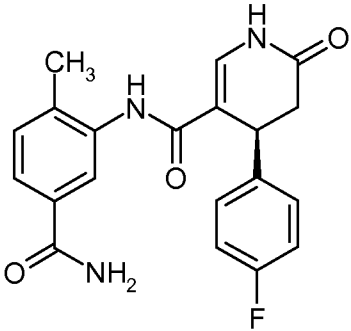
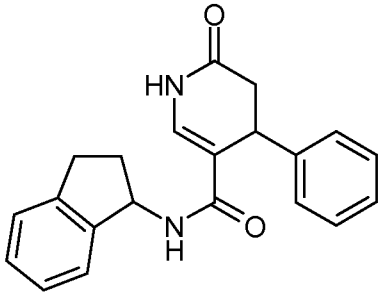
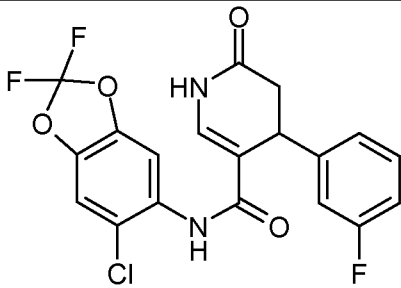
108		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydropyridine-3-carboxylic acid (4-fluoro-3-methoxy-phenyl)-amide	6.11
109		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydropyridine-3-carboxylic acid (2-bromo-4-fluoro-5-methoxy-phenyl)-amide	7.15
110		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydropyridine-3-carboxylic acid (3-dimethylcarbamoyl-2-methyl-phenyl)-amide	5.43
111		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydropyridine-3-carboxylic acid (4-methoxy-2-methyl-phenyl)-amide	6.5
112		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydropyridine-3-carboxylic acid [4-chloro-5-(2-hydroxy-ethyl)-2-methyl-phenyl]-amide	7.52

113		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (5-methoxy-2,3-dimethyl-phenyl)-amide	8.035
114		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [5-(2-hydroxy-ethoxy)-2,4-dimethyl-phenyl]-amide	7.815
115		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (3-cyano-2-methyl-phenyl)-amide	5.815
116		(S)-4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [4-chloro-5-(2-hydroxy-propoxy)-2-methyl-phenyl]-amide	7.21
117		(S)-4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [4-chloro-5-(2-hydroxy-propoxy)-2-methyl-phenyl]-amide	7.06

118		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (4-chloro-2-ethyl-5-methoxy-phenyl)-amide	7.075
119		(S)-4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [5-(1-hydroxy-ethyl)-2-methyl-phenyl]-amide	7.2
120		(S)-4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [3-(1-hydroxy-ethyl)-4-methyl-phenyl]-amide	6.635
121		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [3,4-difluoro-5-(2-hydroxy-ethoxy)-2-methyl-phenyl]-amide	7.41
122		4-(4-Chloro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (4,5-dimethoxy-2-methyl-phenyl)-amide	6.465

123		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [4-chloro-2-ethyl-5-(2-hydroxyethoxy)-phenyl]-amide	7.293
124		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (5-[[bis-(2-hydroxyethyl)-amino]-methyl]-4-chloro-2-methyl-phenyl)-amide	6.75
125		(2-Chloro-5-[(S)-4-(4-fluorophenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxyl]-amino)-4-methyl-phenoxy)-acetic acid methyl ester	7.645
126		4-(4-Fluoro-phenyl)-2-methyl-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (4,5-dimethoxy-2-methyl-phenyl)-amide	6.48
127		2-Methyl-6-oxo-4-(4-trifluoromethyl-phenyl)-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (4,5-dimethoxy-2-methyl-phenyl)-amide	5.055

128		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2,3-dichloro-phenyl)-amide	6.75
129		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [2-chloro-5-(2-hydroxy-ethoxy)-4-methyl-phenyl]-amide	7.265
130		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (4-chloro-5-dimethylcarbamoylmethoxy-2-methyl-phenyl)-amide	7.2767
131		(S)-4-(4-Chloro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (4,5-dimethoxy-2-methyl-phenyl)-amide	6.165
132		(R)-4-(4-Chloro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (4,5-dimethoxy-2-methyl-phenyl)-amide	6.38

133		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (3,4-dimethoxy-phenyl)-amide	6.04
134		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (4-chloro-2-methyl-5-methylcarbamoylmethoxy-phenyl)-amide	6.24
135		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (5-carbamoyl-2-methyl-phenyl)-amide	5.8767
136		6-Oxo-4-phenyl-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid indan-1-ylamide	5.412
137		4-(3-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (6-chloro-2,2-difluoro-benzo[1,3]dioxol-5-yl)-amide	4.98

138		4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (7-bromo-2,3-dihydro-benzo[1,4]dioxin-6-yl)-amide	6.69
139		4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (6-chloro-2,2-difluoro-benzo[1,3]dioxol-5-yl)-amide	5.46
140		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (7-methyl-2,3-dihydro-benzo[1,4]dioxin-6-yl)-amide	6.94
141		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [4-fluoro-5-(2-hydroxy-ethoxy)-2-methyl-phenyl]-amide	7.285
142		(S)-4-(4-Fluoro-phenyl)-1-methyl-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [4-chloro-5-(2-hydroxy-ethoxy)-2-methyl-phenyl]-amide	6.835

143		(S)-4-(4-Fluoro-phenyl)-1-methyl-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [4-fluoro-5-(2-hydroxy-ethoxy)-2-methyl-phenyl]-amide	6.535
144		(S)-1-Ethyl-4-(4-fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (4,5-dimethoxy-2-methyl-phenyl)-amide	7.06
145		(3-([(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carbonyl]-amino}-4-methyl-phenyl)-acetic acid ethyl ester	6.55
146		(S)-4-(4-Fluoro-phenyl)-1-(2-hydroxy-ethyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (4,5-dimethoxy-2-methyl-phenyl)-amide	7.71
147		(S)-4-(4-Fluoro-phenyl)-1-methyl-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [4-chloro-5-((S)-2-hydroxy-3-methoxy-propoxy)-2-methyl-phenyl]-amide	5.85

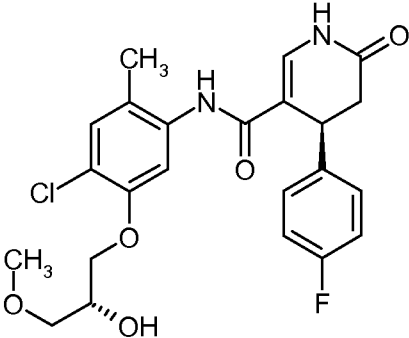
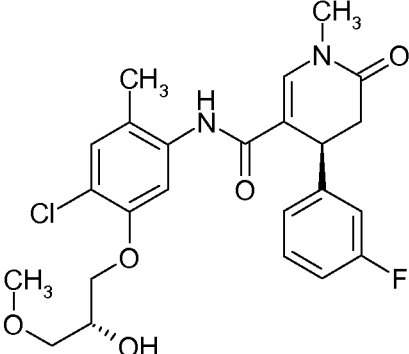
148		(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [4-chloro-5-((S)-2-hydroxy-3-methoxy-propoxy)-2-methyl-phenyl]-amide	6.49
149		(S)-4-(3-Fluoro-phenyl)-1-methyl-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [4-chloro-5-((S)-2-hydroxy-3-methoxy-propoxy)-2-methyl-phenyl]-amide	6.035

TABLE 1

Synthesis

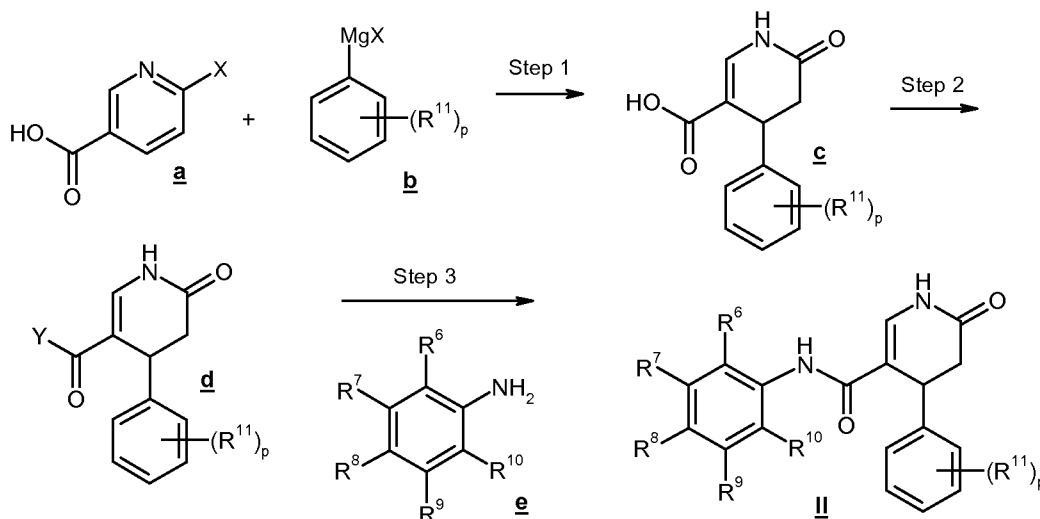
Compounds of the present invention can be made by a variety of methods depicted in the illustrative synthetic reaction schemes shown and described below.

- 5 The starting materials and reagents used in preparing these compounds generally are either available from commercial suppliers, such as Aldrich Chemical Co., or are prepared by methods known to those skilled in the art following procedures set forth in references such as *Fieser and Fieser's Reagents for Organic Synthesis*; Wiley & Sons: New York, **1991**, Volumes 1-15; *Rodd's Chemistry of Carbon Compounds*, Elsevier Science Publishers, 1989,
- 10 Volumes 1-5 and Supplementals; and *Organic Reactions*, Wiley & Sons: New York, **1991**, Volumes 1-40. The following synthetic reaction schemes are merely illustrative of some methods by which the compounds of the present invention can be synthesized, and various modifications to these synthetic reaction schemes can be made and will be suggested to one skilled in the art having referred to the disclosure contained in this Application.
- 15 The starting materials and the intermediates of the synthetic reaction schemes can be isolated and purified if desired using conventional techniques, including but not limited to, filtration, distillation, crystallization, chromatography, and the like. Such materials can be characterized using conventional means, including physical constants and spectral data. Unless specified to the contrary, the reactions described herein preferably are conducted
- 20 under an inert atmosphere at atmospheric pressure at a reaction temperature range of from

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about -78 °C to about 150 °C, more preferably from about 0 °C to about 125 °C, and most preferably and conveniently at about room (or ambient) temperature, e.g., about 20 °C.

Scheme A below illustrates one synthetic procedure usable to prepare specific compounds of formula I, wherein X is halo and may be the same or different upon each occurrence, Y is a leaving group, and R⁶, R⁷, R⁸, R⁹, R¹⁰ and R¹¹ are as defined herein.



SCHEME A

- In step 1 of Scheme A, a Grignard reaction is carried out wherein nicotinic acid compound **a** is reacted with phenyl magnesium halide compound **b** to afford, after hydrolysis, a phenyl dihydropyridone carboxylic acid compound **c**. In many embodiments, for example, commercially available 6-chloro-nicotinic acid may be used for compound **a**. Numerous phenyl magnesium bromide compounds are readily prepared by well known techniques and may be used for compound **b**.
- In step 2, dihydropyridone compound **c** is optionally modified to introduce a leaving group Y to the acyl moiety of compound **d**. Carboxylic acid derivative compound **d** may comprise, for example, a carboxylic acid halide, a carboxylate ester or a carboxylic acid anhydride, depending upon the nature of leaving group Y. In many embodiments Y is halo such as chloro, such that compound **d** may be prepared by treatment of carboxylic acid compound **c** with oxalyl chloride, thionyl chloride, or like halogenating agent.
- In step 3, an amide coupling reaction is carried out wherein an aniline compound **e** is reacted with compound **d**, to afford dihydropyridoneamide compound II, which is a compound of formula I in accordance with the invention. Numerous aniline compounds **e** are commercially available or are readily prepared using synthetic procedures well known in the

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art. Such aniline compounds may in many embodiments be made by reduction of the corresponding aryl nitro compounds, as illustrated in the experimental examples below. In the procedure of Scheme A, aniline compound **a** is shown as a substituted phenyl compound. Other aryl amines such as naphthylamines may be used as well with the invention.

