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**A61K 31/445** <sup>(2006.01)</sup> **A61P 25/04** <sup>(2006.01)</sup>

(54) **1-(4-PIPERIDINYL)-1,3-DIHYDRO-2H-INDOLE-2-ONE DERIVATIVES AND RELATED COMPOUNDS AS NOCICEPTIN ANALOGS AND ORL1 LIGANDS FOR THE TREATMENT OF PAIN**

1-(4-PIPERIDINYL)-1,3-DIHYDRO-2H-INDOL-2-ON DERIVATE UND VERWANDTE VERBINDUNGEN ALS NOCICEPTIN ANALOGE UND ORL1 LIGANDEN ZUR BEHANDLUNG VON SCHMERZ

DERIVÉS DE LA 1-(4-PIPERIDINYL)-1,3-DIHYDRO-2H-INDOLE-2-ONE ET COMPOSÉS SIMILAIRES POUR L'UTILISATION COMME ANALOGUES DU NOCICEPTIN ET LIGANDS DU ORL1 POUR LE TRAITEMENT DE LA DOULEUR

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- KLEIN: "DARSTELLUNG VON 1-(PIPERIDINYL-4)-INDOLINONEN-(2) UND 3,4-DIHYDROCARBOSTYRILEN. 3. MITT.: UBER POTENTIELLE ANALGETIKA. SYNTHESIS OF 1-(PIPERIDINYL-4)-INDOLINONES-(2) AND 3,4-DIHYDROCARBOSTYRILES" ARCHIV DER PHARMAZIE, VCH VERLAGSGESELLSCHAFT MBH, WEINHEIM, DE, vol. 307, no. 5, 1974, pages 360-366, XP000603389 ISSN: 0365-6233
  - DATABASE CA[Online]CHEMICAL ABSTRACTS SERVICE, COLUMBUS, OHIO, US; 1981, LOBBEZOO, MARINUS W. ET AL: "Opiate receptor interaction of compounds derived from or structurally related to fentanyl" XP002344166 retrieved from STN Database accession no. 1981: 417982 & JOURNAL OF MEDICINAL CHEMISTRY , 24(7), 777-82 CODEN: JMCMAR; ISSN: 0022-2623, 1981,
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  - FORBES: "A short and efficient synthesis of N-substituted indol-2-ones (oxindoles)" TETRAHEDRON LETTERS, ELSEVIER SCIENCE PUBLISHERS, AMSTERDAM, NL, vol. 42, no. 39, 24 September 2001 (2001-09-24), pages 6943-6945, XP004317814 ISSN: 0040-4039

**Description**

**[0001]** This application claims priority from U.S. Provisional Application Serial Nos. 60/284,666; 60/284,667; 60/284,668; 60/284,669 all filed April 18, 2001.

**BACKGROUND OF THE INVENTION**

**[0002]** Chronic pain is a major contributor to disability and is the cause of an untold amount of suffering. The successful treatment of severe and chronic pain is a primary goal of the physician with opioid analgesics being preferred drugs.

**[0003]** Until recently, there was evidence of three major classes of opioid receptors in the central nervous system (CNS), with each class having subtype receptors. These receptor classes were designated as  $\mu$ ,  $\delta$  and  $\kappa$ . As opiates had a high affinity to these receptors while not being endogenous to the body, research followed in order to identify and isolate the endogenous ligands to these receptors. These ligands were identified as enkephalins, endorphins and dynorphins.

**[0004]** Recent experimentation has led to the identification of a cDNA encoding an opioid receptor-like (ORL1) receptor with a high degree of homology to the known receptor classes. This newly discovered receptor was classified as an opioid receptor based only on structural grounds, as the receptor did not exhibit pharmacological homology. It was initially demonstrated that non-selective ligands having a high affinity for  $\mu$ ,  $\delta$  and  $\kappa$  receptors had low affinity, for the ORL1. This characteristic, along with the fact that an endogenous ligand had not yet been discovered, led to the term "orphan receptor".

**[0005]** Subsequent research led to the isolation and structure of the endogenous ligand of the ORL1 receptor. This ligand is a seventeen amino acid peptide structurally similar to members of the opioid peptide family.

**[0006]** The discovery of the ORL1 receptor presents an opportunity in drug discovery for novel compounds which can be administered for pain management or other syndromes modulated by this receptor.

**[0007]** WO 99/32481 A in the name of Alcon Laboratories, Inc. discloses a group of compounds having muscarinic activity. Said compounds may be used in the manufacture of a medicament for treating glaucoma, myopia, psychosis and various other conditions involving muscarinic receptors.

**[0008]** US 5 789 402 in the name of Eli Lilly Company discloses compounds having effects on serotonin-related systems. Such hetero-oxy alkanamine compounds are effective pharmaceuticals for the treatment of conditions related to or affected by the reuptake of serotonin and by the serotonin 1 receptor.

**[0009]** WO 95/02405 A in the name of Merck & Co., Inc. discloses benzoxazinone and benzopyrimidinone piperidinyl compounds. Said compounds are useful as oxytocin and vasopressin receptor antagonists.

**[0010]** US 3 325 499 in the name of Ireland Poos discloses certain substituted oxindole compounds [(1-(1-hydrocarbonyl-4-piperidyl)-2-indolinones].

**[0011]** The publication by Klein et al., ARCHIV DER PHARMAZIE, VCH VERLAGSGESELLSCHAFT MBH, WEINHEIM, DE, vol. 307, no. 5, 1974, pages 360-366 describes the synthesis of 1-(piperidinyl-4)-indolinones-(2) and-3,4-dihydrocarbostyriles in order to obtain structural analoga of known analgesics.

**[0012]** The abstract of said article is also listed in the Database CA [online] of chemical abstracts, Columbus, Ohio, US [STN Database (accession no. 1974:477786)].

**[0013]** The publication by Lobbezoo and Soudijn, J.MED.CHEM., vol. 24, 1981, pages 777-782 is concerned with opiate receptor interaction of compounds derived from or structurally related to fentanyl. It discloses several compounds structurally related to fentanyl and the authors determine the affinities of said compounds towards the opiate receptor.

**[0014]** Another article by Klein et al., ARCH. PHARMAZ., vol. 308, no. 75, 1976, pages 910-916 discloses the synthesis and the pharmacological activities of cyclic analoga of fentanyl. Cyclisation of the acyl group with C-2 of the aromatic ring yields a change in stereochemical structure resulting in a loss of analgesic activity.

**[0015]** WO 00/6157S A in the name of EISAI CO., LTD. discloses a process for the production of indole derivatives and intermediates thereof. Said derivatives are useful as drugs.

**[0016]** EP 0 976 732 in the name of EISAI CO., LTD. discloses 1,4-substituted cyclic amine derivatives. Such compounds show serotonin antagonistic activity and are clinically useful as medicaments for treating e.g. ameliorating and preventing spastic paralysis.

**[0017]** WO 99/09984 A in the name of Merck & Co., Inc discloses certain pyrrolidine and piperidine compounds. These compounds may be useful as modulators of chemokine receptor activity.

**[0018]** WO 96/13265 A in the name of Merck & Co., Inc discloses 4-heterocycle substituted piperidines. Such compounds promote the release of growth hormone in humans and animals, which property may be used to promote e.g. the growth of food animals or to treat conditions characterized by a deficiency in growth hormone secretion.

**[0019]** EP 0 355 663 in the name of BASF AG discloses 2,6-polyalkylpiperidin-substituted bislactames and their use for stabilization of organic material.

**[0020]** US 5 760 054 in the name of Merck & Co., Inc discloses alpha 1C adrenergic receptor antagonists. Furthermore,

their synthesis and use as selective antagonists e.g. for the treatment of benign prostatic hypertrophy is disclosed.

**[0021]** WO 01/60796 A in the name of Meiji Seika Kaisha, LTD. discloses phenoxyalkylamine derivatives useful as opioid  $\delta$  receptor agonists.

**[0022]** WO 01/70689 A in the name of Meiji Seika Kaisha, LTD. discloses diphenylalkylamine derivatives useful as opioid  $\delta$  receptor agonists.

**[0023]** WO 02/14315 A in the name of Ortho McNeil Pharmaceutical, Inc. discloses substituted pyrazoles, methods of manufacturing them, compositions containing them, and methods of using them for treatment of e.g. autoimmune diseases mediated by cathepsin S.

**[0024]** WO 02/20011 A in the name of Ortho McNeil Pharmaceutical, Inc. also discloses substituted pyrazoles. Said pyrazoles are used in a method described therein for treating an allergic condition including an atopic allergic condition.

**[0025]** The publication by Forbes, TETRAHEDRON LETTERS, vol. 42, 2001, pages 6943-6945 describes the short and efficient synthesis of N-substituent indol-2-ones (oxindoles). Said synthesis strategy constitutes a general route to N-substituted indol-2-ones.

## OBJECTS AND SUMMARY OF THE INVENTION

**[0026]** It is accordingly an object of certain embodiments of the present invention to provide new compounds which exhibit affinity for the ORL1 receptor.

**[0027]** It is an object of certain embodiments of the present invention to provide new compounds which exhibit affinity for the ORL1 receptor and one or more of the  $\mu$ ,  $\delta$  or  $\kappa$  receptors.

**[0028]** It is an object of certain embodiments of the present invention to provide new compounds for treating a patient suffering from chronic or acute pain by administering a compound having affinity for the ORL1 receptor.

**[0029]** It is an object of certain embodiments of the present invention to provide new compounds which have agonist activity at the  $\mu$ ,  $\delta$  and  $\kappa$  receptors which is greater than compounds currently available e.g. morphine.

**[0030]** It is an object of certain embodiments of the present invention to describe the use of new compounds in accordance with the invention in the manufacture of a medicament for treating chronic and acute pain by administering compounds which have agonist activity at the  $\mu$ ,  $\delta$  and  $\kappa$  receptors which is greater than compounds currently available.

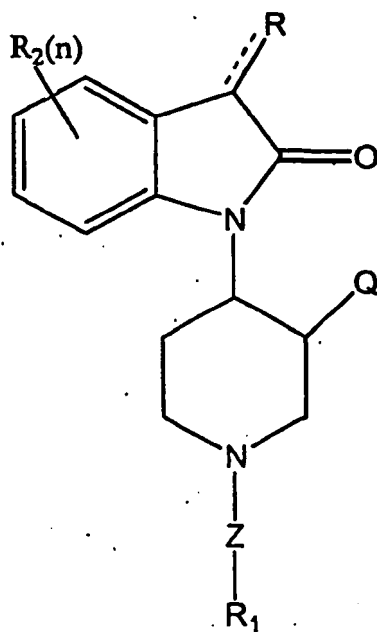
**[0031]** It is an object of certain embodiments of the present invention to describe the use of new compounds in accordance with the invention in the manufacture of a medicament for treating chronic and acute pain by administering non-opioid compounds which have agonist activity at the  $\mu$ ,  $\delta$  and  $\kappa$  receptors and which produce less side effects than compounds currently available.

**[0032]** It is an object of certain embodiments of the present invention to provide compounds useful as analgesics, anti-inflammatories, diuretics, anesthetics and neuroprotective agents, anti-hypertensives, anti-anxiolytics; agents for appetite control; hearing regulators; anti-tussives, anti-asthmatics, modulators of locomotor activity, modulators of learning and memory, regulators of neurotransmitter and hormone release, kidney function modulators, anti-depressants, agents to treat memory loss due to Alzheimer's disease or other dementias, anti-epileptics, anti-convulsants, agents to treat withdrawal from alcohol and drugs of addiction, agents to control water balance, agents to control sodium excretion and agents to control arterial blood-pressure disorders and methods for administering said compounds.

**[0033]** The compounds of the present invention are useful for modulating a pharmacodynamic response from one or more opioid receptors (ORL-1,  $\mu$ ,  $\delta$  and  $\kappa$ ) centrally and/or peripherally. The response can be attributed to the compound stimulating (agonist) or inhibiting (antagonist) the one or more receptors. Certain compounds can stimulate one receptor (e.g., a  $\mu$  agonist) and inhibit a different receptor (e.g., an ORL-1 antagonist).

**[0034]** Other objects and advantages of the present invention will become apparent from the following detailed description thereof.

**[0035]** The present invention in certain embodiments comprises compounds having the formula (IIA):



(IIA)

wherein

the dotted line represents an optional double bond;

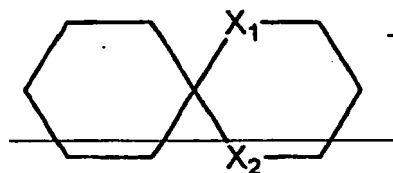
Z is selected from the group consisting of a bond,  $-\text{CH}_2-$ ,  $-\text{NH}-$ ,  $-\text{CH}_2\text{O}-$ ,  $-\text{CH}_2\text{CH}_2-$ ,  $-\text{CH}_2\text{NH}-$ ,  $-\text{CH}_2\text{N}(\text{CH}_3)-$ ,  $-\text{NHCH}_2-$ ,  $-\text{CH}_2\text{CONH}-$ ,  $-\text{NHCH}_2\text{CO}-$ ,  $-\text{CH}_2\text{CO}-$ ,  $-\text{COCH}_2-$ ,  $-\text{CH}_2\text{COCH}_2-$ ,  $-\text{CH}(\text{CH}_3)-$ ,  $-\text{CH}=\text{}$ , and  $-\text{HC}=\text{CH}-$ , wherein the carbon and/or nitrogen atoms are unsubstituted or substituted with a lower alkyl, halogen, hydroxy or alkoxy groups;

R and Q are the same or different and R is selected from the group, consisting of halogen,  $\text{C}_{1-10}$  alkyl,  $\text{C}_{1-10}$  alkenyl,  $\text{C}_{1-10}$  alkylidene,  $\text{C}_{3-12}$  cycloalkyl,  $\text{C}_{1-10}$  alkoxy, oxo;

and Q is selected from the group consisting of hydrogen, halogen,  $\text{C}_{1-10}$  alkyl,  $\text{C}_{1-10}$  alkenyl,  $\text{C}_{1-10}$  alkylidene,  $\text{C}_{3-12}$  cycloalkyl,  $\text{C}_{1-10}$  alkoxy, and oxo;

n is an integer from 0 to 3;

$\text{R}_1$  is selected from the group consisting of hydrogen,  $\text{C}_{1-10}$  alkyl,  $\text{C}_{3-12}$  Cycloalkyl,  $\text{C}_{2-10}$  alkenyl, amino,  $\text{C}_{1-10}$  alkylamino,  $\text{C}_{3-12}$  cycloalkylamino, benzyl,  $\text{C}_{3-12}$  cycloalkenyl, a monocyclic, bicyclic or tricyclic aryl or heteroaryl ring, a heteromonocyclic ring, a bicyclic ring system, and a spiro ring system of the formula (V):