- 5 Many variations on the procedure of Scheme A are possible and will suggest themselves to those skilled in the art. For example, in certain embodiments step 2 may be omitted, and other amide coupling reaction procedures using EDCI, HATU, BOP, PyBOP or the like, may be used in step 3. Specific details for producing compounds of the invention are described in the Examples section below.

10 Utility

The compounds of the invention are usable for the treatment of a wide range of inflammatory diseases and conditions such as arthritis, including but not limited to, rheumatoid arthritis, spondyloarthropathies, gouty arthritis, osteoarthritis, systemic lupus erythematosus and juvenile arthritis, osteoarthritis, gouty arthritis and other arthritic conditions. The subject
15 compounds would be useful for the treatment of pulmonary disorders or lung inflammation, including adult respiratory distress syndrome, pulmonary sarcoidosis, asthma, silicosis, and chronic pulmonary inflammatory disease.

The compounds of the invention are also expected to find utility as analgesics in the treatment of diseases and conditions associated with pain from a wide variety of causes,
20 including, but not limited to, inflammatory pain such as pain associated with arthritis (including rheumatoid arthritis and osteoarthritis), surgical pain, visceral pain, dental pain, premenstrual pain, central pain, pain due to burns, migraine or cluster headaches, nerve injury, neuritis, neuralgias, poisoning, ischemic injury, interstitial cystitis, cancer pain, viral, parasitic or bacterial infection, post-traumatic injuries (including fractures and sports injuries),
25 and pain associated with functional bowel disorders such as irritable bowel syndrome.

Further, compounds of the invention are useful for treating respiratory disorders, including chronic obstructive pulmonary disorder (COPD), asthma, bronchospasm, and the like. Additionally, compounds of the invention are useful for treating gastrointestinal disorders, including Irritable Bowel Syndrome (IBS), Inflammatory Bowel Disease (IBD), biliary colic
30 and other biliary disorders, renal colic, diarrhea-dominant IBS, pain associated with GI distension, and the like.

The compounds of the invention are also useful for the treatment of muscular sclerosis and diabetes.

Administration and Pharmaceutical Composition

The invention includes pharmaceutical compositions comprising at least one compound of the present invention, or an individual isomer, racemic or non-racemic mixture of isomers or a pharmaceutically acceptable salt or solvate thereof, together with at least one

5 pharmaceutically acceptable carrier, and optionally other therapeutic and/or prophylactic ingredients.

In general, the compounds of the invention will be administered in a therapeutically effective amount by any of the accepted modes of administration for agents that serve similar utilities.

Suitable dosage ranges are typically 1-500 mg daily, preferably 1-100 mg daily, and most
10 preferably 1-30 mg daily, depending upon numerous factors such as the severity of the disease to be treated, the age and relative health of the subject, the potency of the compound used, the route and form of administration, the indication towards which the administration is directed, and the preferences and experience of the medical practitioner involved. One of
15 ordinary skill in the art of treating such diseases will be able, without undue experimentation and in reliance upon personal knowledge and the disclosure of this Application, to ascertain a therapeutically effective amount of the compounds of the present invention for a given disease.

Compounds of the invention may be administered as pharmaceutical formulations including those suitable for oral (including buccal and sub-lingual), rectal, nasal, topical, pulmonary,
20 vaginal, or parenteral (including intramuscular, intraarterial, intrathecal, subcutaneous and intravenous) administration or in a form suitable for administration by inhalation or insufflation. The preferred manner of administration is generally oral using a convenient daily dosage regimen which can be adjusted according to the degree of affliction.

A compound or compounds of the invention, together with one or more conventional
25 adjuvants, carriers, or diluents, may be placed into the form of pharmaceutical compositions and unit dosages. The pharmaceutical compositions and unit dosage forms may be comprised of conventional ingredients in conventional proportions, with or without additional active compounds or principles, and the unit dosage forms may contain any suitable effective amount of the active ingredient commensurate with the intended daily dosage range to be
30 employed. The pharmaceutical compositions may be employed as solids, such as tablets or filled capsules, semisolids, powders, sustained release formulations, or liquids such as solutions, suspensions, emulsions, elixirs, or filled capsules for oral use; or in the form of suppositories for rectal or vaginal administration; or in the form of sterile injectable solutions

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for parenteral use. Formulations containing about one (1) milligram of active ingredient or, more broadly, about 0.01 to about one hundred (100) milligrams, per tablet, are accordingly suitable representative unit dosage forms.

The compounds of the invention may be formulated in a wide variety of oral administration dosage forms. The pharmaceutical compositions and dosage forms may comprise a compound or compounds of the present invention or pharmaceutically acceptable salts thereof as the active component. The pharmaceutically acceptable carriers may be either solid or liquid. Solid form preparations include powders, tablets, pills, capsules, cachets, suppositories, and dispersible granules. A solid carrier may be one or more substances which may also act as diluents, flavouring agents, solubilizers, lubricants, suspending agents, binders, preservatives, tablet disintegrating agents, or an encapsulating material. In powders, the carrier generally is a finely divided solid which is a mixture with the finely divided active component. In tablets, the active component generally is mixed with the carrier having the necessary binding capacity in suitable proportions and compacted in the shape and size desired. The powders and tablets preferably contain from about one (1) to about seventy (70) percent of the active compound. Suitable carriers include but are not limited to magnesium carbonate, magnesium stearate, talc, sugar, lactose, pectin, dextrin, starch, gelatine, tragacanth, methylcellulose, sodium carboxymethylcellulose, a low melting wax, cocoa butter, and the like. The term "preparation" is intended to include the formulation of the active compound with encapsulating material as carrier, providing a capsule in which the active component, with or without carriers, is surrounded by a carrier, which is in association with it. Similarly, cachets and lozenges are included. Tablets, powders, capsules, pills, cachets, and lozenges may be as solid forms suitable for oral administration.

Other forms suitable for oral administration include liquid form preparations including emulsions, syrups, elixirs, aqueous solutions, aqueous suspensions, or solid form preparations which are intended to be converted shortly before use to liquid form preparations.

Emulsions may be prepared in solutions, for example, in aqueous propylene glycol solutions or may contain emulsifying agents, for example, such as lecithin, sorbitan monooleate, or acacia. Aqueous solutions can be prepared by dissolving the active component in water and adding suitable colorants, flavors, stabilizers, and thickening agents. Aqueous suspensions can be prepared by dispersing the finely divided active component in water with viscous material, such as natural or synthetic gums, resins, methylcellulose, sodium carboxymethylcellulose, and other well known suspending agents. Solid form preparations

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include solutions, suspensions, and emulsions, and may contain, in addition to the active component, colorants, flavors, stabilizers, buffers, artificial and natural sweeteners, dispersants, thickeners, solubilizing agents, and the like.

The compounds of the invention may be formulated for parenteral administration (e.g., by
5 injection, for example bolus injection or continuous infusion) and may be presented in unit dose form in ampoules, pre-filled syringes, small volume infusion or in multi-dose containers with an added preservative. The compositions may take such forms as suspensions, solutions, or emulsions in oily or aqueous vehicles, for example solutions in aqueous polyethylene glycol. Examples of oily or nonaqueous carriers, diluents, solvents or vehicles include
10 propylene glycol, polyethylene glycol, vegetable oils (e.g., olive oil), and injectable organic esters (e.g., ethyl oleate), and may contain formulatory agents such as preserving, wetting, emulsifying or suspending, stabilizing and/or dispersing agents. Alternatively, the active ingredient may be in powder form, obtained by aseptic isolation of sterile solid or by lyophilization from solution for constitution before use with a suitable vehicle, e.g., sterile,
15 pyrogen-free water.

The compounds of the invention may be formulated for topical administration to the epidermis as ointments, creams or lotions, or as a transdermal patch. Ointments and creams may, for example, be formulated with an aqueous or oily base with the addition of suitable thickening and/or gelling agents. Lotions may be formulated with an aqueous or oily base
20 and will in general also containing one or more emulsifying agents, stabilizing agents, dispersing agents, suspending agents, thickening agents, or coloring agents. Formulations suitable for topical administration in the mouth include lozenges comprising active agents in a flavored base, usually sucrose and acacia or tragacanth; pastilles comprising the active ingredient in an inert base such as gelatine and glycerine or sucrose and acacia; and
25 mouthwashes comprising the active ingredient in a suitable liquid carrier.

The compounds of the invention may be formulated for administration as suppositories. A low melting wax, such as a mixture of fatty acid glycerides or cocoa butter is first melted and the active component is dispersed homogeneously, for example, by stirring. The molten homogeneous mixture is then poured into convenient sized molds, allowed to cool, and to
30 solidify.

The compounds of the invention may be formulated for vaginal administration. Pessaries, tampons, creams, gels, pastes, foams or sprays containing in addition to the active ingredient such carriers as are known in the art to be appropriate.

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The subject compounds may be formulated for nasal administration. The solutions or suspensions are applied directly to the nasal cavity by conventional means, for example, with a dropper, pipette or spray. The formulations may be provided in a single or multidose form. In the latter case of a dropper or pipette, this may be achieved by the patient administering an appropriate, predetermined volume of the solution or suspension. In the case of a spray, this may be achieved for example by means of a metering atomizing spray pump.

The compounds of the invention may be formulated for aerosol administration, particularly to the respiratory tract and including intranasal administration. The compound will generally have a small particle size for example of the order of five (5) microns or less. Such a particle size may be obtained by means known in the art, for example by micronization. The active ingredient is provided in a pressurized pack with a suitable propellant such as a chlorofluorocarbon (CFC), for example, dichlorodifluoromethane, trichlorofluoromethane, or dichlorotetrafluoroethane, or carbon dioxide or other suitable gas. The aerosol may conveniently also contain a surfactant such as lecithin. The dose of drug may be controlled by a metered valve. Alternatively the active ingredients may be provided in a form of a dry powder, for example a powder mix of the compound in a suitable powder base such as lactose, starch, starch derivatives such as hydroxypropylmethyl cellulose and polyvinylpyrrolidone (PVP). The powder carrier will form a gel in the nasal cavity. The powder composition may be presented in unit dose form for example in capsules or cartridges of e.g., gelatine or blister packs from which the powder may be administered by means of an inhaler.

When desired, formulations can be prepared with enteric coatings adapted for sustained or controlled release administration of the active ingredient. For example, the compounds of the present invention can be formulated in transdermal or subcutaneous drug delivery devices. These delivery systems are advantageous when sustained release of the compound is necessary and when patient compliance with a treatment regimen is crucial. Compounds in transdermal delivery systems are frequently attached to an skin-adhesive solid support. The compound of interest can also be combined with a penetration enhancer, e.g., Azone (1-dodecylazacycloheptan-2-one). Sustained release delivery systems are inserted subcutaneously into the subdermal layer by surgery or injection. The subdermal implants encapsulate the compound in a lipid soluble membrane, e.g., silicone rubber, or a biodegradable polymer, e.g., polylactic acid.

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The pharmaceutical preparations are preferably in unit dosage forms. In such form, the preparation is subdivided into unit doses containing appropriate quantities of the active component. The unit dosage form can be a packaged preparation, the package containing discrete quantities of preparation, such as packeted tablets, capsules, and powders in vials or ampoules. Also, the unit dosage form can be a capsule, tablet, cachet, or lozenge itself, or it can be the appropriate number of any of these in packaged form.

Other suitable pharmaceutical carriers and their formulations are described in *Remington: The Science and Practice of Pharmacy* **1995**, edited by E. W. Martin, Mack Publishing Company, 19th edition, Easton, Pennsylvania. Representative pharmaceutical formulations containing a compound of the present invention are described below.

EXAMPLES

The following preparations and examples are given to enable those skilled in the art to more clearly understand and to practice the present invention. They should not be considered as limiting the scope of the invention, but merely as being illustrative and representative thereof.

Unless otherwise stated, all temperatures including melting points (i.e., MP) are in degrees celsius (°C). It should be appreciated that the reaction which produces the indicated and/or the desired product may not necessarily result directly from the combination of two reagents which were initially added, i.e., there may be one or more intermediates which are produced in the mixture which ultimately leads to the formation of the indicated and/or the desired product. The following abbreviations may be used in the Preparations and Examples.

ABBREVIATIONS

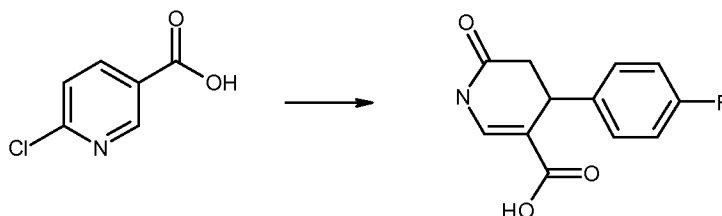
25	BETBDMS	2-bromoethoxy tertbutyldimethylsilane
	DBU	1,8-diazabicyclo[5.4.0]undec-7-ene
	DCM	dichloromethane/methylene chloride
	DIPEA	diisopropyl ethylamine (Hunig's base)
	DME	1,2-dimethoxyethane (glyme)
	DMF	N,N-dimethylformamide
30	DMFDMA	N,N-dimethylformamide dimethyl acetal
	DMSO	dimethyl sulfoxide
	DMAP	4-dimethylaminopyridine
	dppf	1,1'-Bis(diphenylphosphino)ferrocene
	EDCI	1-ethyl-3-(3'-dimethylaminopropyl)carbodiimide
35	EtOAc	ethyl acetate
	EtOH	ethanol
	gc	gas chromatography

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	HATU	O-(7-Azabenzotriazol-1-yl)-N,N,N',N'-tetramethyluronium hexafluorophosphate
	HMPA	hexamethylphosphoramide
	HOBt	N-Hydroxybenzotriazole
5	hplc	high performance liquid chromatography
	IPA	isopropanol
	IPBAPE	isopropenylboronic acid pinacol ester
	mCPBA	<i>m</i> -chloroperbenzoic acid
	MeCN	acetonitrile
10	NMM	N-methyl morpholine
	NMP	N-methyl pyrrolidinone
	Pd ₂ (dba) ₃	Tris(dibenzylideneacetone)dipalladium(0)
	TBAF	tetra- <i>n</i> -butyl ammonium fluoride
	tBDMSiCl	tert-butyl-dimethylsilyl chloride
15	TEA	triethylamine
	THF	tetrahydrofuran
	LDA	lithium diisopropylamine
	TBDMS	tert-butyl dimethylsilyl chloride
	TLC	thin layer chromatography
20	Xantphos	4,5-bis(diphenylphosphino)-9,9-dimethyl-xanthene

Preparation 1**4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid**

The synthetic procedure used in this preparation is outlined in Scheme B.

**SCHEME B**

4-Fluorophenylmagnesium bromide (2M in THF; 130 ml) was added dropwise at 0°C to a stirring solution of 6-chloronicotinic acid (12.92 g) in 150 mL of THF. After the addition was complete the reaction mixture was stirred at ambient temperature for 16 hours. The reaction mixture was cooled to -60°C and acetic acid (105 ml) was added dropwise, resulting in formation of a solid. After the addition was complete the reaction mixture was warmed to ambient temperature. The reaction mixture was then cooled to 0°C and quenched by addition of saturated aqueous ammonium chloride solution. The mixture was partitioned between water and ethyl acetate, and the organic layer was separated, washed with water and brine, dried over Na₂SO₄, filtered and concentrated under reduced pressure. The residue was dissolved in hot ethyl acetate. Upon standing a solid precipitate formed, which was

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collected and dried to give 10.04 g of 4-(4-fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid as a white solid.

Preparation 2

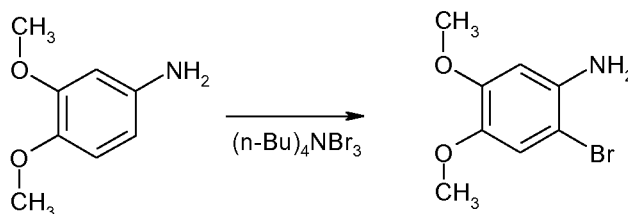
Chiral Separation of (R) and (S) 4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid

The (R) and (S) isomers of 4-(4-fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid were separated using an R,R Whelk-O1 (Regis Technologies) chiral column, 30 mm I.D. x 250 mm length, designed for use with supercritical CO₂ fluid chromatography. Racemic 4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid was dissolved in a 5% THF/95% methanol solution to 100 mg/ml concentration. The solution was filtered and warmed to 40° C. The solution was injected onto the column in 1.7 mL increments and eluted with 35% methanol (HPLC grade), 65% supercritical CO₂ at 40 °C. The (S) isomer was recovered from the first fraction ([α]_D²⁰ = +197.3° (CHCl₃ c=0.629), mp. 210-212°C) and the (R) isomer was recovered from the second fraction ([α]_D²⁰ = -197.4° (CHCl₃ c=0.618), mp. 213-215°C). Stacked injections were used with a single run time of seven minutes.

Preparation 3

2-Bromo-4,5-dimethoxy-aniline

The synthetic procedure used in this preparation is outlined in Scheme C.

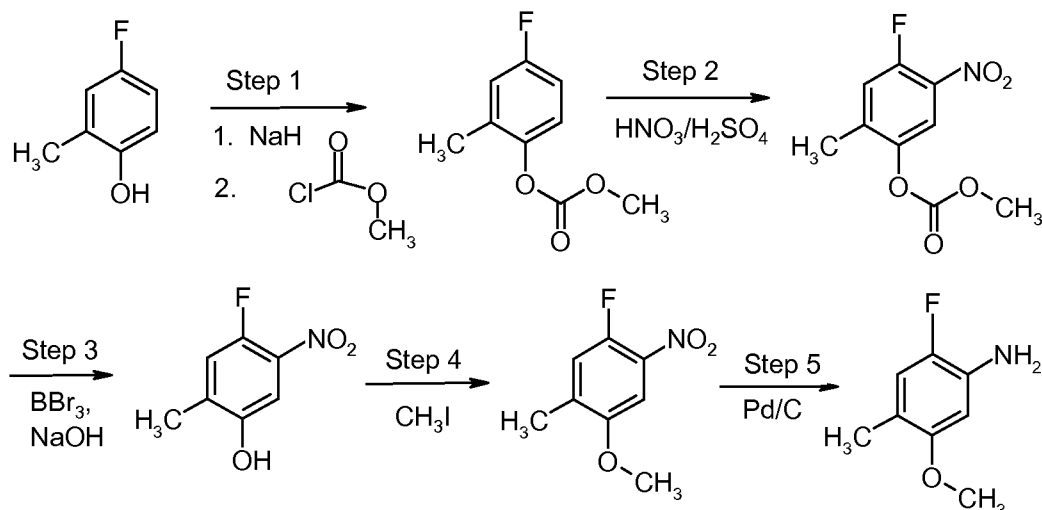


SCHEME C

Following the procedure reported in *JACS* **1996**, *118*, 1028-1030, 4-aminoveratrole (3.06 g, 20.0 mmol) was dissolved in a mixture of dichloromethane (80 ml) and methanol (40 ml) at room temperature. Tetrabutylammonium tribromide (1.15 eq, 11.09 g) was added and the mixture was allowed to stir for 20 minutes. The mixture was extracted with saturated aqueous sodium sulfite solution. The organic layer was washed with water, dried over anhydrous sodium sulfate, filtered and concentrated in vacuo. The residue was purified by flash chromatography (gradient 10:1 to 7:3 Hexanes/Ethyl Acetate) to give 2-Bromo-4,5-dimethoxy-aniline 1.403g (30%) of a yellow oil.

Preparation 42-Fluoro-5-methoxy-4-methyl-phenylamine

The synthetic procedure used in this example is outlined in Scheme D.



5

SCHEME DStep 1 Carbonic acid 4-fluoro-2-methyl-phenyl ester methyl ester

Following the procedure of *J. Med. Chem.* **1999**, 42, 5369, 4-fluoro-2-methylphenol (10.0 g, 79.0 mmol) was dissolved in THF and the mixture was cooled to 0°C . NaH (1 eq, 3.16 g of a 60% dispersion in oil) was added carefully. After gas evolution ceased, methyl

10 chloroformate (1eq, 6.8ml) was added. The mixture was allowed to warm to room temperature and stir for 3 hours. The mixture was washed with cold water, dried over anhydrous sodium sulfate, filtered and then concentrated in vacuo to give carbonic acid 4-fluoro-2-methyl-phenyl ester methyl ester (12.8 g, 88.0%) as an oil.

Step 2 Carbonic acid 4-fluoro-2-methyl-5-nitro-phenyl ester methyl ester

15 Carbonic acid 4-fluoro-2-methyl-phenyl ester methyl ester (12.8 g, 69.5 mmol) was suspended in 8 ml of concentrated sulfuric acid and cooled to 0°C . A mixture of concentrated nitric acid (8 ml) in concentrated sulfuric acid (8 ml) was added slowly, maintaining a reaction temperature below 50°C . After addition the mixture was stirred for 2 hours. The reaction mixture was poured into ice-water, forming a precipitate which was

20 filtered and dried to give carbonic acid 4-fluoro-2-methyl-5-nitro-phenyl ester methyl ester (8.0 g, 50.3%) as a white powder.

Step 3 4-Fluoro-2-methyl-5-nitro-phenol

Carbonic acid 4-fluoro-2-methyl-5-nitro-phenyl ester methyl ester (1.8 g, 7.8 mmol) was dissolved in dichloromethane (100 ml) and cooled to 0°C . Boron tribromide (1 M in

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dichloromethane, 8 ml) was added. The mixture was allowed to warm to room temperature and was stirred overnight. To the solution was added 1N sodium hydroxide (25 ml) and the mixture was stirred vigorously for 1 hour. The layers were separated and the organic layer was dried over anhydrous sodium sulfate, and filtered and concentrated in vacuo to give 4-fluoro-2-methyl-5-nitro-phenol (1.083 g, 80.6%) as a red crystalline solid.

Step 4 1-Fluoro-4-methoxy-5-methyl-2-nitro-benzene

4-Fluoro-2-methyl-5-nitro-phenol (1.08 g, 6.3 mmol) was dissolved in acetone (100 ml). To this was added solid sodium carbonate (2 eq, 1.34 g) and iodomethane (10 eq, 3.75 ml). The mixture was allowed to stir at room temperature overnight. The mixture was filtered and the filtrate was concentrated in vacuo to give 1-fluoro-4-methoxy-5-methyl-2-nitro-benzene (1.18 g, quantitative) as a pale yellow solid.