(V)

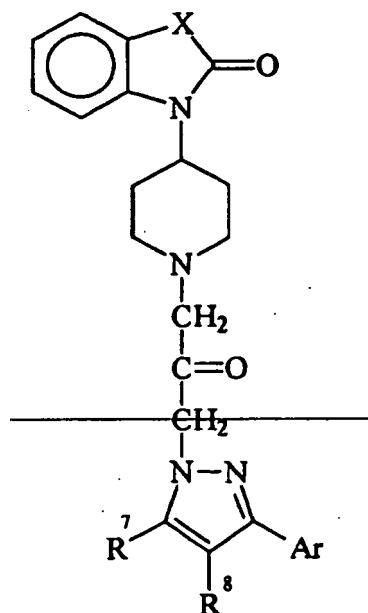
wherein  $\text{X}_1$  and  $\text{X}_2$  are independently selected from the group consisting of  $\text{NH}$ ,  $\text{O}$ ,  $\text{S}$  and  $\text{CH}_2$ ;

wherein said monocyclic aryl is preferably phenyl;

wherein said bicyclic aryl is preferably naphthyl;

wherein said alkyl, cycloalkyl, alkenyl,  $\text{C}_{1-10}$  alkylamino,  $\text{C}_{3-12}$  cycloalkylamino, or benzyl is optionally substituted with 1-3 substituents selected from the group consisting of halogen,  $\text{C}_{1-10}$  alkyl,  $\text{C}_{1-10}$  alkoxy, nitro, trifluoromethyl, cyano,

phenyl, benzyl, benzyloxy, said phenyl, benzyl, and benzyloxy optionally being substituted with 1-3 substituents selected from the group consisting of halogen, C<sub>1-10</sub> alkyl, C<sub>1-10</sub> alkoxy, and cyano;  
 wherein said C<sub>3-12</sub> cycloalkyl, C<sub>3-12</sub> cycloalkenyl, monocyclic, bicyclic or tricyclic aryl, heteroaryl ring, heteromono-cyclic ring, heterobicyclic ring system, and spiro ring system of the formula (V) are optionally substituted with 1-3  
 5 substituents selected from the group consisting of halogen, C<sub>1-10</sub> alkyl, C<sub>1-10</sub> alkoxy, nitro, trifluoromethyl, phenyl, benzyl, phenoxy and benzyloxy, wherein said phenyl, benzyl, phenoxy and benzyloxy are optionally substituted with 1-3 substituents selected from the group consisting of halogen, C<sub>1-10</sub> alkyl, C<sub>1-10</sub> alkoxy, and cyano;  
 R<sub>2</sub> is selected from the group consisting of hydrogen, C<sub>1-10</sub> alkyl, C<sub>3-12</sub>cycloalkyl and halogen, said alkyl optionally substituted with an oxo group;  
 10 but not a compound of the following formula



wherein X is CHR<sup>41</sup> and R<sup>41</sup> is C<sub>1-5</sub> alkyl and wherein Ar is a monocyclic aryl ring optionally substituted with halogen, C<sub>1-5</sub>alkoxy, C<sub>1-5</sub>alkyl and cyano and wherein R<sup>7</sup> and R<sup>8</sup> independently are hydrogen, C<sub>1-5</sub> alkyl and C<sub>1-5</sub> alkoxy or halogen; alternatively, R<sup>7</sup> and R<sup>8</sup> can be taken together to form an optionally substituted 5- to 7- membered carbocyclic or heterocyclic ring, which ring may be saturated, unsaturated or aromatic;

and pharmaceutically acceptable salts thereof.

**[0036]** In certain preferred embodiments Q of formula (IIA), is hydrogen or methyl.

**[0037]** In certain preferred embodiments, R of formula (IIA), is methyl, ethyl, or ethylidene.

**[0038]** In certain preferred embodiments of formula (IIA), the R<sub>1</sub> alkyl is methyl, ethyl, propyl, butyl, pentyl, or hexyl.

**[0039]** In certain preferred embodiments of formula (IIA), the R<sub>r</sub> cycloalkyl is cyclohexyl, cycloheptyl, cyclooctyl, cyclononyl, cyclodecyl, or norbornyl.

**[0040]** In other preferred embodiments of formula (IIA), the R<sub>1</sub> bicyclic ring system is naphthyl. In other preferred embodiments of formula (IIA), the R<sub>1</sub> bicyclic ring system is tetrahydronaphthyl, or decahydronaphthyl and the R<sub>1</sub> tricyclic ring system is dibenzocycloheptyl. In other preferred embodiments R<sub>1</sub> is phenyl or benzyl.

**[0041]** In other preferred embodiments of formula (IIA), the R<sub>1</sub> bicyclic aromatic ring is a 10-membered ring, preferably quinoline or naphthyl.

**[0042]** In other preferred embodiments of formula (IIA), the R<sub>1</sub> bicyclic aromatic ring is a 9-membered ring, preferably indenyl.

**[0043]** In certain embodiments of formula (IIA), Z is a bond, methyl, or ethyl.

**[0044]** In certain embodiments of formula (IIA), the Z group is maximally substituted as not to have any hydrogen substitution on the base Z group. For example, if the base Z group is -CH<sub>2</sub>-, substitution with two methyl groups would remove hydrogens from the -CH<sub>2</sub>- base Z group.

**[0045]** In other preferred embodiments of formula (IIA), n is 0.

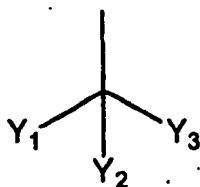
**[0046]** In certain embodiments of formula (IIA), X<sub>1</sub> and X<sub>2</sub> are both O.

[0047] In other preferred embodiments, the dotted line is a double bond.

[0048] In certain embodiments of formula (IV), at least one of  $ZR_1$  or R is  $-CH_2COOV_1$ , tetrazolylmethyl-, cyanomethyl-,  $NH_2SO_2$ methyl-,  $NH_2SO$ methyl-, aminocarbonylmethyl-,  $C_{1-4}$ alkylaminonylmethyl-, or  $diC_{1-4}$ alkylaminocarbonylmethyl-.

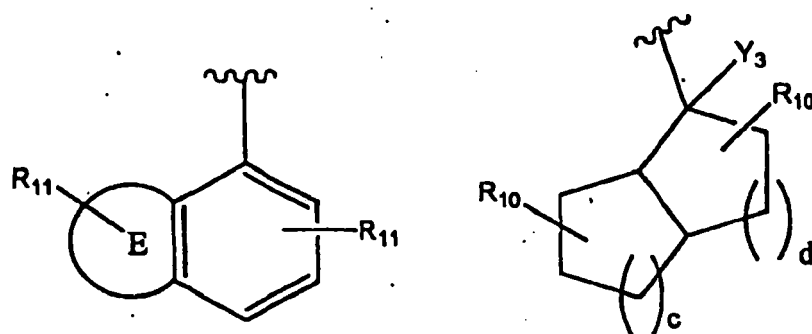
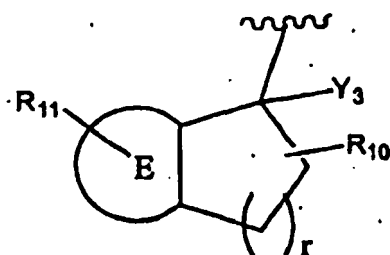
[0049] In certain embodiments of formula (IV),  $ZR_1$  is 3,3 diphenylpropyl optionally substituted at the 3 carbon of the propyl with  $-COOV_1$ , tetrazolyl $C_{0-4}$ alkyl-, cyano-, aminocarbonyl-,  $C_{1-4}$ alkylaminocarbonyl-, or  $diC_{1-4}$ alkylaminocarbonyl-.

[0050] In alternate embodiments of formula (IIA),  $ZR_1$  can be the following

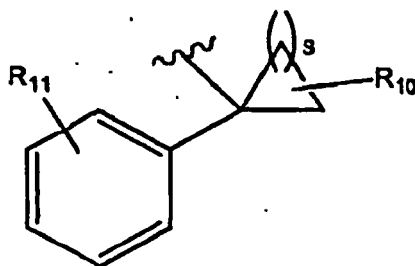


wherein

$Y_1$  is  $R_3-(C_1-C_{12})$ alkyl,  $R_4$ -aryl,  $R_5$ -heteroaryl,  $R_6-(C_3-C_{12})$ cyclo-alkyl,  $R_7-(C_3-C_7)$ heterocycloalkyl,  $-CO_2(C_1-C_6)$ alkyl, CN or  $-C(O)NR_8R_9$ ;  $Y_2$  is hydrogen or  $Y_1$ ;  $Y_3$  is hydrogen or  $(C_1-C_6)$ alkyl; or  $Y_1$ ,  $Y_2$  and  $Y_3$ , together with the carbon to which they are attached, form one of the following structures:



or



wherein  $r$  is 0 to 3;  $c$  and  $d$  are independently 1 or 2;  $s$  is 1 to 5; and ring E is a fused  $R_4$ -phenyl or  $R_5$ -heteroaryl ring;  $R_{10}$  is 1 to 3 substituents independently selected from the group consisting of H,  $(C_1-C_6)$ alkyl,  $-OR_8$ ,  $-(C_1-C_6)$ alkyl- $OR_8$ ,  $-NR_8R_9$  and  $-(C_1-C_6)$ alkyl- $NR_8R_9$ ;

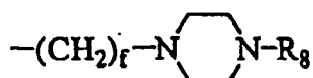
$R_{11}$  is 1 to 3 substituents independently selected from the group consisting of  $R_{10}$ ,  $-CF_3$ ,  $-OCF_3$ ,  $NO_2$  and halo, or  $R_{11}$  substituents on adjacent ring carbon atoms may together form a methylenedioxy or ethylenedioxy ring;

$R_8$  and  $R_9$  are independently selected from the group consisting of hydrogen,  $(C_1-C_6)$ alkyl,  $(C_3-C_{12})$ cycloalkyl, aryl and aryl $(C_1-C_6)$ alkyl;

$R_3$  is 1 to 3 substituents independently selected from the group consisting of H,  $R_4$ -aryl,  $R_6$ -( $C_3-C_{12}$ )cycloalkyl,  $R_5$ -heteroaryl,  $R_7$ -( $C_3-C_7$ )heterocycloalkyl,  $-NR_8R_9$ ,  $-OR_{12}$  and  $-S(O)_{0-2}R_{12}$ ;

$R_6$  is 1 to 3 substituents independently selected from the group consisting of H,  $(C_1-C_6)$ alkyl,  $R_4$ -aryl,  $-NR_8R_9$ ,  $-OR_{12}$  and  $-SR_{12}$ ;

$R_4$  is 1 to 3 substituents independently selected from the group consisting of hydrogen, halo,  $(C_1-C_6)$ alkyl,  $R_{13}$ -aryl,  $(C_3-C_{12})$ cycloalkyl,  $-CN$ ,  $-CF_3$ ,  $-OR_8$ ,  $-(C_1-C_6)$ alkyl- $OR_8$ ,  $-OCF_3$ ,  $-NR_8R_9$ ,  $-(C_1-C_6)$ alkyl- $NR_8R_9$ ,  $-NHSO_2R_8$ ,  $-SO_2N(R_{14})_2$ ,  $-SO_2R_8$ ,  $-SOR_8$ ,  $-SR_8$ ,  $-NO_2$ ,  $-CONR_8R_9$ ,  $-NR_9COR_8$ ,  $-COR_8$ ,  $-COCF_3$ ,  $-OCOR_8$ ,  $-OCO_2R_8$ ,  $-COOR_8$ ,  $-(C_1-C_6)$ alkyl- $NHCOOC(CH_3)_3$ ,  $-(C_1-C_6)$ alkyl- $NHCOCF_3$ ,  $-(C_1-C_6)$ alkyl- $NHSO_2$ -( $C_1-C_6$ )alkyl,  $-(C_1-C_6)$ alkyl- $NHCONH$ -( $C_1-C_6$ )alkyl and



wherein  $f$  is 0 to 6; or  $R_4$  substituents on adjacent ring carbon atoms may together form a methylenedioxy or ethylenedioxy ring;

$R_5$  is 1 to 3 substituents independently selected from the group consisting of hydrogen, halo,  $(C_1-C_6)$ alkyl,  $R_{13}$ -aryl,  $(C_3-C_{12})$ cycloalkyl,  $-CN$ ,  $-CF_3$ ,  $-OR_8$ ,  $-(C_1-C_6)$ alkyl- $OR_8$ ,  $-OCF_3$ ,  $-NR_8R_9$ ,  $-(C_1-C_6)$ alkyl- $NR_8R_9$ ,  $-NHSO_2R_8$ ,  $-SO_2N(R_{14})_2$ ,  $NO_2$ ,  $-CONR_8R_9$ ,  $-NR_9COR_8$ ,  $-COR_8$ ,  $-OCOR_8$ ,  $-OCO_2R_8$  and  $-COOR_8$ ;

$R_7$  is H,  $(C_1-C_6)$ alkyl,  $-OR_8$ ,  $-(C_1-C_6)$ alkyl- $OR_8$ ,  $-NR_8R_9$  or  $-(C_1-C_6)$ alkyl- $NR_8R_9$ ;

$R_{12}$  is H,  $(C_1-C_6)$ alkyl,  $R_4$ -aryl,  $-(C_1-C_6)$ alkyl- $OR_8$ ,  $-(C_1-C_6)$ alkyl- $NR_8R_9$ ,  $-(C_1-C_6)$ alkyl- $SR_8$ , or aryl  $(C_1-C_6)$ alkyl;

$R_{13}$  is 1-3 substituents independently selected from the group consisting of H,  $(C_1-C_6)$ alkyl,  $(C_1-C_6)$ alkoxy and halo;

$R_{14}$  is independently selected from the group consisting of H,  $(C_1-C_6)$ alkyl and  $R_{13}$ - $C_6H_4$ - $CH_2$ -.

**[0051]** As used herein, the term "alkyl" means a linear or branched saturated aliphatic hydrocarbon group having a single radical and 1-10 carbon atoms. Examples of alkyl groups include methyl, propyl, isopropyl, butyl, n-butyl, isobutyl, sec-butyl, tert-butyl, and pentyl. A branched alkyl means that one or more alkyl groups such as methyl, ethyl or propyl, replace one or both hydrogens in a  $-CH_2-$  group of a linear alkyl chain. The term "lower alkyl" means an alkyl of 1-3 carbon atoms.