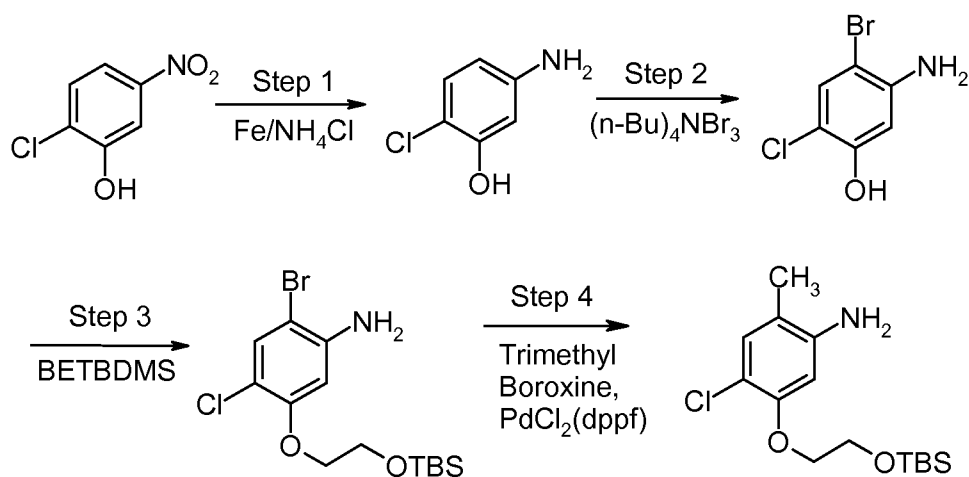
Step 5 2-Fluoro-5-methoxy-4-methyl-phenylamine

1-Fluoro-4-methoxy-5-methyl-2-nitro-benzene (1.18 g, 6.4 mmol) was dissolved in 40 ml of methanol at room temperature. 10% Palladium on Carbon (200 mg) was added and the mixture was stirred under a balloon of hydrogen overnight. The mixture was filtered through celite. The filtrate was concentrated in vacuo to give 2-fluoro-5-methoxy-4-methyl-phenylamine (990 mg, quantitative) as a solid.

Preparation 5

5-[2-(tert-Butyl-dimethyl-silanyloxy)-ethoxy]-4-chloro-2-methyl-phenylamine

The synthetic procedure used in this preparation is outlined in Scheme E.



SCHEME E

Step 1 5-Amino-2-chloro-phenol

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To a solution of 2-chloro-5-nitrophenol (20.0 g, 115.2 mmol) in ethanol (150 ml) and water (150 ml) was added iron powder (32.2 g, 576.2 mmol) and ammonium chloride (32.1 g, 599.3 mmol). The mixture was heated at reflux for two hours, then cooled to room temperature and filtered. The filtrate was concentrated to dryness under reduced pressure.

- 5 Purification of the residue by flash chromatography (hex:EtOAc/9:1) gave 5-amino-2-chloro-phenol (15.85g, 96%) as a white solid.

Step 2 5-Amino-4-bromo-2-chloro-phenol

- To a solution of 5-amino-2-chloro-phenol (15.85 g, 110.4 mmol) in dichloromethane (300 ml) and MeOH (150 ml) was added tetrabutylammonium tribromide (58.6 g, 121.4 mmol). The mixture was stirred at room temperature for 20 minutes, and then was partitioned between saturated aqueous Na₂SO₃ and Et₂O. The organic layer was separated, washed with water and brine, dried over MgSO₄, filtered and concentrated to dryness under reduced pressure. Purification of the residue by flash chromatography (hex:EtOAc/7:3) gave 5-amino-4-bromo-2-chloro-phenol (4.38g, 18%) as a white solid.
- 10

- 15 Step 3 2-Bromo-5-[2-(tert-butyl-dimethyl-silanyloxy)-ethoxy]-4-chloro-phenylamine

- To a solution of 5-amino-4-bromo-2-chloro-phenol (0.338 g, 1.52 mmol) in NMP (5 ml) was added cesium carbonate (0.644 g, 1.97 mmol), sodium iodide (0.228 g, 1.52 mmol) and 2-bromoethoxy tertbutyldimethylsilane (0.424 g, 1.97 mmol). The mixture was heated to 100° C for two hours, then cooled to room temperature. Water was added and the mixture was extracted with EtOAc. The combined organic extracts were washed with water and brine, dried over MgSO₄, filtered and concentrated to dryness under reduced pressure. Purification of the residue by flash chromatography (hex:EtOAc/8:2) gave 2-bromo-5-[2-(tert-butyl-dimethyl-silanyloxy)-ethoxy]-4-chloro-phenylamine (0.505g, 78%) as a white solid.
- 20

Step 4 5-[2-(tert-Butyl-dimethyl-silanyloxy)-ethoxy]-4-chloro-2-methyl-phenylamine

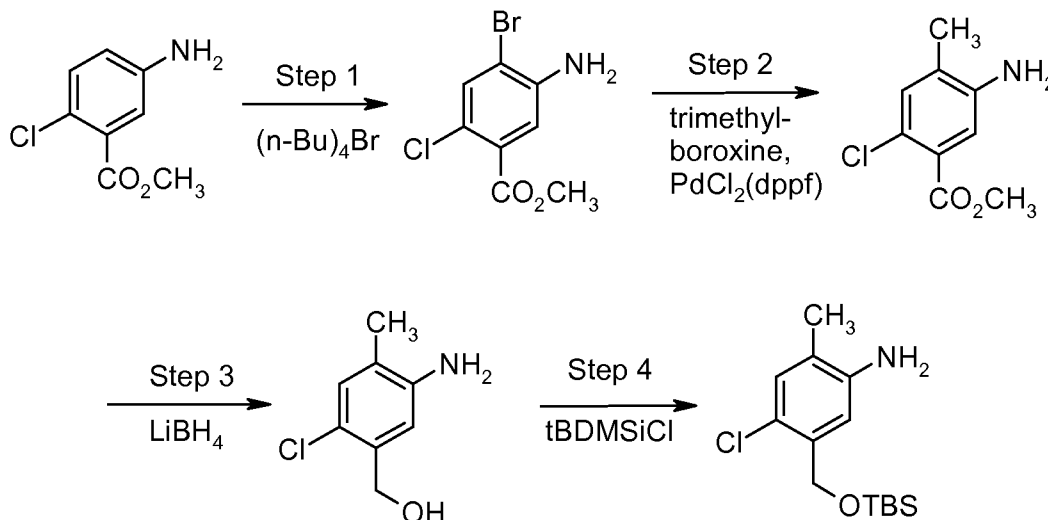
- 25 To a solution of 2-bromo-4-chloro-5 (2-dimethyl-tert-butyloxyethyl)-oxy aniline (6.5 g, 17.07 mmol) in Dioxane (120 ml)-Water (12 ml) under Ar atmosphere was added potassium carbonate (7.08 g, 51.2 mmol), trimethylboroxine (2.408 ml, 17.07 mmol) and PdCl₂(dppf)-CH₂Cl₂ (1.394 g, 1.707 mmol). The mixture was heated to 110 °C for 20 hours, then cooled to room temperature and filtered through Celite. Water and EtOAc were added, and the organic layer was separated, washed with water and brine, dried (Na₂SO₄), filtered and concentrated under reduced pressure. The crude product was purified by flash chromatography (0 to 20% EtOAc in hexanes to give 3.66 g of 5-[2-(tert-butyl-dimethyl-
- 30

silanyloxy)-ethoxy]-4-chloro-2-methyl-phenylamine as a white solid. Recrystallization from EtOAc gave 2.35 g of white crystals.

Preparation 6

(5-Amino-2-chloro-4-methyl-phenyl)-tert-butyl-dimethylsilyl-methanol

- 5 The synthetic procedure used in this preparation is outlined in Scheme F.



SCHEME F

Step 1 5-Amino-4-bromo-2-chloro-benzoic acid methyl ester

- To a solution of 5-amino-2-chloro-benzoic acid methyl ester (6.76 g, 36.4 mmol) in
 10 dichloromethane (100 mL) and methanol (50 mL) was added tetra-*n*-butylammonium
 tribromide (17.7 g, 36.4 mmol). The mixture was stirred at 25 °C for 90 minutes. Sodium
 thiosulfate (10% aqueous solution) was added and the mixture was extracted with
 dichloromethane. The combined extracts were washed with water, dried (Na₂SO₄), filtered,
 and concentrated to dryness under reduced pressure. The crude material was purified by flash
 15 column chromatography (hexane/acetone 8 : 2). Fractions with the desired product were
 concentrated to small volume. The resulting suspension was allowed to stand for two hours
 and was then filtered to obtain 5-amino-6-bromo-2-chloro-benzoic acid methyl ester as a
 white solid (2.7 g, 28 %).

Step 2 5-Amino-2-chloro-4-methyl-benzoic acid methyl ester

- 20 To a solution of 5-amino-6-bromo-2-chloro-benzoic acid methyl ester (0.5 g, 1.89 mmol) in
 dioxane (10 ml) and water (1 ml) was added potassium carbonate (0.784g, 5.67mmol),
 PdCl₂(dppf) (0.54g, 0.189mmol) and trimethyl boroxine (0.276 ml, 1.985 mmol). The
 mixture was stirred at 110 °C for 18 hours, then cooled to room temperature and filtered. The
 filtrate was concentrated to dryness under reduced pressure. Purification of the residue by

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flash chromatography (hexanes:EtOAc 8:2) gave 0.270 g (71%) of 5-amino-2-chloro-4-methyl-benzoic acid methyl ester as a tan solid.

Step 3 (5-Amino-2-chloro-4-methyl-phenyl)-methanol

- To a solution of 5-amino-2-chloro-4-methyl-benzoic acid methyl ester (0.44 g, 2.204 mmol) in THF (5 ml) was added lithium borohydride (0.12 g, 5.509mmol). The mixture was heated at reflux for three hours. The mixture was cooled to 0 °C, acidified with 2N aqueous HCl, and the mixture was stirred for 10 minutes. The mixture was taken to pH7 with 2N aqueous NaOH and the product was extracted with EtOAc. The combined extracts were washed with water, brine dried over MgSO₄, filtered and concentrated to dryness under reduced pressure.
- 10 Purification of the crude product by flash chromatography (hexanes:EtOAc 6:4) gave 0.278 g (73%) of (5-amino-2-chloro-4-methyl-phenyl)-methanol as a white solid.

Step 4 (5-Amino-2-chloro-4-methyl-phenyl)-tert-butyl-dimethylsilyl-methanol

- To a solution of (5-amino-2-chloro-4-methyl-phenyl)-methanol (0.275 g, 1.602 mmol) in DMF (5 ml) was added tBDMSCl (0.314 g, 2.08 mmol) and imidazole (0.142 g, 2.083 mmol). The mixture was stirred at room temperature for 16 hours. Water was added and the product was extracted with EtOAc. The combined extracts were washed with water and brine, dried over MgSO₄, filtered and concentrated to dryness under reduced pressure. Purification of the crude product by flash chromatography (hex:EtOAc 10:0-9:1) gave 0.429 g (94%) of (5-amino-2-chloro-4-methyl-phenyl)-tert-butyl-dimethylsilyl-methanol as a white solid.

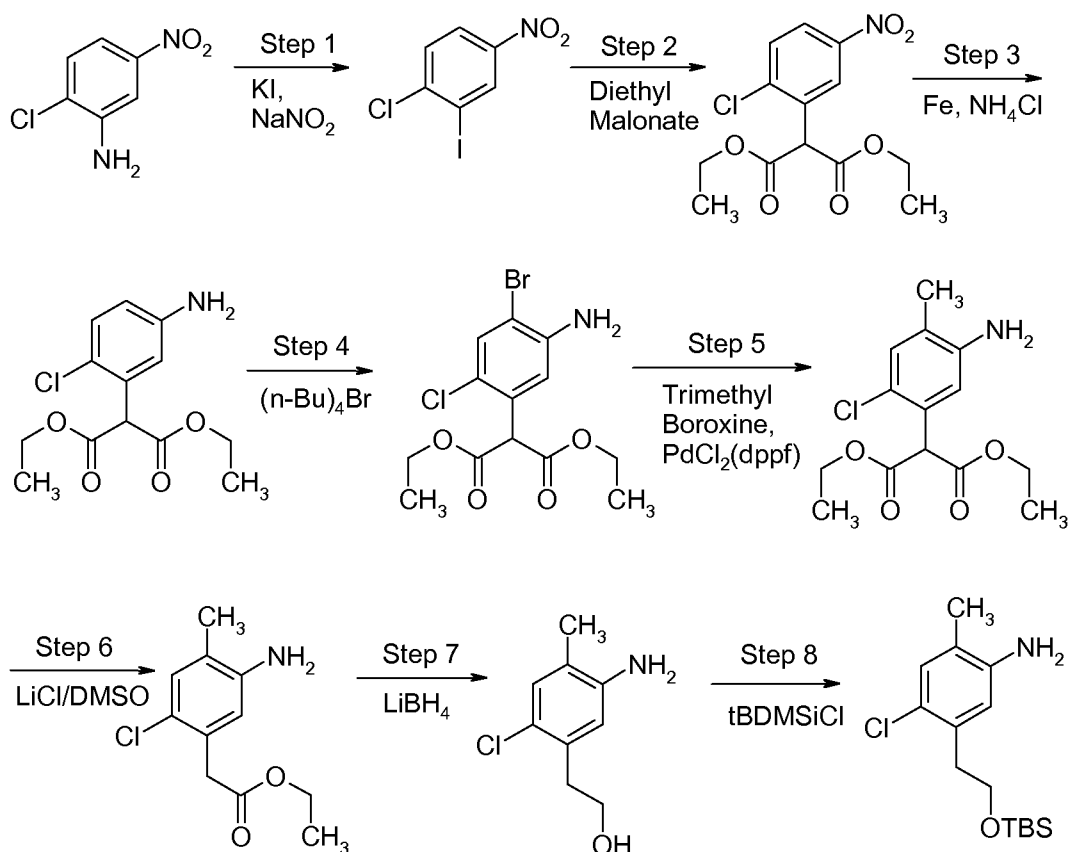
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Preparation 7

2-(5-Amino-2-chloro-4-methyl-phenyl)-tert-butyl-dimethylsilyl-ethanol

The synthetic procedure used in this preparation is outlined in Scheme G.

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SCHEME G

Step 1 1-Chloro-2-iodo-4-nitro-benzene

To a solution of 2-chloro-5-nitroaniline (10.0 g, 57.9 mmol) in concentrated aqueous HCl (27 ml) and water ice (10 g) was added at 0 °C a solution of NaNO₂ (4.2 g, 60.8 mmol) in water (10 ml). The mixture was stirred at 0 °C for 10 minutes, and a solution of KI (9.67g, 58.2mmol)) in water (10 ml) was added. The mixture was allowed to warm to room temperature and was stirred for three hours. The mixture was partitioned between water and dichloromethane. The organic layer was separated, washed with water, brine, dried over MgSO₄, filtered and concentrated to dryness. Purification of the crude product by flash chromatography (hexanes:EtOAc 9:1) gave 10.81 g (66%) of 1-chloro-2-iodo-4-nitro-benzene as a yellow solid.

Step 2 2-(2-Chloro-5-nitro-phenyl)-malonic acid diethyl ester

To a suspension of 1-chloro-2-iodo-4-nitro-benzene (3.0 g, 10.58 mmol) in THF (11 ml) was added diethylmalonate (3.22 ml, 21.16 mmol), CuI (0.1 g, 0.529 mmol), 2-phenyl phenol (0.18 g, 1.058 mmol), and cesium carbonate (5.17 g, 15.87 mmol). The mixture was heated in a sealed tube at 70 °C for 28 hours. The mixture was cooled and partitioned between

saturated aqueous ammonium chloride and EtOAc. The organic layer was separated, washed with water and brine, dried over MgSO_4 , filtered and concentrated to dryness under reduced pressure. Purification of the crude product by flash chromatography (hexanes:EtOAc 9:1) gave 2.3 g (688%) of 2-(2-chloro-5-nitro-phenyl)-malonic acid diethyl ester as a clear oil.

5 Step 3 2-(5-Amino-2-chloro-phenyl)-malonic acid diethyl ester

To a solution of 2-(2-chloro-5-nitro-phenyl)-malonic acid diethyl ester (2.3 g, 7.28 mmol) in EtOH (20 ml) and water (20 ml) was added Fe powder (2.0 g, 36.4 mmol) and ammonium chloride (2.0 g, 37.8 mmol). The mixture was heated at 100 °C for two hours. The mixture was filtered and the filtrate was concentrated to dryness under reduced pressure. The residue
10 was partitioned between water and dichloromethane, and the organic layer was separated, washed with water and brine, dried over MgSO_4 , filtered and concentrated to dryness under reduced pressure. Purification of the crude product by flash chromatography (hexanes:EtOAc 8:2) gave 1.35 g (65%) of 2-(5-amino-2-chloro-phenyl)-malonic acid diethyl ester as a yellow solid.

15 Step 4 2-(5-Amino-4-bromo-2-chloro-phenyl)-malonic acid diethyl ester

To a solution of 2-(5-amino-2-chloro-phenyl)-malonic acid diethyl ester (1.35g, 4.72mmol) in dichloromethane (10ml) and MeOH (5ml) was added tetrabutyl ammoniumtribromide (1.82g, 3.78mmol). The mixture was stirred at rt for 20 min. The mixture was partitioned between sat. Na_2SO_3 and Et₂O. The organic layer was separated, washed with water, brine
20 dried over MgSO_4 and concentrated to dryness. Purification by flash chromatography (hex:EtOAc/8:2) gave 1.25g (73%) of 2-(5-amino-4-bromo-2-chloro-phenyl)-malonic acid diethyl ester as a yellow solid.

Step 5 2-(5-Amino-2-chloro-4-methyl-phenyl)-malonic acid diethyl ester

To a solution of 2-(5-amino-4-bromo-2-chloro-phenyl)-malonic acid diethyl ester (1.25 g, 3.43 mmol) in dioxane (20 ml) and water (2 ml) was added potassium carbonate (1.42 g, 10.28 mmol), $\text{PdCl}_2(\text{dppf})$ (0.28 g, 0.342 mmol) and trimethyl boroxine (0.501 ml, 3.42 mmol). The mixture was stirred at 110 °C for 18 hours, then cooled to room temperature and filtered. The filtrate was concentrated to dryness under reduced pressure. Purification of the crude product by flash chromatography (hexanes:EtOAc 8:2) gave 0.270 g (71%) of 2-(5-
25 amino-2-chloro-4-methyl-phenyl)-malonic acid diethyl ester as a yellow oil.

Step 6 (5-Amino-2-chloro-4-methyl-phenyl)-acetic acid ethyl ester

To a solution of 2-(5-amino-2-chloro-4-methyl-phenyl)-malonic acid diethyl ester (0.50 g, 2.17 mmol) in DMSO (3 ml) and water (0.078 ml) was added, followed by lithium chloride

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(0.138 g, 3.26 mmol). The mixture was heated to 170 °C for three hours, then cooled to room temperature. Water was added and the mixture was extracted with EtOAc. The combined extracts were washed with water and brine, dried over MgSO₄, filtered and concentrated to dryness under reduced pressure. Purification of the crude product by flash chromatography (hexanes:EtOAc 8:2) gave 0.250 g (50%) of (5-amino-2-chloro-4-methyl-phenyl)-acetic acid ethyl ester as a white foam.

Step 7 2-(5-Amino-2-chloro-4-methyl-phenyl)-ethanol

To a solution of (5-amino-2-chloro-4-methyl-phenyl)-acetic acid ethyl ester (0.25 g, 1.09 mmol) in THF (15 ml) was added lithium borohydride (0.059 g, 2.74 mmol) and the mixture was heated at reflux for three hours. The mixture was cooled to 0 °C and acidified to pH 1 with aqueous 2N HCl. The mixture was taken to pH 7 by addition of aqueous 2N NaOH and the mixture was extracted with EtOAc. The combined extracts were washed with water and brine, dried, over MgSO₄, filtered and concentrated to dryness under reduced pressure. Purification of the crude product by flash chromatography (hexanes:EtOAc 1:1) gave 0.203 g (99%) of 2-(5-amino-2-chloro-4-methyl-phenyl)-ethanol as a white solid.

Step 8 2-(5-Amino-2-chloro-4-methyl-phenyl)-tert-butyl-dimethylsilyl-ethanol

To a solution of 2-(5-amino-2-chloro-4-methyl-phenyl)-ethanol (0.203 g, 1.092 mmol) in DMF (3 ml) was added tBDMSCl (0.214 g, 1.42 mmol) and imidazole (0.97 g, 1.42 mmol). The mixture was stirred at room temperature for 16 hours. Water was added and the mixture was extracted with EtOAc. The combined extracts were washed with water and brine, dried over MgSO₄, filtered and concentrated to dryness under reduced pressure. Purification of the crude product by flash chromatography (hexanes:EtOAc 8:2) gave 0.194 g (59%) of 2-(5-amino-2-chloro-4-methyl-phenyl)-tert-butyl-dimethylsilyl-ethanol as a white solid.

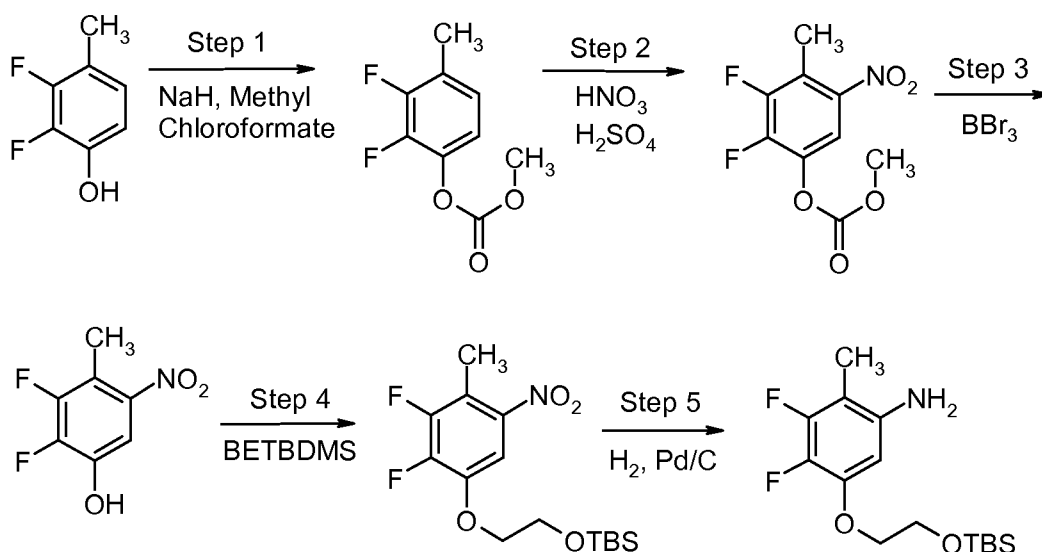
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Preparation 8

5-[2-(tert-Butyl-dimethyl-silanyloxy)-ethoxy]-3,4-difluoro-2-methyl-phenylamine

The synthetic procedure used in this preparation is outlined in Scheme H.

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SCHEME H

Step 1 Carbonic acid 2,3-difluoro-4-methyl-phenyl ester methyl ester

A solution of 2,3-difluoro-4-methyl phenol (3.3 g, 22.89 mmol) in THF (30 ml) was cooled to 0 °C in an ice bath, and 60% NaH (0.916g, 22.9mmol) was added. When the gas evolution ceased, methyl chloroformate (1.76 ml, 22.9 mmol) was added. The ice-bath was removed and the mixture was stirred at room temperature for three hours. Water was added and the mixture was extracted with EtOAc. The combined extracts were washed with water and brine, dried over MgSO₄, filtered and concentrated to dryness under reduced pressure. Purification of the crude product by flash chromatography (hexanes:EtOAc 9:1) gave 3.85 g (83%) of carbonic acid 2,3-difluoro-4-methyl-phenyl ester methyl ester as a clear oil.