**[0052]** The term "alkoxy" means an "alkyl" as defined above connected to an oxygen radical.

**[0053]** The term "cycloalkyl" means a non-aromatic mono- or multicyclic hydrocarbon ring system having a single radical and 3-12 carbon atoms. Exemplary monocyclic cycloalkyl rings include cyclopropyl, cyclopentyl, and cyclohexyl. Exemplary multicyclic cycloalkyl rings include adamantyl and norbornyl.

**[0054]** The term "alkenyl" means a linear or branched aliphatic hydrocarbon group containing a carbon-carbon double bond having a single radical and 2-10 carbon atoms.

**[0055]** A "branched" alkenyl means that one or more alkyl groups such as methyl, ethyl or propyl replace one or both hydrogens in a  $-CH_2-$  or  $-CH=$  linear alkenyl chain. Exemplary alkenyl groups include ethenyl, 1- and 2-propenyl, 1-, 2- and 3-butenyl, 3-methylbut-2-enyl, 2-propenyl, heptenyl, octenyl and decenyl.



**[0056]** The term "cycloalkenyl" means a non-aromatic monocyclic or multicyclic hydrocarbon ring system containing a carbon-carbon double bond having a single radical and 3 to 12 carbon atoms. Exemplary monocyclic cycloalkenyl rings include cyclopropenyl, cyclopentenyl, cyclohexenyl or cycloheptenyl. An exemplary multicyclic cycloalkenyl ring is norbornenyl.

**[0057]** The term "aryl" means a carbocyclic aromatic ring system containing one, two or three rings which may be attached together in a pendent manner or fused, and containing a single radical. Exemplary aryl groups include phenyl, naphthyl and acenaphthyl.

**[0058]** The term "heterocyclic" means cyclic compounds having one or more heteroatoms (atoms other than carbon) in the ring, and having a single radical. The ring may be saturated, partially saturated or unsaturated, and the heteroatoms may be selected from the group consisting of nitrogen, sulfur and oxygen. Examples of saturated heterocyclic radicals include saturated 3 to 6- membered hetero-monocyclic groups containing 1 to 4 nitrogen atoms, such as pyrrolidinyl, imidazolidinyl, piperidino, piperazinyl; saturated 3- to 6- membered hetero-monocyclic groups containing 1 to 2 oxygen atoms and 1 to 3. nitrogen atoms, such as morpholinyl; saturated 3- to 6- membered hetero-monocyclic groups containing 1 to 2 sulfur atoms and 1 to 3 nitrogen atoms, such as thiazolidinyl. Examples of partially saturated heterocyclic radicals include dihydrothiophene, dihydropyran, and dihydrofuran. Other heterocyclic groups can be 7 to 10 carbon rings substituted with heteroatoms such as oxocanyl and thiocanyl. When the heteroatom is sulfur, the sulfur can be a sulfur dioxide such as thiocanyldioxide.

**[0059]** The term "heteroaryl" means unsaturated heterocyclic radicals, wherein "heterocyclic" is as previously described. Exemplary heteroaryl groups include unsaturated 3 to 6 membered hetero-monocyclic groups containing 1 to 4 nitrogen atoms, such as pyrrolyl, pyridyl, pyrimidyl, and pyrazinyl; unsaturated condensed heterocyclic groups containing 1 to 5 nitrogen atoms, such as indolyl, quinolyl and isoquinolyl; unsaturated 3 to 6- membered hetero-monocyclic groups containing an oxygen atom, such as furyl; unsaturated 3 to 6 membered hetero-monocyclic groups containing a sulfur atom, such as thienyl; unsaturated 3 to 6 membered hetero-monocyclic groups containing 1 to 2 oxygen atoms and 1 to 3 nitrogen atoms, such as oxazolyl; unsaturated condensed, heterocyclic groups containing 1 to 2 oxygen atoms and 1 to 3 nitrogen atoms, such as benzoxazolyl; unsaturated 3 to 6 membered hetero-monocyclic groups containing 1 to 2 sulfur atoms and 1 to 3 nitrogen atoms, such as thiazolyl; and unsaturated condensed heterocyclic group containing 1 to 2 sulfur atoms and 1 to 3 nitrogen atoms, such as benzothiazolyl. The term "heteroaryl" also includes unsaturated heterocyclic radicals, wherein "heterocyclic" is as previously described, in which the heterocyclic group is fused with an aryl group, in which aryl is as previously described. Exemplary fused radicals include benzofuran, benzodioxole and benzothiophene.

**[0060]** As used herein, the term "heterocyclic<sub>C<sub>1-4</sub></sub> alkyl", "heteroaromatic<sub>C<sub>1-4</sub></sub>alkyl" and the like refer to the ring structure bonded to a C<sub>1-4</sub> alkyl radical.

**[0061]** All of the cyclic ring structures disclosed herein can be attached at any point where such connection is possible, as recognized by one skilled in the art.

**[0062]** As used herein, the term "patient" includes a human or an animal such as a companion animal or livestock.

**[0063]** As used herein, the term "halogen" includes fluoride, bromide, chloride, iodide or alabamide.

**[0064]** The invention disclosed herein is meant to encompass all pharmaceutically acceptable salts thereof of the disclosed compounds. The pharmaceutically acceptable salts include, but are not limited to, metal salts such as sodium salt, potassium salt, cesium salt and the like; alkaline earth metals such as calcium salt, magnesium salt and the like; organic amine salts such as triethylamine salt, pyridine salt, picoline salt, ethanolamine salt, triethanolamine salt, dicyclohexylamine salt, N,N'-dibenzylethylenediamine salt and the like; inorganic acid salts such as hydrochloride, hydrobromide, sulfate, phosphate and the like; organic acid salts such as formate, acetate, trifluoroacetate, maleate, fumarate, tartrate and the like; sulfonates such as methanesulfonate, benzenesulfonate, p-toluenesulfonate, and the like; amino acid salts such as arginate, asparinate, glutamate and the like.

**[0065]** The invention disclosed herein is also meant to encompass the disclosed compounds being isotopically-labelled by having one or more atoms replaced by an atom having a different atomic mass or mass number. Examples of isotopes that can be incorporated into the disclosed compounds include isotopes of hydrogen, carbon, nitrogen, oxygen, phosphorous, fluorine and chlorine, such as <sup>2</sup>H, <sup>3</sup>H, <sup>13</sup>C, <sup>14</sup>C, <sup>15</sup>N, <sup>18</sup>O, <sup>17</sup>O, <sup>13</sup>P, <sup>32</sup>P, <sup>35</sup>S, <sup>18</sup>F, and <sup>36</sup>Cl, respectively. Some of the compounds disclosed herein may contain one or more asymmetric centers and may thus give rise to enantiomers, diastereomers, and other stereoisomeric forms. The present invention is also meant to encompass all such possible forms as well as their racemic and resolved forms and mixtures thereof. When the compounds described herein contain olefinic double bonds or other centers of geometric asymmetry, and unless specified otherwise, it is intended to include both E and Z geometric isomers. All tautomers are intended to be encompassed by the present invention as well.

**[0066]** As used herein, the term "stereoisomers" is a general term for all isomers of individual molecules that differ only in the orientation of their atoms in space. It includes enantiomers and isomers of compounds with more than one chiral center that are not mirror images of one another (diastereomers).

**[0067]** The term "chiral center" refers to a carbon atom to which four different groups are attached.

**[0068]** The term "enantiomer" or "enantiomeric" refers to a molecule that is nonsuperimposable on its mirror image.

and hence optically active wherein the enantiomer rotates the plane of polarized light in one direction and its mirror image rotates the plane of polarized light in the opposite direction.

**[0069]** The term "racemic" refers to a mixture of equal parts of enantiomers and which is optically inactive.

**[0070]** The term "resolution" refers to the separation or concentration or depletion of one of the two enantiomeric forms of a molecule.

**[0071]** The term "modulate" as used herein with respect to the ORL-1 receptor means the mediation of a pharmacodynamic response (e.g., analgesia) in a subject from (i) inhibiting or activating the receptor, or (ii) directly or indirectly affecting the normal regulation of the receptor activity. Compounds which modulate the receptor activity include agonists, antagonists, mixed agonists/antagonists and compounds which directly or indirectly affect regulation of the receptor activity.

**[0072]** Certain preferred compounds of formula (IIA) include:

3-ethylidene-1-[1-(5-methylhex-2-yl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethylidene-1-[1-(4-propylcyclohexyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethylidene-1-[1-(1,2,3,4-tetrahydro-2-naphthyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethylidene-1-[1-(1,3-dihydroinden-2-yl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethylidene-1-[1-(naphth-2-yl-methyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethylidene-1-[1-(*p*-benzyloxybenzyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethylidene-1-[1-(benzyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethylidene-1-[1-(cyclooctylmethyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethylidene-1-[1-(norbornan-2-yl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethylidene-1-[1-(3,3-diphenylpropyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethylidene-1-[1-(*p*-cyanobenzyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethyl-1-[1-(5-methylhex-2-yl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethyl-1-[1-[4-(1-methylethyl)-cyclohexyl]-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethyl-1-[1-(4-propylcyclohexyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethyl-1-[1-(1,2,3,4-tetrahydro-2-naphthyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethyl-1-[1-(decahydro-2-naphthyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethyl-1-[1-(1,3-dihydroinden-2-yl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethyl-1-[1-(cyclooctylmethyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethyl-1-[1-(norbornan-2-yl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethyl-1-[1-(3,3-Bis(phenyl)propyl)-3-(methyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethyl-1-[1-(4-propylcyclohexyl)-3-(methyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethyl-1-[1-(5-methylhex-2-yl)-3-(methyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethyl-1-[1-[4-(1-methylethyl)cyclohexyl]-3-methyl-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethyl-1-[1-(decahydro-2-naphthyl)-3-(methyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one; and  
 pharmaceutically acceptable salts thereof and solvates thereof.

**[0073]** The present invention also provides use of any of the disclosed compounds in the preparation of a medicament for treating pain and other disease states modulated by an opioid receptor, e.g., the ORL-1 receptor.

## **DETAILED DESCRIPTION OF THE INVENTION**

**[0074]** The compounds of the present invention can be administered to anyone requiring modulation of the opioid and ORL1 receptors: Administration may be orally, topically, by suppository, inhalation, or parenterally.

**[0075]** The present invention also encompasses all pharmaceutically acceptable salts of the foregoing compounds. One skilled in the art will recognize that acid addition salts of the presently claimed compounds may be prepared by reaction of the compounds with the appropriate acid via a variety of known methods.

**[0076]** Various oral dosage forms can be used, including such solid forms as tablets, gelcaps, capsules, caplets, granules, lozenges and bulk powders and liquid forms such as emulsions, solution and suspensions. The compounds of the present invention can be administered alone or can be combined with various pharmaceutically acceptable carriers and excipients known to those skilled in the art, including but not limited to diluents suspending agents, solubilizers, binders, disintegrants, preservatives, coloring agents, lubricants and the like.

**[0077]** When the compounds of the present invention are incorporated into oral tablets, such tablets can be compressed, tablet triturates, enteric-coated, sugar-coated, film-coated, multiply compressed or multiply layered. Liquid oral dosage forms include aqueous and nonaqueous solutions, emulsions, suspensions, and solutions and/or suspensions reconstitute from non-effervescent granules, containing suitable solvents, preservatives, emulsifying agents, suspending agents, diluents, sweeteners, coloring agents, and flavoring agents. When the compounds of the present invention are

to be injected parenterally, they may be, e.g., in the form of an isotonic sterile solution. Alternatively, when the compounds of the present invention are to be inhaled, they may be formulated into a dry aerosol or may be formulated into an aqueous or partially aqueous solution.

**[0078]** In addition, when the compounds of the present invention are incorporated into oral dosage forms, it is contemplated that such dosage forms may provide an immediate release of the compound in the gastrointestinal tract, or alternatively may provide a controlled and/or sustained release through the gastrointestinal tract. A wide variety of controlled and/or sustained release formulations are well known to those skilled in the art, and are contemplated for use in connection with the formulations of the present invention. The controlled and/or sustained release may be provided by, e.g., a coating on the oral dosage form or by incorporating the compound(s) of the invention into a controlled and/or sustained release matrix.

**[0079]** Specific examples of pharmaceutically acceptable carriers and excipients that may be used to formulate oral dosage forms, are described in the Handbook of Pharmaceutical Excipients, American Pharmaceutical Association (1986). Techniques and compositions for making solid oral dosage forms are described in Pharmaceutical Dosage Forms: Tablets (Lieberman, Lachman and Schwartz, editors) 2nd edition, published by Marcel Dekker, Inc. Techniques and compositions for making tablets (compressed and molded), capsules (hard and soft gelatin) and pills are also described in Remington's Pharmaceutical Sciences (Arthur Osol, editor), 1553B1593 (1980). Techniques and composition for making liquid oral dosage forms are described in Pharmaceutical Dosage forms: Disperse Systems, (Lieberman, Rieger and Banker, editors) published by Marcel Dekker, Inc.

**[0080]** When the compounds of the present invention are incorporated for parenteral administration by injection (e.g., continuous infusion or bolus injection), the formulation for parenteral administration may be in the form of suspensions, solutions, emulsions in oily or aqueous vehicles, and such formulations may further comprise pharmaceutically necessary additives such as stabilizing agents, suspending agents, dispersing agents, and the like. The compounds of the invention may also be in the form of a powder for reconstitution as an injectable formulation.

**[0081]** In certain embodiments, the compounds of the present invention can be used in combination with at least one other therapeutic agent. Therapeutic agents include, but are not limited to,  $\mu$ -opioid agonists; non-opioid analgesics; non-steroid antiinflammatory agents; Cox-II inhibitors; antiemetics;  $\beta$ -adrenergic blockers; anticonvulsants; antidepressants;  $\text{Ca}^{2+}$ -channel blockers; anticancer agent and mixtures thereof.