Step 2 Carbonic acid 2,3-difluoro-4-methyl-5-nitro-phenyl ester methyl ester

To a suspension of carbonic acid 2,3-difluoro-4-methyl-phenyl ester methyl ester (3.85 g, 19.04 mmol) in sulfuric acid (2.23 ml) at 0 °C was added nitric acid (2.23 ml). The mixture was stirred at 0 °C for one hour. Ice-water was added and the mixture was extracted with dichloromethane. The combined extracts were washed with water and brine, dried over MgSO₄, filtered and concentrated to dryness under reduced pressure. Purification of the crude product by flash chromatography (hexanes:EtOAc 95:5) gave 2.3 g (49%) of carbonic acid 2,3-difluoro-4-methyl-5-nitro-phenyl ester methyl ester a clear oil.

Step 3 2,3-Difluoro-4-methyl-5-nitro-phenol

A solution of carbonic acid 2,3-difluoro-4-methyl-5-nitro-phenyl ester methyl ester (2.3 g, 9.3 mmol) in dichloromethane (30 ml) was cooled to 0 °C in an ice bath, and 1.0M boron tribromide in dichloromethane (9.3 ml, 9.3 mmol) was added. The ice-bath was removed and

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the mixture was stirred at room temperature for 18 hours. Water was added and the mixture was extracted with EtOAc. The combined extracts were washed with water and brine, dried over MgSO₄, filtered and concentrated to dryness under reduced pressure. Purification of the crude product by flash chromatography (hexanes:EtOAc 9:1) gave 1.02 g (58%) of 2,3-difluoro-4-methyl-5-nitro-phenol as a white solid.

Step 4 tert-Butyl-[2-(2,3-difluoro-4-methyl-5-nitro-phenoxy)-ethoxy]-dimethyl-silane

To a solution of 2,3-difluoro-4-methyl-5-nitro-phenol (1.02 g, 5.39 mmol) in NMP (10 ml) was added cesium carbonate (2.28 g, 7.01 mmol), sodium iodide (0.807 g, 5.39 mmol) and 2-bromoethoxy tertbutyldimethylsilane (1.5 ml, 7.01 mmol). The mixture was heated at 100 °C for one hour, then cooled to room temperature. Water was added and the mixture was extracted with EtOAc. The combined extracts were washed with water and brine, dried over MgSO₄, filtered and concentrated to dryness under reduced pressure. Purification of the crude product by flash chromatography (hexanes :EtOAc 9:1) gave 1.16 g (62%) of tert-butyl-[2-(2,3-difluoro-4-methyl-5-nitro-phenoxy)-ethoxy]-dimethyl-silane as a tan solid.

Step 5 5-[2-(tert-Butyl-dimethyl-silanyloxy)-ethoxy]-3,4-difluoro-2-methyl-phenylamine

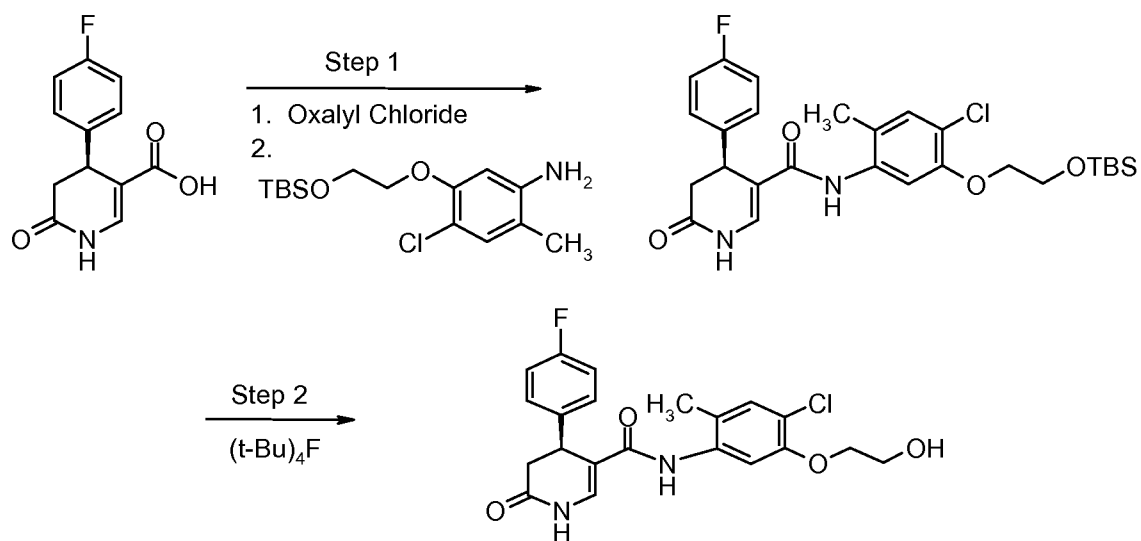
To a solution of tert-butyl-[2-(2,3-difluoro-4-methyl-5-nitro-phenoxy)-ethoxy]-dimethyl-silane (1.16 g, 3.33 mmol) in EtOH (10 ml) was added 10% Pd/C (0.116 g) and the mixture was hydrogenated under balloon pressure for two hours. The mixture was filtered and the filtrate was concentrated to dryness under reduced pressure. Purification of the crude product by flash chromatography (hexanes:EtOAc 7:3) gave 0.638 g of 5-[2-(tert-butyl-dimethyl-silanyloxy)-ethoxy]-3,4-difluoro-2-methyl-phenylamine as a tan solid.

Example 1

(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [4-chloro-5-(2-hydroxy-ethoxy)-2-methyl-phenyl]-amide

The synthetic procedure used in this preparation is outlined in Scheme I.

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SCHEME I

Step 1 (S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid {5-[2-(tert-butyl-dimethyl-silanyloxy)-ethoxy]-4-chloro-2-methyl-phenyl}-amide

- 5 Oxalylchloride (0.91 g 7.2 mmol) was added to a room temperature solution of (S)-4-(4-fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (1.124 g, 4.8 mmol) in dichloromethane (10 ml) containing 2 drops of DMF. The reaction mixture was stirred for 30 minutes and then solvent was removed under reduced pressure to give crude (S)-4-(4-fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid chloride, which was not
- 10 removed from the flask. Dichloromethane (10 mL) was added, and the dichloromethane solution of the acid chloride was added to a stirring solution of 5-[2-(tert-butyl-dimethyl-silanyloxy)-ethoxy]-4-chloro-2-methyl-phenylamine (1.51 g, 4.7 mmol) and triethyl amine (0.97 g) in dichloromethane (30 ml). The reaction was stirred at 0 °C for 10 minutes, then at ambient temperature for 20 minutes. Solvent was removed under reduced pressure and the
- 15 residue was purified by flash chromatography (0 to 5% methanol in dichloromethane) to 1.776 g of (S)-4-(4-fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid {5-[2-(tert-butyl-dimethyl-silanyloxy)-ethoxy]-4-chloro-2-methyl-phenyl}-amide as a yellowish solid (69.5% yield).

Step 2 (S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [4-chloro-5-(2-hydroxy-ethoxy)-2-methyl-phenyl]-amide

- 20

A solution tetrabutylammonium fluoride (1M in THF) was added drop wise to a 0 °C solution of (S)-4-(4-fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid {5-[2-(tert-butyl-dimethyl-silanyloxy)-ethoxy]-4-chloro-2-methyl-phenyl}-amide (1.75 g, 3.38 mmol) in

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THF (400 ml). The mixture was stirred at 0 °C for 45 minutes and then stirred at room temperature for 18 hours. The mixture was partitioned between water and EtOAc. The organic layer was washed with water and brine, dried over MgSO₄, filtered and concentrated to dryness under reduced pressure. Purification of the crude product by flash

- 5 chromatography (0 to 5% CH₃OH in CH₂Cl₂) gave 1.15 g of (S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [4-chloro-5-(2-hydroxy-ethoxy)-2-methyl-phenyl]-amide as a light yellowish solid. Recrystallize from EtOAc-Hexanes) gave 863 mg of white crystals, MS (M+H) = 419.

Similarly prepared were:

- 10 (S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [3,4-difluoro-5-(2-hydroxy-ethoxy)-2-methyl-phenyl]-amide, MS (M+H) = 421;

(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid [4-chloro-5-(2-hydroxy-ethyl)-2-methyl-phenyl]-amide, MS (M+H) = 403;

- 15 (S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (4-chloro-5-hydroxymethyl-2-methyl-phenyl)-amide, MS (M+H) = 389;

(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-bromo-4-chloro-5-hydroxy-phenyl)-amide, MS (M+H) = 440; and

(S)-4-(4-Fluoro-phenyl)-6-oxo-1,4,5,6-tetrahydro-pyridine-3-carboxylic acid (2-bromo-4,5-dimethoxy-phenyl)-amide, MS (M+H) = 450.

- 20 Additional compounds made by the above procedure are shown in Table 1.

Example 2

Formulations

Pharmaceutical preparations for delivery by various routes are formulated as shown in the following Tables. "Active ingredient" or "Active compound" as used in the Tables means

- 25 one or more of the Compounds of Formula I.

Composition for Oral Administration

Ingredient	% wt./wt.
Active ingredient	20.0%
Lactose	79.5%
Magnesium stearate	0.5%

The ingredients are mixed and dispensed into capsules containing about 100 mg each; one capsule would approximate a total daily dosage.

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Composition for Oral Administration

Ingredient	% wt./wt.
Active ingredient	20.0%
Magnesium stearate	0.5%
Crosscarmellose sodium	2.0%
Lactose	76.5%
PVP (polyvinylpyrrolidone)	1.0%

The ingredients are combined and granulated using a solvent such as methanol. The formulation is then dried and formed into tablets (containing about 20 mg of active

5 compound) with an appropriate tablet machine.

Composition for Oral Administration

Ingredient	Amount
Active compound	1.0 g
Fumaric acid	0.5 g
Sodium chloride	2.0 g
Methyl paraben	0.15 g
Propyl paraben	0.05 g
Granulated sugar	25.5 g
Sorbitol (70% solution)	12.85 g
Veegum K (Vanderbilt Co.)	1.0 g
Flavoring	0.035 ml
Colorings	0.5 mg
Distilled water	q.s. to 100 ml

The ingredients are mixed to form a suspension for oral administration.

10

Parenteral Formulation

Ingredient	% wt./wt.
Active ingredient	0.25 g
Sodium Chloride	qs to make isotonic
Water for injection	100 ml

The active ingredient is dissolved in a portion of the water for injection. A sufficient quantity of sodium chloride is then added with stirring to make the solution isotonic. The solution is made up to weight with the remainder of the water for injection, filtered through a 0.2 micron

15 membrane filter and packaged under sterile conditions.

Suppository Formulation

Ingredient	% wt./wt.
Active ingredient	1.0%
Polyethylene glycol 1000	74.5%
Polyethylene glycol 4000	24.5%

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The ingredients are melted together and mixed on a steam bath, and poured into molds containing 2.5 g total weight.

Topical Formulation

Ingredients	Grams
Active compound	0.2-2
Span 60	2
Tween 60	2
Mineral oil	5
Petrolatum	10
Methyl paraben	0.15
Propyl paraben	0.05
BHA (butylated hydroxy anisole)	0.01
Water	q.s. 100

5

All of the ingredients, except water, are combined and heated to about 60°C with stirring. A sufficient quantity of water at about 60°C is then added with vigorous stirring to emulsify the ingredients, and water then added q.s. about 100 g.

Nasal Spray Formulations

- 10 Several aqueous suspensions containing from about 0.025-0.5 percent active compound are prepared as nasal spray formulations. The formulations optionally contain inactive ingredients such as, for example, microcrystalline cellulose, sodium carboxymethylcellulose, dextrose, and the like. Hydrochloric acid may be added to adjust pH. The nasal spray formulations may be delivered via a nasal spray metered pump typically delivering about 50-
 15 100 microliters of formulation per actuation. A typical dosing schedule is 2-4 sprays every 4-12 hours.