**[0082]** In certain embodiments, the compounds of the present invention can be formulated in a pharmaceutical dosage form in combination with a  $\mu$ -opioid agonist.  $\mu$ -opioid agonists, which may be included in the formulations of the present invention include but are not limited to include alfentanil, allylprodine, alphaprodine, anileridine, benzylmorphine, bezitramide, buprenorphine, butorphanol, clonitazene, codeine, desomorphine, dextromoramide, dezocine, diampromide, diamorphine, dihydrocodeine, dihydromorphine, dimenoxadol, dimepheptanol, dimethylthiambutene, dioxaphetyl butyrate, dipipanone, eptazocine, ethoheptazine, ethylmethylthiambutene, ethylmorphine, etonitazene fentanyl, heroin, hydrocodone, hydromorphone, hydroxypethidine, isomethadone, ketobemidone, levorphanol, levophenacymorphan, lofentanil, meperidine, meptazinol, metazocine, methadone, metopon, morphine, myrophine, nalbuphine, narceine, nicomorphine, norlevorphanol, normethadone, nalorphine, normorphine, norpipanone, opium, oxycodone, oxymorphone, papaveretum, pentazocine; phenadoxone, phenomorphan, phenazocine, phenoperidine, piminodine, piritramide, proheptazine, promedol, properidine, propiram, propoxyphene, sufentanil, tilidine, tramadol, pharmaceutically acceptable salts thereof, and mixtures thereof.

**[0083]** In certain preferred embodiments, the  $\mu$ -opioid agonist is selected from codeine, hydromorphone, hydrocodone, oxycodone, dihydrocodeine, dihydromorphine, morphine, tramadol, oxymorphone, pharmaceutically acceptable salts thereof, and mixtures thereof.

**[0084]** In another embodiment of the invention, the medicament comprises a mixture of a Cox-II inhibitor and an inhibitor of 5-lipoxygenase for the treatment of pain and/or inflammation. Suitable Cox-II inhibitors and 5-lipoxygenase inhibitors, as well as combinations thereof are described in U.S. Patent No. 6,136,839, which is hereby incorporated by reference in its entirety. Cox-II inhibitors include, but are not limited to rofecoxib (Vioxx), celecoxib (Celebrex), DUP-697, flosulide, meloxicam, 6-MNA, L-745337, nabumetone, nimesulide, NS-398, SC-5766, T-614, L-768277, GR-253035, JTE-522, RS-57067-000, SC-58125, SC-078, PD-138387, NS-398, flosulide, D-1367, SC-5766, PD-164387, etoricoxib, valdecoxib and parecoxib or pharmaceutically acceptable salts, enantiomers or tautomers thereof.

**[0085]** The compounds of the present invention can also be combined in dosage forms with non-opioid analgesics, e.g., non-steroidal anti-inflammatory agents, including aspirin, ibuprofen, diclofenac, naproxen, benoxaprofen, flurbiprofen, fenoprofen, flubufen, ketoprofen, indoprofen, piroprofen, carprofen, oxaprozin, pramoprofen, muprofen, trioxaprofen, suprofen, aminoprofen, tiaprofenic acid, fluprofen, bucloxic acid, indomethacin, sulindac, tolmetin, zomepirac, tiopinac, zidometacin, acemetacin, fentiazac, clidanac, oxpinac, mefenamic acid, meclofenamic acid, flufenamic acid, niflumic acid, tolfenamic acid, diflurisal, flufenisal, piroxicam, sudoxicam or isoxicam, pharmaceutically acceptable salts thereof, and mixtures thereof. Other suitable non-opioid analgesics which may be included in the dosage forms of the present invention include the following, nonlimiting, chemical classes of analgesic, Antipyretic, nonsteroidal antiinflammatory drugs: salicylic acid derivatives, including aspirin, sodium salicylate, choline magnesium trisalicylate, salsalate,

diflunisal, salicylsalicylic acid, sulfasalazine, and olsalazin; para-aminophenol derivatives including acetaminophen; indole and indene acetic acids, including indomethacin, sulindac, and etodolac; heteroaryl acetic acids including tolmetin, diclofenac, and ketorolac; anthranilic acids (fenamates), including mefenamic acid, and meclofenamic acid; enolic acids, including oxicams (piroxicam, tenoxicam), and pyrazolidinediones (phenylbutazone, oxyphenanthazone); and alkanones, including nabumetone. For a more detailed description of the NSAIDs that may be included within the medicaments employed in the present invention, see Paul A. Insel Analgesic-Antipyretic and Antiinflammatory Agents and Drugs Employed in the treatment of Gout in Goodman & Gilman's The Pharmacological Basis of Therapeutics, 617-57 (Perry B. Molinoff and Raymond W. Ruddon, Eds., Ninth Edition, 1996), and Glen R. Hanson Analgesic, Antipyretic and Anti-Inflammatory Drugs in Remington: The Science and Practice of Pharmacy Vol II, 1196-1221 (A. R. Gennaro, Ed. 19th Ed. 1995).

**[0086]** In certain embodiments, the compounds of the present invention can be formulated in a pharmaceutical dosage form in combination with antimigraine agents. Antimigraine agents include, but are not limited to, alpiropride, dihydroergotamine, dolasetron, ergocornine, ergocorninine, ergocryptine, ergot, ergotamine, flumetorexone acetate, fonazine, lisuride, lomerizine, methysergide oxetorone, pizotyline, and mixtures thereof.

**[0087]** The other therapeutic agent can also be an adjuvant to reduce any potential side effects such as, for example, an antiemetic agent. Suitable antiemetic agents include, but are not limited to, metoclopramide, domperidone, prochlorperazine, promethazine, chlorpromazine, trimethobenzamide, ondansetron, granisetron, hydroxyzine, acetylleucine monoethanolamine, alizapride, azasetron, benzquinamide, biantanautine, bromopride, buclizine, clebopride, cyclizine, dimenhydrinate, diphenidol, dolasetron, meclizine, methallatal, metopimazine, nabilone, oxypemdyll, pipamazine, scopalamine, sulpiride, tetrahydrocannabinols, thiethylperazine, thioproperazine, tropisetron, and mixtures thereof.

**[0088]** In certain embodiments, the compounds of the present invention can be formulated in a pharmaceutical dosage form in combination with  $\beta$ -adrenergic blockers. Suitable  $\beta$ -adrenergic blockers include, but are not limited to, acebutolol, alprenolol, amosulabol, arotinolol, atenolol, befunolol, betaxolol, bevantolol, bisoprolol, bopindolol, bucumotol, bufetolol, bufuralol, bunitrolol, bupranolol, butidrine hydrochloride, butofilolol, carazolol, carteolol, carvedilol, celiprolol, cetamolol, cloranolol, dilevalol, epanolol, esmolol, indenolol, labetalol, levobunolol, mepindolol, metipranolol, metoprolol, moprolol, nadolol, nadoxolol, nebivolol, nifenalol, nipradilol, oxprenolol, penbutolol, pindolol, practolol, pronethalol, propranolol, sotalol, sulfinalol, talinolol, tertatolol, tilisolol, timolol, toliprolol, and xibenolol.

**[0089]** In certain embodiments, the compounds of the present invention can be formulated in a pharmaceutical dosage form in combination with anticonvulsants. Suitable anticonvulsants include, but are not limited to, acetylpheneturide, albutoin, aloxidone, aminoglutethimide, 4-amino-3-hydroxybutyric acid, atrolactamide, beclamide, buramate, calcium bromide, carbamazepine, cinromide, clomethiazole, clonazepam, decimemide, diethadione, dimethadione, doxenitroin, eterobarb, ethadione, ethosuximide, ethotoin, felbamate, fluoresone, gabapentin, 5-hydroxytryptophan, lamotrigine, magnesium bromide, magnesium sulfate, mephentoin, mephobarbital, metharbital, methetoin, methsuximide, 5-methyl-5-(3-phenanthryl)-hydantoin, 3-methyl-5-phenylhydantoin, narcobarbital, nimetazepam, nitrazepam, oxcarbazepine, paramethadione, phenacemide, phenetharbital, pheneturide, phenobarbital, phensuximide, phenylmethylbarbituric acid, phenytoin, phethenylate sodium, potassium bromide, pregabalin, primidone, progabide, sodium bromide, solanum, strontium bromide, suclofenide, sulthiame, tetrantoin, tiagabine, topiramate, trimethadione, valproic acid, valpromide, vigabatrin, and zonisamide.

**[0090]** In certain embodiments, the compounds of the present invention can be formulated in a pharmaceutical dosage form in combination with antidepressants. Suitable antidepressants include, but are not limited to, binedaline, caroxazone, citalopram, dimethazan, fencamine, indalpine, indeloxazine hydrochloride, nefopam, nomifensine, oxitriptan, oxyperline, paroxetine, sertraline, thiazesim, trazodone, benmoxine, iproclozide, iproniazid, isocarboxazid, nialamide, octamoxin, phenelzine, cotinine, rolicyprine, rolipram, maprotiline, metralindole, mianserin, mirtazepine, adinazolam, amitriptyline, amitriptylinoxide, amoxapine, butriptyline, clomipramine, demexiptiline, desipramine, dibenzepin, dimetacrine, dothiepin, doxepin, fluacizine, imipramine, imipramine N-oxide, iprindole, lofepramine, melitracen, metapramine, nortriptyline, noxiptilin, opipramol, pizotyline, propizepine, protriptyline, quinupramine, tianeptine, trimipramine, adrafinil, benactyzine, bupropion, butacetin, dioxadrol, duloxetine, etoperidone, febarbamate, femoxetine, fempentadiol, fluoxetine, fluvoxamine, hematoporphyrin, hypericin, levophacetoperane, medifoxamine, milnacipran, minaprine, moclobemide, nefazodone, oxaflozane, piberaline, prolintane, pyrisuccideanol, ritanserin, roxindole, rubidium chloride, sulpiride, tandospirone, thozalinone, tofenacin, toloxatone, tranlycypromine, L-tryptophan, venlafaxine, viloxazine, and zimeldine.

**[0091]** In certain embodiments, the compounds of the present invention can be formulated in a pharmaceutical dosage form in combination with  $\text{Ca}^{2+}$ -channel blockers. Suitable  $\text{Ca}^{2+}$ -channel blockers include, but are not limited to, bepridil, clentiazem, diltiazem, fendiline, gallopamil, mibefradil, prenylamine, semotiadil, terodiline, verapamil, amlodipine, arandipine, barnidipine, benidipine, cilnidipine, efonidipine, elgodipine, felodipine, isradipine, lacidipine, lercanidipine, manidipine, nifedipine, nifedipine, nilvadipine, nimodipine, nisoldipine, nitrendipine, cinnarizine, flunarizine, lidoflazine, lomerizine, bencyclane, etafenone, fantofarone, and perhexiline.

**[0092]** In certain embodiments, the compounds of the present invention can be formulated in a pharmaceutical dosage form in combination with anticancer agents. Suitable anticancer agents include, but are not limited to, acivicin; aclarubicin;