Example 3

Intracellular Calcium Flux (FLIPR) Assay

Compound and Reagent Preparation

- 20 Stock solutions of compounds were prepared from powders as a 10 mM DMSO stock solution. These solutions were stored at RT during the two week period of these experiments to prevent freeze-thaw of the DMSO stocks. The DMSO stocks were added to the appropriate assay buffer at a concentration of 10 μ M, and then diluted serially to the final concentrations that were tested. No observable precipitate was formed at any time during this
 25 process. The aqueous solutions of compounds as well as ATP (Sigma A7699) and BzATP (Sigma B6396) were prepared fresh for each day of experiment.

Cell culture: 1321N1-hP2X₇ and HEK293-rP2X₇

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1321N1 cells stably expressing the full length human P2X₇ gene (1321N1-hP2X₇) and HEK293 cells stably expressing the full length rat P2X₇ gene (HEK293-rP2X₇) were obtained from the Roche Cell Culture Facility. 1321N1-hP2X₇ cells were grown in Dulbecco's Modified Eagle's Medium (DMEM) high glucose supplemented with 10% FBS and 250 µg/mL G418. HEK293-rP2X₇ cells were grown in DMEM/F-12 supplemented with 10% FBS, 1 mM CaCl₂, 2 mM MgCl₂, 2 mM L-Glutamine and 500 µg/ml G418. Cells were split such that they never became >70% confluent.

Intracellular Calcium Flux (FLIPR)

On the day prior to the experiment, 1321N1-hP2X₇ or HEK293-rP2X₇ cells were released into suspension with calcium-free PBS + Versene and washed by centrifugation with calcium-free PBS to remove the Versene. Cells were resuspended in growth medium at a density of 2.5×10^5 cells/mL and seeded into black walled, clear bottom 96 well plates (50,000 cells/well) approximately 18 hr prior to intracellular calcium flux experiments.

On the day of the experiment, plates were washed with FLIPR buffer (calcium- and magnesium-free Hank's Balanced Salt Solution (HBSS) supplemented with 10 mM Hepes, 2.5 mM probenecid and 2 mM calcium chloride) using a BIO-TEK 96 channel plate washer and incubated with 2 mM fluo-3 dye at 37°C for one hr. The dye was then removed by plate washing and the cells were allowed to equilibrate for 20 min at room temperature with antagonist or vehicle (FLIPR buffer). Agonist (100 µM BzATP final concentration for hP2X₇; 5 µM BzATP final concentration or rP2X₇) was added online with the FLIPR and fluorescence measurements made at 1 sec intervals for 60 sec followed by 3 sec intervals for a further 4 min (5 min total). A final addition of 5 µM ionomycin was made and the maximal BzATP-evoked fluorescence normalized to the maximal ionomycin-evoked fluorescence.

Example 4

Human Whole Blood IL-1β Release Assay

Compound & Reagent Preparation

10 mM stock solutions of compounds in DMSO (Sigma D2650) were prepared and used either fresh or after storage at -20°C. Appropriate (200x) serial dilutions of the compounds were made in DMSO, then freshly diluted 1 to 20 (10x) with Dulbecco's phosphate buffered saline (DPBS; Mediatech Inc., 21-030), such that final DMSO concentration in the blood always equaled 0.5%.

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30 mM ATP (Sigma A7699) was prepared immediately before use in 50 mM HEPES (Gibco 15630) and the pH adjusted to 7.2 with 1M sodium hydroxide.

Blood Donors

Human blood donors were medication free and restricted from utilizing alcohol or caffeine for at least the 24 hr preceding collection. The blood was collected into sodium heparin vacutainer tubes and used the same day.

Assay Method

The OptEIA Human IL-1 β ELISA Set, OptEIA Coating Buffer, Assay Diluent and TMB Substrate Reagent Set used in the assay were commercially obtained from BD Pharmingen.

10 Blood was diluted 1:1 with Dulbecco's PBS, LPS (*Escherichia Coli* 0127:B8, Sigma L3129) added to a final concentration of 25 ng/mL and incubated for 2 hr at 37°C. 48 μ L of this LPS primed blood was added to 6 μ L of the 10x compound in 5% DMSO/PBS in the appropriate well of a 96-well polypropylene plate. The blood and compound were mixed and allowed to incubate for 30 min at 37°C. 6 μ L of 30 mM ATP was added to the LPS-primed blood +

15 compound, mixed thoroughly and incubated for a further 30 min at 37°C. 96 μ L of ELISA assay buffer was added to each well and the plate centrifuged at 4°C 1,200 rpm for 10 min. Supernatant was removed and assayed for IL-1 β using the OptiEIA kit according to the manufacturer's protocol (Serum may be frozen at -20°C prior to assay). IC₅₀s were calculated using XLfit.

20

Example 5

In vivo Assay for Asthma and Lung Function

BALb/cJ mice are immunized with a standard immunization protocol. Briefly, mice (N=8/group) are immunized i.p. with ovalbumin (OVA; 10 μ g) in alum on days 0 and 14. Mice are then challenged with aerosolized OVA (5%) on day 21 and 22. Animals receive

25 vehicle (p.o.) or a compound of the invention (100 mg/kg p.o.) all starting on day 20. Lung function is evaluated on day 23 using the Buxco system to measure PenH in response to an aerosol methacholine challenge. Mice are then euthanized and plasma samples collected at the end of the study.

While the present invention has been described with reference to the specific embodiments

30 thereof, it should be understood by those skilled in the art that various changes may be made and equivalents may be substituted without departing from the true spirit and scope of the invention. In addition, many modifications may be made to adapt a particular situation,

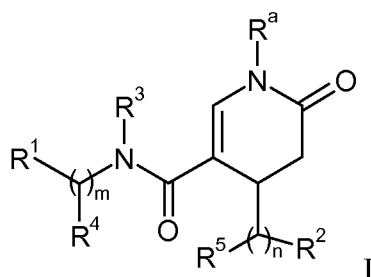
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material, composition of matter, process, process step or steps, to the objective spirit and scope of the present invention. All such modifications are intended to be within the scope of the claims appended hereto.

CLAIMS

What is claimed is:

1. A compound of formula I:



or pharmaceutically acceptable salts thereof,
wherein:

m is 0 or 1;

n is 0 or 1;

R¹ is:

optionally substituted aryl;

R² is:

optionally substituted aryl;

optionally substituted heteroaryl;

C₃₋₆cycloalkyl; or

R² is C₁₋₆alkyl;

R³ is:

hydrogen;

C₁₋₆alkyl;

alkylcarbonylalkyl; or

alkoxycarbonylalkyl;

R⁴ and R⁵ each independently is:

hydrogen; or

C₁₋₆alkyl; and

R^a is:

hydrogen;

C₁₋₆alkyl;

hydroxy-C₁₋₆alkyl; or

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C₁₋₆alkoxy-C₁₋₆alkyl; or
hydroxy C₁₋₆alkoxy- C₁₋₆alkyl.

2. The compound of claim 1, wherein m is 0.

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3. The compound according to claim 1 or 2, wherein n is 0.

4. The compound according to any one of claims 1 to 3, wherein R³, R⁴, R⁵ and R^a are hydrogen.

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5. The compound according to any one of claims 1 to 4, wherein R¹ is optionally substituted phenyl.

6. The compound according to any one of claims 1 to 5, wherein R¹ is phenyl substituted

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one, two, three or four times with a substituent or substituents each independently selected from: halo; C₁₋₆alkyl; C₁₋₆alkoxy; halo-C₁₋₆alkyl; halo-C₁₋₆alkoxy; C₁₋₆alkylsulfonyl; C₁₋₆alkylsulfanyl; C₁₋₆alkylsulfinyl; phenylsulfonyl wherein the phenyl portion is optionally substituted with C₁₋₆alkyl; nitrile; hydroxy; C₁₋₆alkylcarbonyl; aminocarbonyl; C₁₋₆alkoxycarbonyl; C₁₋₆alkoxycarbonyl-C₁₋₆alkoxy; C₁₋₆alkylcarbonyl-C₁₋₆alkoxy;

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hydroxycarbonyl; hydroxycarbonyl-C₁₋₆alkoxy; C₁₋₆alkoxy-hydroxyC₁₋₆alkoxy; C₁₋₆alkylaminocarbonyl-C₁₋₆alkoxy; C₁₋₆alkoxy-C₁₋₆alkoxy; hydroxy-C₁₋₆alkoxy; C₁₋₆alkylamino-C₁₋₆alkoxy; C₁₋₆alkylsulfonyl-C₁₋₆alkoxy; sulfonamido; hydroxy-C₁₋₆alkyl; C₃₋₆cycloalkyl-C₁₋₆alkoxy; amino; amino-C₁₋₆alkyl; C₁₋₆alkenyl; C₁₋₆alkynyl; morpholynyl; morpholynyl-C₁₋₆alkyl; piperazinyl; piperidinyloxy; aminocarbonyl-C₁₋₆alkoxy; C₁₋₆alkoxyamino-C₁₋₆alkyl; hydroxy-C₁₋₆alkylamino-C₁₋₆alkyl; di(hydroxy-C₁₋₆alkyl)amino-C₁₋₆alkyl; C₁₋₆alkoxycarbonylamino-C₁₋₆alkyl; C₁₋₆alkylcarbonylamino-C₁₋₆alkyl; C₁₋₆alkylaminocarbonyl; C₁₋₆alkoxycarbonylC₁₋₆alkyl; C₁₋₆alkylaminocarbonyl-C₁₋₆alkyl; C₁₋₆alkylamino-C₁₋₆alkyl; hydroxycarbonyl-C₁₋₆alkyl; or nitro; or two adjacent substituents may form a C₃₋₄alkylene, C₁₋₂alkylenedioxy or halo-C₁₋₂alkylenedioxy.

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7. The compound according to any one of claims 1 to 5, wherein R¹ is phenyl substituted one, two, three or four times with a substituent or substituents each independently selected from: halo; C₁₋₆alkyl; C₁₋₆alkoxy; halo-C₁₋₆alkyl; halo-C₁₋₆alkoxy; C₁₋₆alkylsulfonyl; C₁₋

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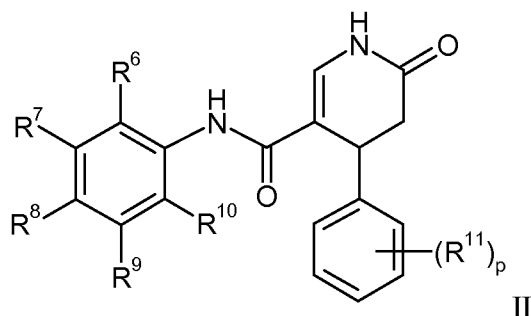
alkylsulfanyl; C₁₋₆alkylsulfinyl; phenylsulfonyl wherein the phenyl portion is optionally substituted with C₁₋₆alkyl; nitrile; hydroxy; C₁₋₆alkylcarbonyl; aminocarbonyl; C₁₋₆alkoxycarbonyl; C₁₋₆alkoxycarbonyl-C₁₋₆alkoxy; hydroxycarbonyl; hydroxycarbonyl-C₁₋₆alkoxy; C₁₋₆alkylaminocarbonyl-C₁₋₆alkoxy; C₁₋₆alkoxy-C₁₋₆alkoxy; hydroxy-C₁₋₆alkoxy; C₁₋₆alkylamino-C₁₋₆alkoxy; C₁₋₆alkylsulfonyl-C₁₋₆alkoxy; hydroxy-C₁₋₆alkyl; C₃₋₆cycloalkyl-C₁₋₆alkoxy; amino; amino-C₁₋₆alkyl; C₁₋₆alkenyl; C₁₋₆alkynyl; morpholinyl; morpholinyl-C₁₋₆alkyl; piperazinyl; piperidinyloxy; aminocarbonyl-C₁₋₆alkoxy; C₁₋₆alkoxyamino-C₁₋₆alkyl; hydroxy-C₁₋₆alkylamino-C₁₋₆alkyl; C₁₋₆alkoxycarbonylamino-C₁₋₆alkyl; C₁₋₆alkylcarbonylamino-C₁₋₆alkyl; C₁₋₆alkylaminocarbonyl; C₁₋₆alkoxycarbonyl-C₁₋₆alkyl; C₁₋₆alkylaminocarbonyl-C₁₋₆alkyl; C₁₋₆alkylamino-C₁₋₆alkyl; hydroxycarbonyl-C₁₋₆alkyl; or nitro; or two adjacent substituents may form a C₁₋₂alkylenedioxy or halo-C₁₋₂alkylenedioxy.