acodazole hydrochloride; acronine; adozelesin; aldesleukin; altretamine; ambomycin; ametantrone acetate; aminoglu-  
tethimide; amsacrine; anastrozole; anthramycin; asparaginase; asperlin; azacitidine; azetepa; azotomycin; batimastat;  
benzodepa; bicalutamide; bisantrene hydrochloride; bisnafide dimesylate; bizelesin; bleomycin sulfate; brequinar sodi-  
um; bropirimine; busulfan; cactinomycin; calusterone; caracemide; carbetimer; carboplatin; carmustine; carubicin hy-  
drochloride; carzelesin; cedefingol; chlorambucil; cirolemycin; cisplatin; cladribine; crisnatol mesylate; cyclophospha-  
mide; cytarabine; dacarbazine; dactinomycin; daunorubicin hydrochloride; decitabine; dexormaplatin; dezaguanine; de-  
zaguanine mesylate; diaziqune; docetaxel; doxorubicin; doxorubicin hydrochloride; droloxifene; droloxifene citrate;  
dromostanolone propionate; duazomycin; edatrexate; eflomithine hydrochloride; elsamitrucin; enloplatin; enpromate;  
epipropidine; epirubicin hydrochloride; erbulozole; esorubicin hydrochloride; estramustine; estramustine phosphate so-  
dium; etanidazole; etoposide; etoposide phosphate; etoprine; fadrozole hydrochloride; fazarabine; fenretinide; floxurid-  
ine; fludarabine phosphate; fluorouracil; fluocitabine; fosquidone; fostriecin sodium; gemcitabine; gemcitabine hydro-  
chloride; hydroxyurea; idarubicin hydrochloride; ifosfamide; ilmofofosine; interleukin II (including recombinant interleukin  
II, or rIL2), interferon alfa-2a; interferon alfa-2b; interferon alfa-n1 ; interferon alfa-n3; interferon beta-I a; interferon  
gamma-I b; iproplatin; irinotecan hydrochloride; lanreotide acetate; letrozole; leuprolide acetate; liarozole hydrochloride;  
lometrexol sodium; lomustine; losoxantrone hydrochloride; masoprocol; maytansine; mechlorethamine hydrochloride;  
megestrol acetate; melengestrol acetate; melphalan; menogaril; mercaptopurine; methotrexate; methotrexate sodium;  
metoprine; meturedopa; mitindomide; mitocarcin; mitocromin; mitogillin; mitomalcin; mitomycin; mitosper, mitotane; mi-  
toxantrone hydrochloride; mycophenolic acid; nocodazole; nogalamycin; ormaplatin; oxisuran; paclitaxel; pegaspargase;  
peliomycin; pentamustine; peplomycin sulfate; perfosfamide; pipobroman; piposulfan; piroxantrone hydrochloride; pli-  
camycin; plomestane; porfimer sodium; porfiromycin; prednimustine; procabazine hydrochloride; puromycin; puromycin  
hydrochloride; pyrazofurin; riboprime; rogletimide; safingol; safingol hydrochloride; semustine; simtrazene; sparfosate  
sodium; sparsomycin; spirogermanium hydrochloride; spiromustine; spiroplatin; streptonigrin; streptozocin; sulofenur;  
talisomycin; tecogalan sodium; tegafur; teloxantrone hydrochloride; temoporfin; teniposide; teroxirone; testolactone;  
thiamiprine; thioguanine; thiotepa; tiazoferin; tirapazamine; toremifene citrate; trestolone acetate; tricitabine phosphate;  
trimetrexate; trimetrexate glucuronate; triptorelin; tubulozole hydrochloride; uracil mustard; uredepa; vapreotide; verte-  
porfin; vinblastine sulfate; vincristine sulfate; vindesine; vindesine sulfate; vinepidine sulfate; vinglycinatate sulfate; vin-  
leurosine sulfate; vinorelbine tartrate; vinrosidine sulfate; vinzolidine sulfate; varozole; zeniplatin; zinostatin; zorubicin  
hydrochloride. Other anti-cancer drugs include, but are not limited to: 20-epi-1,25 dihydroxyvitamin D3; 5-ethynyluracil;  
abiraterone; aclarubicin; acylfulvene; adecypenol; adozelesin; aldesleukin; ALL-TK antagonists; altretamine; ambamus-  
tine; amidox; amifostine; aminolevulinic acid; amrubicin; amsacrine; anagrelide; anastrozole; andrographolide; angio-  
genesis inhibitors; antagonist D; antagonist G; antarelix; anti-dorsalizing morphogenetic protein-1; antiandrogen, pros-  
tatic carcinoma; antiestrogen; antineoplaston; antisense oligonucleotides; aphidicolin glycinate; apoptosis gene modu-  
lators; apoptosis regulators; apurinic acid; ara-CDP-DL-PTBA; arginine deaminase; asulacrine; atamestane; atrimustine;  
axinastatin 1; axinastatin 2; axinastatin 3; azasetron; azatoxin; azatyrosine; baccatin III derivatives; balanol; batimastat;  
BCR/ABL antagonists; benzochlorins; benzoylstauosporine; beta lactam derivatives; beta-aethine; betaclamycin B;  
betulinic acid; bFGF inhibitor; bicalutamide; bisantrene; bisaziridinylspermine; bisnafide; bistratene A; bizelesin; breflate;  
bropirimine; budotitane; buthionine sulfoximine; calcipotriol; calphostin C; camptothecin derivatives; canarypox IL-2;  
capecitabine; carboxamide-amino-triazole; carboxyamidotriazole; CaRest M3; CARN 700; cartilage derived inhibitor,  
carzelesin; casein kinase inhibitors (ICOS); castanospermine; cecropin B; cetorelix; chlorIns; chloroquinoxaline sulfon-  
amide; cicaprost; cis-porphyrin; cladribine; clomifene analogues; clotrimazole; collismycin A; collismycin B; combret-  
astatin A4; combretastatin analogue; conagenin; crambescidin 816; crisnatol; cryptophycin 8; cryptophycin A derivatives;  
curacin A; cyclopentantraquinones; cycloplatin; cypemycin; cytarabine ocfosfate; cytolytic factor; cytostatin; daclixi-  
mab; decitabine; dehydrodidemnin B; deslorelin; dexamethasone; dexifosfamide; dexrazoxane; dexverapamil; diaziq-  
uone; didemnin B; didox; diethylnorspermine; dihydro-5-azacytidine; dihydrotaxol, 9-; dioxamycin; diphenyl spiromustine;  
docetaxel; docosanol; dolasetron; doxifluridine; droloxifene; dronabinol; duocarmycin SA; ebselen; ecomustine; edelfo-  
sine; edrecolomab; eflornithine; elemene; emitfur; epirubicin; epristeride; estramustine analogue; estrogen agonists;  
estrogen antagonists; etanidazole; etoposide phosphate; exemestane; fadrozole; fazarabine; fenretinide; filgrastim; fi-  
nasteride; flavopiridol; flezelastine; fluasterone; fludarabine; fluorodaunorubicin hydrochloride; forfenimex; formestane;  
fostriecin; fotemustine; gadolinium texaphyrin; gallium nitrate; galocitabine; ganirelix; gelatinase inhibitors; gemcitabine;  
glutathione inhibitors; hepsulfam; heregulin; hexamethylene bisacetamide; hypericin; ibandronic acid; idarubicin; idox-  
itene; idramantone; ilmofofosine; ilomastat; imidazoacridones; imiquimod; immunostimulant peptides; insulin-like growth  
factor-1 receptor inhibitor; interferon agonists; interferons; interleukins; iobenguane; iododoxorubicin; ipomeanol, 4-;  
iropact; irsogladine; isobengazole; isohomohalicondrin B; itasetron; jasplakinolide; kahalalide F; lamellarin-N triacetate;  
lanreotide; leinamycin; lenograstim; lentinan sulfate; leptolstatin; letrozole; leukemia inhibiting factor, leukocyte alpha  
interferon; leuprolide+estrogen+progesterone; leuprorelin; levamisole; liarozole; linear polyamine analogue; lipophilic  
disaccharide peptide; lipophilic platinum compounds; lissoclinamide 7; lobaplatin; lombricine; lometrexol; lonidamine;  
losoxantrone; lovastatin; loxoribine; lurtotecan; lutetium texaphyrin; lysofylline; lytic peptides; maitansine; mannostatin  
A; marimastat; masoprocol; maspin; matrilysin inhibitors; matrix metalloproteinase inhibitors; menogaril; merbarone;

meterelin; methioninase; metoclopramide; MIF inhibitor; mifepristone; miltefosine; mirimostim; mismatched double stranded RNA; mitoguazone; mitolactol; mitomycin analogues; mitonafide; mitotoxin fibroblast growth factor-saporin; mitoxantrone; mofarotene; molgramostim; monoclonal antibody, human chorionic gonadotrophin; monophosphoryl lipid A+myobacterium cell wall sk; mopidamol; multiple drug resistance gene inhibitor; multiple tumor suppressor 1-based therapy; mustard anticancer agent; mycaperoxide B; mycobacterial cell wall extract; myriaporone; N-acetyldinaline; N-substituted benzamides; nafarelin; nagrestip; naloxone+pentazocine; napavin; naphterpin; nartograstim; nedaplatin; nemorubicin; neridronic acid; neutral endopeptidase; nilutamide; nisamycin; nitric oxide modulators; nitroxide antioxidant; nitrullyn; O6-benzylguanine; octreotide; okicenone; oligonucleotides; onapristone; ondansetron; ondansetron; oracin; oral cytokine inducer; ormaplatin; osaterone; oxaliplatin; oxaunomycin; paclitaxel; paclitaxel analogues; paclitaxel derivatives; palauamine; palmitoylrhizoxin; pamidronic acid; panaxytriol; panomifene; parabactin; pazelliptine; pegaspargase; peldesine; pentosan polysulfate sodium; pentostatin; pentozole; perflubron; perfosfamide; perillyl alcohol; phenazinomycin; phenylacetate; phosphatase inhibitors; picibanil; pilocarpine hydrochloride; pirarubicin; piritrexim; placetin A; placetin B; plasminogen activator inhibitor; platinum complex; platinum compounds; platinum-triamine complex; porfimer sodium; porfiromycin; prednisone; propyl bis-acridone; prostaglandin J2; proteasome inhibitors; protein A-based immune modulator, protein kinase C inhibitor; protein kinase C inhibitors, microalgal; protein tyrosine phosphatase inhibitors; purine nucleoside phosphorylase inhibitors; purpurins; pyrazoloacridine; pyridoxylated hemoglobin polyoxyethylene conjugate; raf antagonists; raltitrexed; ramosetron; ras farnesyl protein transferase inhibitors; ras inhibitors; ras-GAP inhibitor; retelliptine demethylated; rhenium Re 186 etidronate; rhizoxin; ribozymes; RII retinamide; rogletimide; rohitukine; romurtide; roquinimex; rubiginone B1; ruboxyl; safingol; saintopin; SarCNU; sarcophytol A; sargramostim; Sdi 1 mimetics; semustine; senescence derived inhibitor 1; sense oligonucleotides; signal transduction inhibitors; signal transduction modulators; single chain antigen binding protein; sizofiran; sobuzoxane; sodium borocaptate; sodium phenylacetate; solverol; somatomedin binding protein; sonermin; sparfosic acid; spicamycin D; spiromustine; splenopentin; spongistatin 1; squalamine; stem cell inhibitor; stem-cell division inhibitors;stipiamide; stromelysin inhibitors; sulfinosine; superactive vasoactive intestinal peptide antagonist; suradista; suramin; swainsonine; synthetic glycosaminoglycans; tallimustine; tamoxifen methiodide; tauromustine; tazarotene; tecogalan sodium; tegafur; tellurapyrylium; telomerase inhibitors; temoporfin; temozolomide; teniposide; tetrachlorodecaoxide; tetrazomine; thaliblastine; thiocoraline; thrombopoietin; thrombopoietin mimetic; thymalfasin; thymopoietin receptor agonist; thymotrinan; thyroid stimulating hormone; tin ethyl etiopurpurin; tirapazamine; titanocene bichloride; topsentin; toremifene; totipotent stem cell factor; translation inhibitors; tretinoin; triacetyluridine; triciribine; trimetrexate; triptorelin; tropisetron; turosteride; tyrosine kinase inhibitors; tyrphostins; UBC inhibitors; ubenimex; urogenital sinus-derived growth inhibitory factor; urokinase receptor antagonists; vapreotide; variolin B; vector system, erythrocyte gene therapy; velaresol; veramine; verdins; verteporfin; vinorelbine; vinxaltine; vitaxin; vorozole; zanoterone; zeniplatin; zilascorb; and zinostatin stimalamer.

**[0093]** The compounds of the present invention and the other therapeutic agent can act additively or, more preferably, synergistically. In a preferred embodiment, a composition comprising a compounds of the present invention is administered concurrently with the administration of another therapeutic agent, which can be part of the same composition or in a different composition from that comprising the compounds of the present invention. In another embodiment, a composition comprising the compounds of the present invention is administered prior to or subsequent to administration of another therapeutic agent.

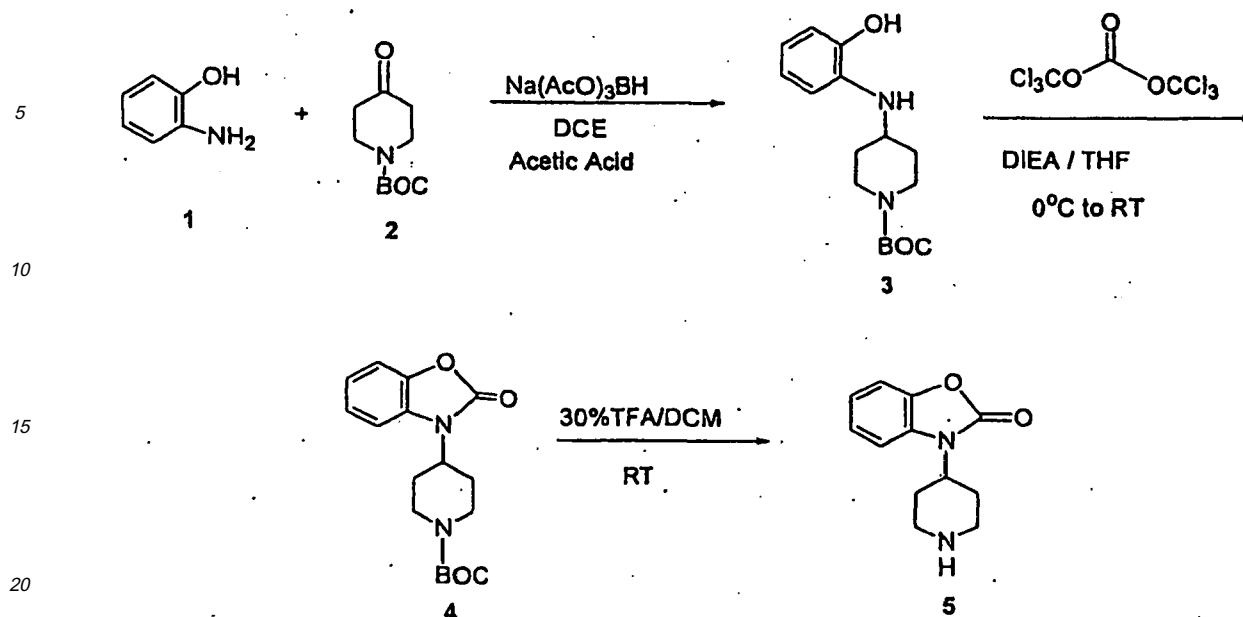
**[0094]** The compounds of the present invention when administered, e.g., via the oral, parenteral or topical routes to mammals, can be in a dosage in the range of about 0.01 mg/kg to about 3000 mg/kg body weight of the patient per day, preferably about 0.01 mg/kg to about 1000 mg/kg body weight per day administered singly or as a divided dose. However, variations will necessarily occur depending upon the weight and physical condition (e.g., hepatic and renal function) of the subject being treated, the affliction to be treated, the severity of the symptoms, the route of administration, the frequency of the dosage interval, the presence of any deleterious side-effects, and the particular compound utilized, among other things.

**[0095]** The compounds of the present invention preferably have a binding affinity  $K_1$  for the human ORL-1 receptor of about 500 nM or less; 100 nM or less; 50 nM or less; 20 nM or less or 5 nM or less. The binding affinity  $K_1$  can be measured by one skilled in the art by an assay utilizing membranes from recombinant HEK-293 cells expressing the human opioid receptor-like receptor (ORL-1) as described below.

## REFERENCE EXAMPLE 1

### SYNTHESIS OF BENZOXAZOLONE HEAD GROUPS.

**[0096]** The head groups of the present invention were synthesized according to the following procedure:



#### Procedure:

**[0097]** To a mixture of 1 (1.09 g, 10 mmol), 2 (1.99 g, 10 mmol) and acetic acid (0.60 g, 10 mmol) in 50 mL of dichloroethane, was added sodium triacetoxyborohydride (2.97 g, 14 mmol). The mixture was stirred at room temperature overnight. The mixture was filtered through Celite and 1 N NaOH (50 mL) was added to quench the reaction. The organic layer was separated and the aqueous layer was extracted with EtOAc (2 x 30 mL). The combined organic layers were dried over  $K_2CO_3$ , filtered and evaporated in vacuum to give crude 3 as a brown solid (2.75 g, yield: 94%).

$^1H$  NMR ( $CDCl_3$ ):  $\delta$  1.20-1.60. (m, 11 H), 2.00 (dd, 2H), 2.9 (m, 2H), 3.40 (m, 1H), 4.00 (m, 2H), 6.60-6.85 (m, 4H).

**[0098]** To an ice cooled solution of crude 3 (12.0 g, 40 mmol) and DIEA (20.8 mL, 120 mmol) in 200 mL of THF, was added a solution of triphosgene (4.32 g, 14.4 mmol) in 200 mL of THF. After the addition was complete the ice bath was removed and the mixture stirred at room temperature overnight. The solids were filtered off and the filtrate evaporated in vacuum. The residual brown oil was dissolved in EtOAc and washed with saturated aqueous  $K_2CO_3$ . The organic phase was dried over  $K_2CO_3$ , filtered and evaporated in vacuum to give a red oil which was filtered through a column of silica gel eluting with a mixture of 5%  $Et_3N$ , 25% EtOAc and 70% hexane. The selected fractions were combined and the solvent evaporated in vacuum to give a brown solid which was crystallized from EtOAc to give pure 4 (10.0 g, 78% yield).

$^1H$  NMR ( $CDCl_3$ ):  $\delta$  1.50 (s, 9H), 1.85 (d, 2H), 2.25 (m, 2H), 2.85 (m, 2H); 4.20-4.45 (m, 3H), 7.00-7.25 (m, 4H).

**[0099]** A solution of 4 (4.0 g, 17.2 mmol) in 30% TFA/dichloromethane (25 mL) was stirred at room temperature for 3 h. The solvent was evaporated in vacuum and saturated aqueous  $K_2CO_3$  was added to the oily residue. The resulting mixture was extracted with dichloromethane (3 x 50 mL). The combined organic extracts were dried over  $K_2CO_3$ , filtered and evaporated in vacuum to give the crude product. Chromatography on silica gel eluting with a mixture of 10%  $Et_3N$ , 60% EtOAc and 30% hexane gave 5 as a yellow solid (1.82 g, 66% yield).

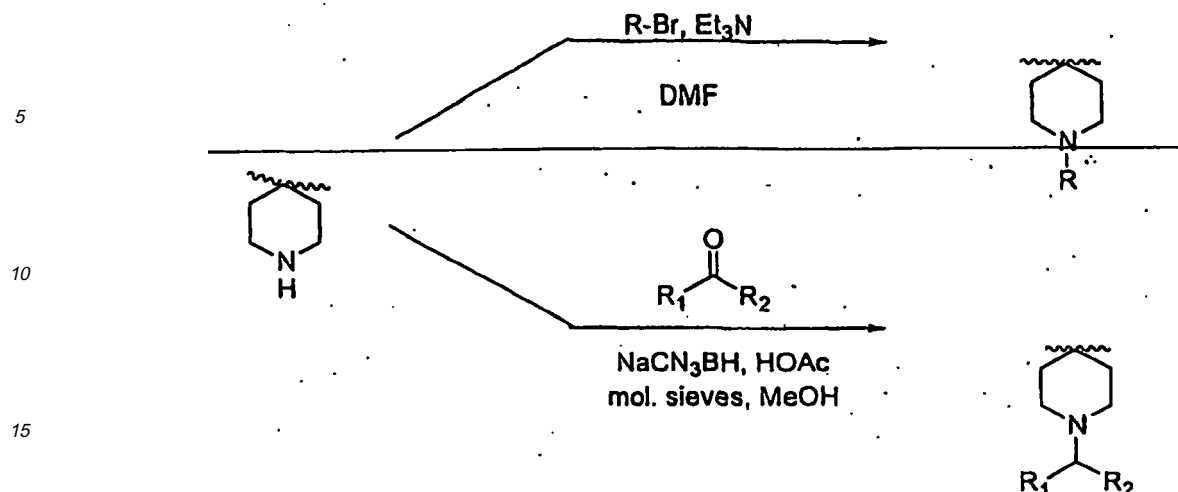
MS: m/z 450

$^1H$  NMR ( $CDCl_3$ ):  $\delta$  1.75-2.10 (m, 3H), 2.30 (d, 2H), 2.80 (m, 2H), 3.20 (m, 2H), 4.25 (m, 1H), 7.00-7.25 (m, 4H).

#### REFERENCE EXAMPLE 2

#### ATTACHMENT OF TAIL GROUPS

**[0100]** Tail groups were attached to the head groups according to the following procedures: .



#### General procedure for alkylation:

**[0101]** To a solution of the amine (1 eq) and triethylamine (1 eq) in dimethylformamide, was added 1 eq of alkyl bromide or chloride in one portion. The mixture was stirred and heated at 80°C over night. TLC indicated the reaction was complete. The reaction was quenched by the addition of water followed by 1 N NaOH to pH 10. The mixture was extracted 2x with Et<sub>2</sub>O. The combined organic extracts were dried over potassium carbonate and the solvent evaporated, followed by chromatography to give the pure product.

#### General procedure for reductive amination:

**[0102]** To a mixture of ketone or aldehyde (1 eq), amine (1 eq), and acetic acid (1 eq) in methanol, was added sodium cyanoborohydride (1.4 eq) in one portion. The mixture was stirred over night at room temperature. TLC indicated the reaction was complete. The reaction was quenched by the addition of water followed by 1 N NaOH to pH 10. The mixture was extracted 2x with Et<sub>2</sub>O. The combined organic extracts were dried over potassium carbonate and the solvent evaporated, followed by chromatography to give the pure product.

**[0103]** The following reference compounds were prepared by attaching the tail groups using the general procedures described:

3-[1-(naphth-2-yl-methyl)-4-piperidiny]-2H-benzoxazol-2-one

3-[1-(naphth-1-yl-methyl)-4-piperidiny]-2H-benzoxazol-2-one

3-[1-(*p*-phenylbenzyl)-4-piperidiny]-2H-benzoxazol-2-one

3-[1-(*p*-benzyloxybenzyl)-4-piperidiny]-2H-benzoxazol-2-one

3-[1-(*p*-cyanobenzyl)-4-piperidiny]-2H-benzoxazol-2-one  
MS: m/z 334.4 (M+1)

3-[1-(3,3-diphenylpropyl)-4-piperidiny]-2H-benzoxazol-2-one

3-[1-[4,4-Bis-(4-fluorophenyl)butyl]-4-piperidiny]-2H-benzoxazol-2-one  
MS: m/z 463.6 (M+1).

3-[1-(2-phenylethyl)-4-piperidiny]-2H-benzoxazol-2-one

3-[1-(cyclooctylmethyl)-4-piperidiny]-2H-benzoxazol-2-one  
LC: 100%  
MS: m/z 343.6 (M+1).



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<sup>1</sup>H-NMR (CDCl<sub>3</sub>): d 1.25 (m, 2H), 1.40-1.7 (m, 17H), 2.10 (m, 4H), 3.10 (m, 2H), 4.20 (m, 1H), 7.10-7.20 (4H).  
13C-NMR (CDCl<sub>3</sub>): d 26.02, 26.87, 27.55, 29.27, 31.23, 35.31, 53.39, 53.70, 66.28, 110.45, 110.51, 122.45, 123.96, 130.45, 143.08, 154.51.

3-[1-(1,2,3,4-tetrahydro-2-naphthyl)-4-piperidiny]-2H-benzoxazol-2-one

LC: 100%

MS: 349.6 (M+1)

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): d 1.70 (m, 1H), 2.00 (b, 2H), 2.10 (b, 1H), 2.40 (m, 4H), 2.90 (m, 5H), 3.10 (m, 2H), 4.20 (m, 1H), 7.10-7.30 (m, 8H).

3-[1-(5-methylhex-2-yl)-4-piperidiny]-2H-benzoxazol-2-one

LC: 100%

MS: 317.4 (M+1)

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): d 0.90 (d, 6H), 1.00 (d, 3H), 1.20 (m, 3H), 1.50-1.60 (m, 4H), 1.80 (m, 2H), 2.20-2.60 (m, 5H), 2.90 (b, 2H), 4.2 (m, 1H), 6.90-7.30 (m, 4H).

3-[1-(10,11-Dihydro-5H-dibenzo[a,d]-cyclohepten-5-yl)-4-piperidiny]-2H-benzoxazol-2-one

LC: 96.4%

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): d 1.80 (dd, 2H), 2.00 (dt, 2H), 2.30 (dq, 2H), 2.80-2.95 (m, 4H), 4.01 (s, 1H), 4.05-4.22 (m, 3H), 7.05-7.25 (m, 12H).

3-[1-(4-propyl-cyclohexyl)-4-piperidiny]-2H-benzoxazol-2-one

MS: m/z 343.0

3-[1-(norbornan-2-yl)-4-piperidiny]-2H-benzoxazol-2-one

LC: 97%

MS: m/z 313.41 (M+1)

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): d 0.90 (m, 1H), 1.30-2.50 (m, 17H), 3.20 (m, 2H), 4.3 (m, 1H), 6.90-7.30 (m, 4H).

3-[1-(decahydro-2-naphthyl)-4-piperidiny]-2H-benzoxazol-2-one

MS: m/z 355.4

3-[1-(3,3-dimethyl-1,5-dioxaspiro[5.5]undeca-9-yl)-4-piperidiny]-2H-benzoxazol-2-one

MS: m/z 401.3

3-[1-[4-(1-methylethyl)-cyclohexyl]-4-piperidiny]-2H-benzoxazol-2-one

MS: m/z 343.0

3-[1-(1,3-dihydroinden-2-yl)-4-piperidiny]-2H-benzoxazol-2-one

LC: 100%

MS: m/z 335.4 (M+1)

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): d 1.90 (m, 1H), 2.40 (m, 2H), 2.50 (m, 2H), 2.90 (m, 2H), 3.10-3.40 (m, 6H), 4.20 (m, 1H), 7.10-7.30 (m, 8H).

3-[1-(cyclooctyl)-4-piperidiny]-2H-benzoxazol-2-one

LC: 100%

MS: m/z 329.2 (M+1)

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): d 1.40-2.00 (m, 16H), 2.40-2.65 (m, 4H), 2.80 (m, 1H), 3.05 (m, 2H), 4.25 (m, 1H), 7.10-7.40 (m, 4H).

### REFERENCE EXAMPLE 3

**[0104]** Nociceptin affinity at the ORL 1 receptor for preferred compounds was obtained using the following assay: Membranes from recombinant HEK-293 cells expressing the human opioid receptor-like receptor (ORL-1) (Receptor Biology) were prepared by lysing cells in ice-cold hypotonic buffer (2.5 mM MgCl<sub>2</sub>, 50 mM HEPES, pH 7.4) (10 ml/10 cm dish) followed by homogenization with a tissue grinder/teflon pestle. Membranes were collected by centrifugation at 30,000 x g for 15 min at 4°C and pellets resuspended in hypotonic buffer to a final concentration of 1-3 mg/ml. Protein concentrations were determined using the BioRad protein assay reagent with bovine serum albumen as standard. Aliquots of the ORL-1 receptor membranes were stored at -80°C.

Functional SGTPgS binding assays were conducted as follows. ORL-1 membrane solution was prepared by sequentially adding final concentrations of 0.066 mg/ml ORL-1 membrane protein, 10 mg/ml saponin, 3 mM GDP and 0.20 nM [<sup>35</sup>S] GTPgS to binding buffer (100 mM NaCl, 10 mM MgCl<sub>2</sub>, 20 mM HEPES, pH 7.4) on ice. The prepared membrane solution (190 ml/well) was transferred to 96-shallow well polypropylene plates containing 10 ml of 20x concentrated stock solutions of agonist prepared in DMSO. Plates were incubated for 30 min at room temperature with shaking. Reactions were terminated by rapid filtration onto 96-well Unifilter GF/B filter plates (Packard) using a 96-well tissue harvester (Brandel) and followed by three filtration washes with 200 ml ice-cold binding buffer (10 mM NaH<sub>2</sub>PO<sub>4</sub>, 10 mM Na<sub>2</sub>HPO<sub>4</sub>, pH 7.4). Filter plates were subsequently dried at 50°C for 2-3 hours. Fifty ml/well scintillation cocktail (BetaScint; Wallac) was added and plates were counted in a Packard Top-Count for 1 min/well.

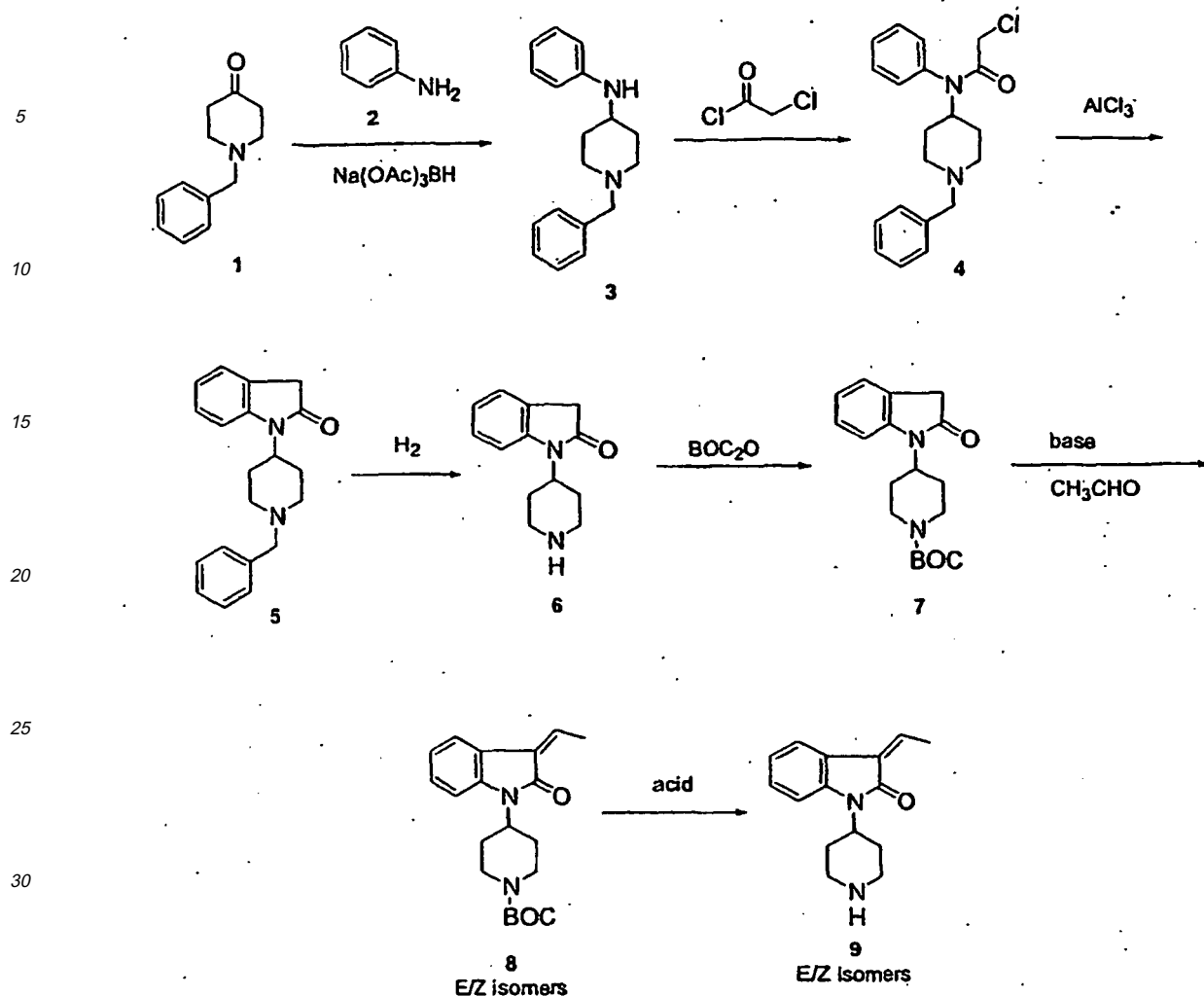
Data was analyzed using the curve fitting functions in GraphPad PRISM<sup>®</sup>, v. 3.0 and the results are set forth in table 1. below:

<b>TABLE 1</b>	
<b>Nociceptin Affinity</b>	
<b>REFERENCE Compound</b>	<b>calc K<sub>i</sub>(nM)</b>
3-[1-(naphth-2-yl-methyl)-4-piperidiny]-2H-benzoxazol-2-one	3030
3-(1-(naphth-1-yl-methyl)-4-piperidiny)-2H-benzoxazol-2-one	370
3-[1-( <i>p</i> -phenylbenzyl)-4-piperidiny]-2H-benzoxazol-2-one	>10,000
3-[1-( <i>p</i> -benzyloxybenzyl)-4-piperidiny]-2H-benzoxazol-2-one	2173
3-[1-( <i>p</i> -cyanobenzyl)-4-piperidiny]-2H-benzoxazol-2-one	>10,000
3-[1-(3,3-diphenylpropyl)-4-piperidiny]-2H-benzoxazol-2-one	726
3-[1-[4,4-Bis-(4-fluorophenyl)butyl]-4-piperidiny]-2Hbenzoxazol-2-one	3070
3-[1-(2-phenylethyl)-4-piperidiny]-2H-benzoxazol-2-one	7087
3-[1-(cyclooctylmethyl)-4-piperidiny]-2H-benzoxazol-2-one	64
3-[1-(1,2,3,4-tetrahydro-2-naphthyl)-4-piperidiny]-2Hbenzoxazol-2-one	93
3-[1-(5-methylhex-2-yl)-4-piperidiny]-2H-benzoxazol-2-one	60
3-[1-(10,11-Dihydro-5H-dibenzo[a,d]-cyclohepten-5-yl)-4-piperidiny]-2H-benzoxazol-2-one	>10,000
3-[1-(3,3-dimethyl-1,5-dioxaspiro[5.5]undeca-9-yl)-4-piperidiny]-2H-benzoxazol-2-one	>10,000
3-[1-(1,3-dihydroinden-2-yl)-4-piperidiny]-2H-benzoxazol-2-one	512
3-[1-(cyclooctyl)-4-piperidiny]-2H-benzoxazol-2-one	16

#### EXAMPLE 4

#### SYNTHESIS OF SUBSTITUTED INDOLE HEAD GROUPS

[0105]



#### Procedure:

**[0106]** To a mixture of 2 (23.3 g, 0.25 mol), 1 (47.3 g, 0.25 mol), acetic acid (15 g, 0.25 mol) and molecular sieves (15 g) in 500 mL of dichloroethane, sodium triacetoxyborohydride (74.2 g, 0.35 mol) was added in one portion and the mixture stirred overnight. The molecular sieves were filtered off and 1 N NaOH (500 mL) was added to quench the reaction. The organic layer was separated and the aqueous layer extracted with EtOAc (2 x 300 mL). The combined organic extracts were dried over  $\text{K}_2\text{CO}_3$ , filtered and the solvent evaporated under vacuum to give crude 3 as a brown solid which was directly used in next step.

#### Compound 3

**[0107]**  $^1\text{H-NMR}$  ( $\text{CDCl}_3$ ): d 1.50 (m, 2H), 2.05 (m, 2H), 2.20 (bt, 2H), 2.85 (m, 2H), 3.30 (m, 1H), 3.52 (s, 2H), 6.60 (d, 2H), 6.70 (t, 1H), 7.20 (m, 2H), 7.25-7.40 (m, 5H),

**[0108]** To an ice cooled solution of crude 3 (0.25 mol, 100% yield assumed) and DIEA (48.4 g, 0.38 mol) in 500 mL of dichloromethane, was added dropwise chloroacetyl chloride (42.4 g, 0.375 mol). After the addition was complete the ice bath was removed and the reaction mixture stirred overnight. The solvent was removed in vacuum and the residue dissolved in dichloromethane. The organic phase was washed with saturated aqueous  $\text{K}_2\text{CO}_3$ , dried over  $\text{K}_2\text{CO}_3$ , filtered and the solvent removed in vacuum to give a brown gum which was filtered through a column of silica gel eluting with a mixture of 10%  $\text{Et}_3\text{N}$ , 40% EtOAc and 50% hexane. The selected fractions were combined and the solvent evaporated in vacuum to give a brown solid which was further crystallized from EtOAc to give 42.2 g of 4 (49.2%, 2 steps).

**Compound 4**

**[0109]**  $^1\text{H}$  NMR (DMSO): d 1.22 (m, 2H), 1.70 (b, 2H), 2.00 (t, 2H), 2.80 (b, 2H), 3.40 (s, 2H), 3.80 (s, 2H), 4.40 (m, 1H), 7.15-7.30 (m, 7H), 7.45 (m, 3H).

5 **[0110]** A mixture of 4 (42.2 g, 0.12 mol) and  $\text{AlCl}_3$  (49.2 g, 0.369 mol) was mixed in a flask by rapid stirring. The mixture was then heated in an oil bath at 130 °C. Within a few minutes the solids melted and became a dark liquid with concomitant gas evolution. After heating for 1 h the reaction mixture was cooled somewhat and while still mobile poured into a beaker containing 500 mL of ice water. The solution was basified and extracted with dichloromethane. The organic layer was dried over  $\text{Na}_2\text{SO}_4$ , filtered and the solvent evaporated in vacuum to give a dark oil which was filtered through a column of silica gel eluting with a mixture of 10%  $\text{Et}_3\text{N}$ , 40% EtOAc and 50% hexane. The selected fractions were combined and the solvent evaporated in vacuum to give 5 as a red oil which set to a pale solid (22.0 g, 58.5%).

**Compound 5**

15 **[0111]**  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ): d 1.70 (m, 2H), 2.17 (m 2H), 2.50 (m, 2H), 3.05 (m, 2H), 3.55 (s, 2H), 3.60 (s, 2H), 4.33 (m, 1H), 7.00-7.40 (m, 9H).

**[0112]** To a solution of 5 (16.0 g, 0.052 mol) in 35 mL of methanol was added  $\text{Pd}(\text{OH})_2$  (4.0 g). The resulting suspension was hydrogenated at 50 psi for 12 h at room temperature. The solution was filtered through a pad of Celite and the pad washed with methanol (2 x 20 mL). Evaporation of the solvent in vacuum gave 6 as a pale solid (11.2 g, 100%).

20

**Compound 6**

**[0113]** LC: 100%

MS: m/z 217 (M+1).

25  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ): d 1.75 (m, 3H), 2.35 (m 2H), 2.75 (m, 2H), 3.25 (m, 2H), 3.50 (s, 2H), 4.33 (m, 1H), 7.00-7.30 (m, 4H)

**[0114]** To a solution of 6 (8.0 g, 37.0 mmol) in 50 mL of dichloromethane was added  $\text{Et}_3\text{N}$  (4.07 g, 40.7 mmol) and BOC anhydride (8.87 g, 40.7 mmol). After stirring for 3 h saturated aqueous  $\text{K}_2\text{CO}_3$  was added and the layers separated. The aqueous phase was extracted with dichloromethane (2 x 50 mL). The combined organic phase was dried over  $\text{K}_2\text{CO}_3$ , filtered and evaporated in vacuum to give a brown oil which was filtered through a column of silica gel eluting with a mixture of 10%  $\text{Et}_3\text{N}$ , 40% EtOAc and 50% hexane. The selected fractions were combined and the solvent evaporated in vacuum to give 7 as an off white solid (8.50 g, 73%).

30

**Compound 7**

35 **[0115]**  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ): d 1.50 (m, 9H), 1.70 (m 2H), 2.20-2.50 (m, 2H), 2.80-3.00 (m, 2H), 3.50 (s, 2H), 4.20-4.50 (m, 3H), 6.90-7.60 (m, 5H).

**[0116]** To a mixture of 7 (6.0 g, 19.0 mmol) and sodium acetate (2.58 g, 19.0 mmol) in 150 mL of methanol was added acetaldehyde (1.67 g, 38.0 mmol). The mixture was refluxed for 2 h. The solvent was evaporated in vacuum to give a dark oil which was filtered through a column of silica gel eluting with a mixture of 10%  $\text{Et}_3\text{N}$ , 40% EtOAc and 50% hexane. The selected fractions were combined and the solvent evaporated in vacuum to give 8 as a red oil (5.90 g, 91 %).

40

**Compound 8**

**[0117]** LC: 2 isomers in a ratio of 2:1.

45  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ): (mixture of 2 isomers) d 1.50 (m, 9H), 1.70 (m 2H), 2.20-2.50 (m, 6H), 2.60-3.00 (m, 2H), 4.20-4.50 (m, 3H), 6.90-7.60 (m, 5H).

**[0118]** A solution of 8 (5.90 g, 17.2 mmol) in 30% TFA/dichloromethane (100 mL) was stirred at room temperature for 3 h. The solvent was evaporated in vacuum and saturated aqueous  $\text{K}_2\text{CO}_3$  was added to the oily residue. The resulting mixture was extracted with dichloromethane (3 x 150 mL). The combined organic extracts were dried over  $\text{K}_2\text{CO}_3$ , filtered and evaporated in vacuum to give the crude product. Chromatography on silica gel eluting with a mixture of 10%  $\text{Et}_3\text{N}$ , 50% EtOAc and 40% hexane gave 9 (E/Z isomers) as a yellow foam (3.60 g, 82%).

50

**Compound 9**

55 **[0119]** LC: 2 isomers in a ratio of 2:1.

MS: m/z 243.1 (M+1).

$^1\text{H}$  NMR ( $\text{CDCl}_3$ ): (mixture of 2 isomers) d 0.85 (m, 1H), 1.50 -2.00 (m, 4H), 2.20-2.50 (m, 5H), 2.60 (m, 1H), 3.10-3.50 (m, 2H), 4.30 (m, 1H), 6.90-7.60 (m, 5H).

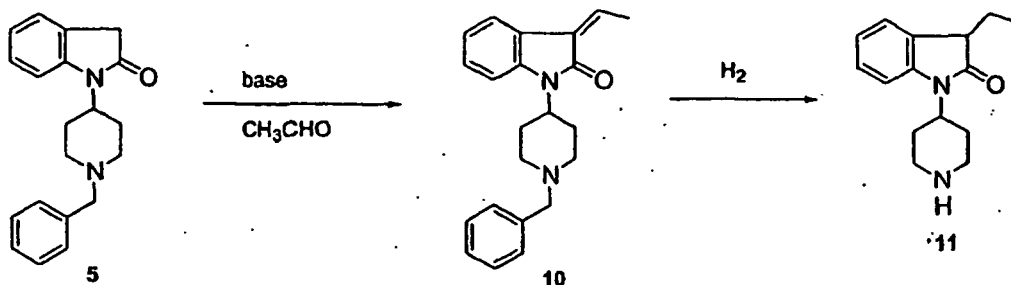
## EXAMPLE 5

[0120]

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[0121] To a mixture of 5 (5.50 g, 18 mmol) and sodium acetate (2.45 g, 18 mmol) in 150 mL of methanol was added acetaldehyde (1.58 g, 36 mmol). The mixture was refluxed for 2 h. The solvent was evaporated in vacuum to give a dark oil which was filtered through a column of silica gel eluting with a mixture of 10%  $\text{Et}_3\text{N}$ , 40% EtOAc and 50% hexane. The selected fractions were combined and the solvent evaporated in vacuum to give 10 as a red oil (5.90 g, 98%).

## Compound 10

25

[0122] LC: 2 isomers in a ratio of 2:1.

MS:  $m/z$  333.2 ( $M+1$ ).

$^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  1.70 (m, 2H), 2.17 (m, 2H), 2.30 (d, 3H), 2.50 (m, 2H), 3.05 (m, 2H), 3.55 (s, 2H), 4.33 (m, 1H), 7.00-7.40 (m, 9H), 7.6 (d, 1H).

30

[0123] To a solution of 10 (5.90 g, 17.7 mmol) in 30 mL of methanol was added  $\text{Pd}(\text{OH})_2$  (3.0 g). The resulting suspension was hydrogenated at 50 psi for 12 h at room temperature. The solution was filtered through a pad of Celite and the pad washed with methanol (2 x 20 mL). Evaporation of the solvent in vacuum gave a pale solid which was purified by chromatography on silica gel eluting with a mixture of 10% methanol and 90% EtOAc to give 11 as an off white solid (2.02 g, 50%).

35

## Compound 11

[0124] LC: 97%

MS:  $m/z$  245.2 ( $M+1$ )

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$^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  0.85 (t, 3H), 1.26 (m, 2H), 2.00 (m, 2H), 2.43 (m, 2H), 2.90 (m, 2H), 3.3 (m, 2H), 3.4 (m, 1H), 4.4 (m, 1H), 7.05 (m, 1H), 7.15-7.30 (m, 3H).