8. The compound according to any one of claims 1 to 7, wherein R¹ is phenyl substituted one, two, three or four times with a substituent or substituents each independently selected from: fluoro; chloro; bromo; iodo; methyl; ethyl; methoxy; ethoxy; trifluoromethyl; difluoromethoxy; trifluoromethoxy; methanesulfonyl; methanesulfanyl; methanesulfinyl; toluenesulfonyl; nitrile; acetyl; aminocarbonyl; methoxycarbonyl; methoxycarbonylmethoxy; carboxy; hydroxycarbonylmethoxy; methylaminocarbonylmethoxy; methoxyethoxy; hydroxyethoxy; methylaminoethoxy; methanesulfonylpropyloxy; hydroxymethyl; hydroxyethyl; cyclopropylmethoxy; amino; or nitro; morpholinyl; N,N-dimethylaminocarbonylmethoxy; boc-piperazinyl; N-(2-methoxyethyl)-N-methylaminomethyl; N,N-dimethylaminomethyl; aminomethyl; boc-aminomethyl; methylcarbonylaminoethyl; N,N-di-(2-hydroxyethyl)-aminomethyl; morpholinylmethyl; 2-hydroxy-1-hydroxymethyl-ethyl; methylaminocarbonyl; piperidinyloxy; tert-butoxycarbonylmethyl; N,N-dimethylaminocarbonylmethyl; n-propyl; isopropyl; hydroxycarbonylmethyl; hydroxypropoxy; or two adjacent substituents may form methylenedioxy, ethylenedioxy or difluoromethylenedioxy.

9. The compound according to any one of claims 1 to 8, wherein R¹ is phenyl substituted one, two, three or four times with a substituent or substituents each independently selected from: halo; C₁₋₆alkyl; C₁₋₆alkoxy; halo-C₁₋₆alkyl; halo-C₁₋₆alkoxy; C₁₋₆alkylsulfonyl; nitrile; C₁₋₆alkoxy-C₁₋₆alkoxy; hydroxy-C₁₋₆alkoxy; C₁₋₆alkylsulfonyl-C₁₋₆alkoxy; hydroxy-C₁₋₆alkyl; hydroxy-C₁₋₆alkylamino; C₁₋₂alkylenedioxy; or C₃₋₆cycloalkyl-C₁₋₆alkoxy.

10. The compound according to any one of claims 1 to 9, wherein R^1 is phenyl substituted one, two, three or four times with a substituent or substituents each independently selected from: fluoro; chloro; bromo; iodo; methyl; ethyl; methoxy; ethoxy; trifluoromethyl; difluoromethoxy; methanesulfonyl; nitrile; methoxyethoxy; hydroxyethoxy; hydroxymethyl; hydroxyethyl; hydroxypropoxy; methylenedioxy; or ethylenedioxy.
11. The compound according to any one of claims 1 to 10, wherein R^1 is phenyl optionally substituted one, two or three times with a substituent or substituents each independently selected from: fluoro; chloro; bromo; methyl; ethyl; methoxy; ethoxy; trifluoromethyl; difluoromethoxy; nitrile; methoxyethoxy; hydroxyethoxy; hydroxymethyl; hydroxyethyl; or cyclopropylmethoxy.
12. The compound according to any one of claims 1 to 11, wherein R^2 is optionally substituted phenyl.
13. The compound according to any one of claims 1 to 12, wherein R^2 is phenyl optionally substituted one, two or three times with a substituent or substituents each independently selected from: fluoro; chloro; bromo; methyl; ethyl; methoxy; ethoxy; trifluoromethyl; difluoromethoxy; nitrile; methoxyethoxy; hydroxyethoxy; hydroxymethyl; hydroxyethyl; or cyclopropylmethoxy.
14. The compound according to any one of claims 1 to 13, wherein R^2 is phenyl substituted once or twice with a substituent or substituents each independently selected from: fluoro; chloro; methyl; methoxy; or nitrile.
15. The compound according to any one of claims 1 to 14, wherein R^2 is phenyl substituted once or twice with fluoro.
16. The compound of claim 1, wherein said compound is of formula II:

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wherein:

p is from 0 to 3;

- R^6 , R^7 , R^8 , R^9 and R^{10} each independently is: hydrogen; halo; C_{1-6} alkyl; C_{1-6} alkoxy; halo- C_{1-6} alkyl; halo- C_{1-6} alkoxy; C_{1-6} alkylsulfonyl; C_{1-6} alkylsulfanyl; C_{1-6} alkylsulfinyl; phenylsulfonyl wherein the phenyl portion is optionally substituted with C_{1-6} alkyl; nitrile; hydroxy; alkylcarbonyl; aminocarbonyl; alkoxycarbonyl; alkoxycarbonylalkoxy; hydroxycarbonyl; hydroxycarbonylalkoxy; alkylaminocarbonylalkoxy; alkoxyalkoxy; hydroxyalkoxy; alkylaminoalkoxy; alkylsulfonylalkoxy; hydroxyalkyl; C_{3-6} cycloalkyl- C_{1-6} alkoxy; amino; aminoalkyl; or nitro; or two adjacent substituents may form a C_{1-2} alkylenedioxy or halo- C_{1-2} alkylenedioxy; and
- each R^{11} independently is: halo; C_{1-6} alkyl; C_{1-6} alkoxy; halo- C_{1-6} alkyl; halo- C_{1-6} alkoxy; C_{1-6} alkylsulfonyl; or nitrile.

17. The compound of claim 16, wherein at least two of R^6 , R^7 , R^8 , R^9 and R^{10} are not hydrogen.

18. The compound according to claim 16 or 17, wherein R^6 , R^7 , R^8 , R^9 and R^{10} each independently is: hydrogen; fluoro; chloro; bromo; iodo; methyl; ethyl; methoxy; ethoxy; trifluoromethyl; difluoromethoxy; trifluoromethoxy; methanesulfonyl; methanesulfanyl; methanesulfinyl; toluenesulfonyl; nitrile; acetyl; aminocarbonyl; methoxycarbonyl; methoxycarbonylmethoxy; carboxy; hydroxycarbonylmethoxy; methylaminocarbonylmethoxy; methoxyethoxy; hydroxyethoxy; methylaminoethoxy; methanesulfonylpropyloxy; hydroxymethyl; hydroxyethyl; cyclopropylmethoxy; amino; or nitro; morpholinyl; N,N-dimethylaminocarbonylmethoxy; boc-piperazinyl; N-(2-methoxyethyl)-N-methylaminomethyl; N,N-dimethylaminomethyl; aminomethyl; boc-aminomethyl; methylcarbonylaminomethyl; N,N-di-(2-hydroxyethyl)-aminomethyl; morpholinylmethyl; 2-hydroxy-1-hydroxymethyl-ethyl; methylaminocarbonyl;

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piperidinyloxy; tert-butoxycarbonylmethyl; N,N-dimethylaminocarbonylmethyl; n-propyl; isopropyl; hydroxycarbonylmethyl; hydroxypropoxy; or two adjacent substituents may form methylenedioxy, ethylenedioxy or difluoromethylenedioxy

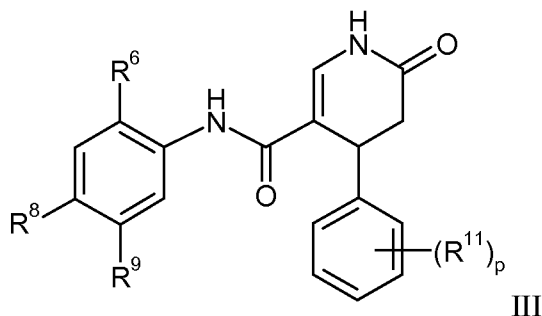
- 5 19. The compound according to any one of claims 16 to 18, wherein R^6 , R^7 , R^8 , R^9 and R^{10} each independently is: hydrogen; halo; C_{1-6} alkyl; C_{1-6} alkoxy; halo- C_{1-6} alkyl; halo- C_{1-6} alkoxy; C_{1-6} alkylsulfonyl; nitrile; alkoxyalkoxy; hydroxyalkoxy; alkylsulfonylalkoxy; hydroxyalkyl; or C_{3-6} cycloalkyl- C_{1-6} alkoxy.
- 10 20. The compound according to any one of claims 16 to 19, wherein R^6 , R^7 , R^8 , R^9 and R^{10} each independently is: hydrogen; fluoro; chloro; bromo; iodo; methyl; ethyl; methoxy; ethoxy; trifluoromethyl; difluoromethoxy; methanesulfonyl; nitrile; methoxyethoxy; hydroxyethoxy; hydroxymethyl; hydroxyethyl; or cyclopropylmethoxy.
- 15 21. The compound according to any one of claims 16 to 20, wherein R^6 , R^7 , R^8 , R^9 and R^{10} each independently is: hydrogen; fluoro; chloro; bromo; methyl; ethyl; methoxy; ethoxy; trifluoromethyl; difluoromethoxy; nitrile; methoxyethoxy; hydroxyethoxy; hydroxymethyl; hydroxyethyl; or cyclopropylmethoxy.
- 20 22. The compound according to any one of claims 16 to 21, wherein R^7 and R^{10} are hydrogen.
23. The compound according to any one of claims 16 to 22, wherein R^6 is: hydrogen; halo; or methyl.
- 25 24. The compound according to any one of claims 16 to 23, wherein R^8 is: hydrogen; methoxy; halo; methyl; or difluoromethoxy.
25. The compound according to any one of claims 16 to 24, wherein R^9 is: methoxy; 30 hydrogen; 2-hydroxy-ethoxy; 2-methoxy-ethoxy; 1-hydroxy-ethyl; or cyclopropylmethyl.
26. The compound according to any one of claims 16 to 25, wherein p is 0, 1 or 2.

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27. The compound according to any one of claims 16 to 26, wherein R^{11} is halo, preferably fluoro.

28. The compound of claim 16, wherein said compound is of formula III

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wherein R^6 , R^8 , R^9 and R^{11} are as recited in claim 16.

29. A pharmaceutical composition comprising:

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- (a) a pharmaceutically acceptable carrier; and
- (b) a compound according to any one of claims 1 to 28.

30. A method for treating arthritis, said method comprising administering to a subject in need thereof an effective amount of a compound according to any one of claims 1 to 28.

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31. A method for treating a pain condition selected from inflammatory pain, surgical pain, visceral pain, dental pain, premenstrual pain, central pain, pain due to burns, migraine or cluster headaches, nerve injury, neuritis, neuralgias, poisoning, ischemic injury, interstitial cystitis, cancer pain, viral, parasitic or bacterial infection, post-traumatic injury, or pain associated with irritable bowel syndrome, said method comprising administering to a subject in need thereof an effective amount of a compound according to any one of claims 1 to 28.

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32. A method for treating a respiratory disorder selected from chronic obstructive pulmonary disorder (COPD), asthma, and bronchospasm, said method comprising administering to a subject in need thereof an effective amount of a compound according to any one of claims 1 to 28.

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33. A method for treating diabetes, said method comprising administering to a subject in need thereof an effective amount of according to any one of claims 1 to 28.

34. Compound according to any one of the claims 1 to 28 for use in the treatment of an
5 inflammatory disorder.

35. The invention as described herein above.