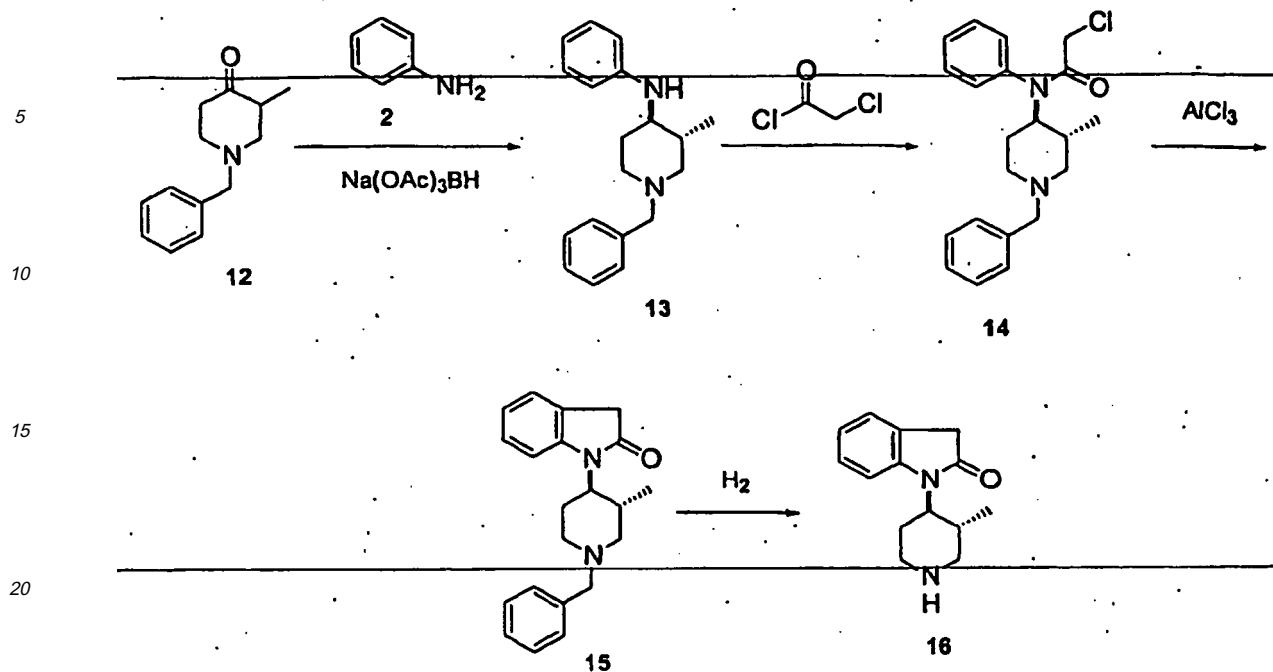
## REFERENCE EXAMPLE 6

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[0125]

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# Procedure:

**[0126]** In a manner similar to the preparation of 6, compound 16 was prepared.

## **Compound 13**

**[0127]** LC: 89.4%

MS: m/z 281.2 (M+1)

<sup>1</sup>H-NMR (mixture of trans and cis) (CDCl<sub>3</sub>): d 0.95 (m, 3H), 1.50-2.75 (m, 5H), 2.80-3.20 (m, 1H), 3.50 (m, 2H), 3.60 (minor)+3.70 (major) (two s, 2H), 6.55-6.80 (m, 2H), 7.05-7.45 (m, 8H).

## **Compound 14**

**[0128]** MS: m/z 357.2 (M+1)

<sup>1</sup>H-NMR (mixture of trans and cis) (CDCl<sub>3</sub>): d 1.10 (m, 3H), 1.40-4.20 (m, 11H), 4.40 (m, 1H), 7.05-7.50 (m, 10H).

## **Compound 15**

**[0129]** LC: 90.0%

MS: m/z 321.2 (M+1)

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): d 1.20 (d, 3H), 1.75 (m, 1H), 2.10 (dt, 1H), 2.25 (b, 1H), 2.30 (dd, 1H), 2.75 (dd, 1H), 3.05 (m, 1H), 3.20 (m, 1H), 3.50 (m, 4H), 4.10 (m, 1H), 6.99 (m, 2H), 7.23 (m, 3H), 7.37 (m, 4H).

## **Compound 16**

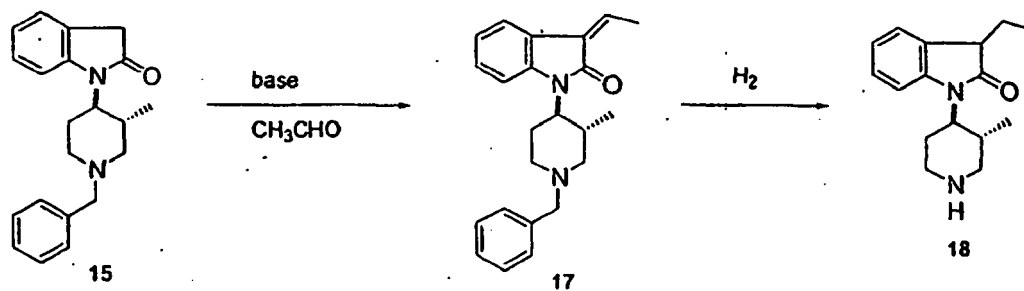
**[0130]** LC: 92.5%

MS: m/z 231.2 (M+1)

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): d d 1.20 (d, 3H), 1.75 (m, 1H), 2.10 (dt, 1H), 2.25 (b, 1H), 2.30 (dd, 1H), 2.75 (dd, 1H), 3.05 (m, 1H), 3.20 (m, 1H), 3.50 (m, 2H), 4.10 (m, 1H), 6.99 (m, 2H), 7.23 (m, 3H), 7.37 (m, 4H).

## **EXAMPLE 7**

**[0131]**

Procedure:

[0132] In a manner similar to the preparation of 11, compound 18 was prepared.

**Compound 17**

[0133] MS: m/z 347.3 (M+1)

**Compound 18**

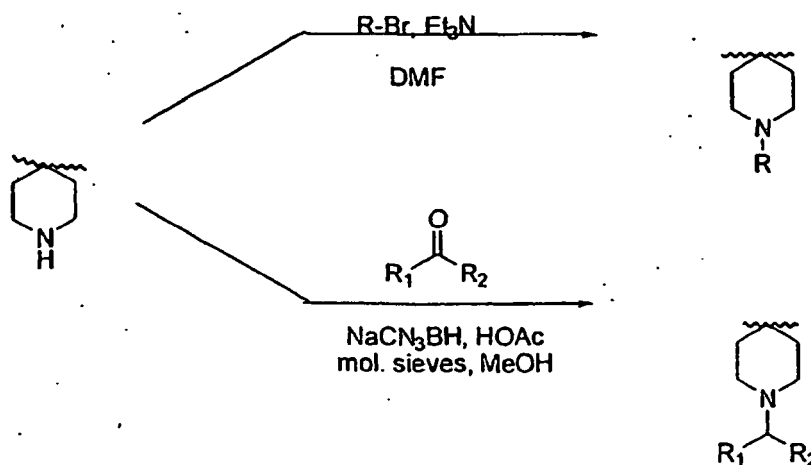
LC: 82.6%

[0134] MS: m/z 259.3 (M+1)

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): d 0.80 (t, 3H), 1.20 (d, 3H), 2.00 (m, 2H), 2.3,0 (m, 1H), 2.65 (m, 1H), 2.82 (m, 1H), 3.15-3.25 (m, 1H), 3.32 (m, 1H), 3.45 (m, 1H), 3.65 (m, 1H), 3.75 (m, 1H), 4.25 (m, 1 H), 6.90 (d, 1H), 7.05 (t, 1H), 7.25 (m, 2H).

**EXAMPLE 8****ATTACHMENT OF TAIL GROUPS**

[0135] Tail groups were attached to the head groups according to the following procedures:

**General procedure for alkylation:**

[0136] To a solution of the amine (1 eq) and triethylamine (1 eq) in dimethylformamide, was added 1 eq of alkyl bromide or chloride in one portion. The mixture was stirred and heated at 80°C over night. TLC indicated the reaction was

complete. The reaction was quenched by the addition of water followed by 1 N NaOH to pH 10. The mixture was extracted 2x with Et<sub>2</sub>O. The combined organic extracts were dried over potassium carbonate and the solvent evaporated, followed by chromatography to give the pure product.

#### 5 General procedure for reductive amination:

**[0137]** To a mixture of ketone or aldehyde (1 eq), amine (1 eq), and acetic acid (1 eq) in methanol, was added sodium cyanoborohydride (1.4 eq) in one portion. The mixture was stirred over night at room temperature. TLC indicated the reaction was complete. The reaction was quenched by the addition of water followed by 1N NaOH to pH 10. The mixture was extracted 2x with Et<sub>2</sub>O. The combined organic extracts were dried over potassium carbonate and the solvent evaporated, followed by chromatography to give the pure product.

**[0138]** The following compounds were prepared by attaching the tail groups using the general procedures described:

- 15 1-[1-(naphth-1-yl-methyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one \*
- MS: m/z 357.2 (M+1).
- 1-[1-(naphth-2-yl-methyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one \*
- MS: m/z 357.3 (M+1).
- 20 1-[1-(*p*-phenylbenzyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one \*
- MS: m/z 383.2 (M+1).
- 1-[1-(3,3-Bis(phenyl)propyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one \*
- LC: 98.7%
- 25 MS: m/z 411.2 (M+1)
- <sup>1</sup>H-NMR (CDCl<sub>3</sub>): δ 1.65 (bd, 2H), 2.05 (bt, 2H), 2.30 (m, 4H), 2.45 (m, 2H), 3.02 (bd, 2H), 3.50 (s, 2H), 4.01 (1, 1H), 4.30 (m; 1H), 7.00 (t, 1H), 7.15-7.35 (m, 13H).
- 1-[1-(*p*-cyanobenzyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one \*
- 30 MS: m/z 332.2 (M+1).
- 1-[1-(*p*-benzyloxybenzyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one \*
- MS: m/z 413.3 (M+1)
- 35 1-[1-(1,2,3,4-tetrahydronaphth-2-yl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one \*
- LC: 100%
- MS: m/z 347.5 (M+1).
- <sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 1.70 (m, 3H), 2.10 (m, 1H), 2.40 (m, 4H), 2.90-3.00(m, 5H), 3.10 (m, 2H), 3.60 (s, 2H), 4.3 (m, 1H), 7.00-7.30 (m, 8H).
- 40 1-[1-(5-methylhex-2-yl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one \*
- 100%
- MS: m/z 315.4 (M+1).
- <sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 0.90 (m, 6H), 1.00 (m, 3H), 1.20 (m, 3H), 1.5-1.8 (m, 2H), 2.2-2.6 (m, 5H), 2.90 (m, 2H), 3.60 (s, 2H), 4.2 (m, 1H), 6.90-7.30 (m, 4H).
- 45 1-[1-(norboman-2-yl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one \*
- LC: 97%
- MS: m/z 311.41 (M+1).
- <sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 0.90 (m, 1H), 1.30-2.00(m, 7H), 2.10-2.30 (m, 5H), 3.20 (m, 2H), 3.60 (s, 2H), 4.3 (m, 1H), 6.90-7.30 (m, 4H).
- 50 1-[1-1,3-dihydroinden-2-yl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one \*
- LC: 100%
- 55 MS: m/z 332.4 (M+1).
- <sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 1.80 (m, 2H), 2.40 (m, 2H), 2.50 (m, 2H), 2.90 (m, 2H), 3.10-3.40 (m, 5H), 3.60 (s, 2H), 4.20 (m, 1H), 7.10-7.30 (m, 8H).



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1-[1-(cyclooctylmethyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one \*

LC: 97%

MS: m/z 341.50 (M+1).

<sup>1</sup>H NMR (CDCl<sub>3</sub>): d 1.25 (m, 3H), 1.4-1.7 (m, 14H), 2.10 (m, 4H), 2.50(m, 2H), 3.10 (m, 2H), 3.60 (s, 2H), 4.3 (m, 1H), 7.10-7.20 (m, 4H).

<sup>13</sup>C-NMR (CDCl<sub>3</sub>): d 23.07, 26.04, 26.89, 27.56, 28.63, 31.27, 32.00, 35.30, 36.33, 46.63, 50.65, 54.06, 66.47, 110.90, 122.17, 124.90, 125.26, 127.94, 144.25, 175.31.

3-ethyl-1-[1-(1,2,3,4-tetrahydro-2-naphthyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one

MS: m/z 375.3 (M+1).

3-ethyl-1-[1-(4-propylcyclohexyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one

MS: m/z 369.2 (M+1).

3-ethyl-1-[1-(5-methylhex-2-yl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one

LC: 100%

MS: m/z 342.4 (M+1).

<sup>1</sup>H NMR (CDCl<sub>3</sub>): d 0.80 (t, 3H), 0.90 (m, 6H), 1.00 (m, 3H), 1.20 (m, 3H), 1.5-1.8 (m, 2H), 2.2-2.6 (m, 5H), 2.90 (m, 2H), 3.40 (m, 1H), 4.3 (m, 1H), 6.90-7.30 (m, 4H).

3-ethyl-1-[1-(norbornan-2-yl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one

LC: 100%

MS: m/z 339.41 (M+1).

<sup>1</sup>H NMR (CDCl<sub>3</sub>): d 0.80 (m, 3H), 0.90 (m, 1H), 1.30-1.45 (m, 5H), 1.50-2.05 (m, 8H), 2.10 (m, 1H), 2.20 (m, 2H), 2.50 (m, 2H), 3.10 (m, 2H), 3.40 (m, 1H), 4.3 (m, 1H), 6.90-7.30 (m, 4H).

3-ethyl-1-[1-(decahydro-2-naphthyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one

MS: m/z 381.3 (M+1).

3-ethyl-1-[1-[4-(1-methylethyl)-cyclohexyl]-4-piperidinyl]-1,3-dihydro-2H-indole-2-one

MS: m/z 369.3 (M+1)

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): d 0.88 (t, 3H), 0.92 (d, 6H), 1.17 (m, 1H), 1.40 (m, 2H), 1.50-1.70 (m, 9H), 2.05 (m, 2H), 2.25 (m, 2H), 2.32-2.55 (m, 3H), 3.15 (b, 2H), 3.43 (t, 1H), 4.35 (m, 1H), 7.05 (t, 1H), 7.22 (d, 1H), 7.28 (m, 2H).

3-ethyl-1-[1-(1,3-dihydroinden-2-yl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one

MS: m/z 361.2 (M+1).

3-ethyl-1-[1-(cyclooctylmethyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one

LC: 97%

MS: m/z 369.50 (M+1).

<sup>1</sup>H NMR (CDCl<sub>3</sub>): d 0.80 (t, 3H), 1.25 (m, 3H), 1.4-1.7 (m, 14H), 2.10 (m, 6H), 2.50(m, 2H); 3.10 (m, 2H), 3.40 (m, 1H), 4.3 (m, 1H), 7.10-7.20 (m, 4H).

3-ethylidene-1-[1-(benzyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one

MS: m/z 333.2 (M+1)

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): d 1.70 (m, 2H), 2.1 (dt, 2H), 2.28 (d, 3H), 2.47 (m, 2H), 3.05 (b, 2H), 3.57 (s, 2H), 4.34 (m, 1H), 7.02 (t, 1H), 7.08-7.40 (m, 8H), 7.58 (d, 1H).

3-ethylidene-1-[1-(naphth-2-yl-methy)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one

MS: m/z 405.2

3-ethylidene-1-[1-(3,3-diphenylpropyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one

LC: >97% (2 isomers combined).

MS: m/z 437.5 (M+1).

<sup>1</sup>H NMR (CDCl<sub>3</sub>): d 1.70 -1.80 (m, 3H), 2.10 (m, 2H), 2.20 - 2.40 (m, 8H), 3.10 (m, 2H), 4.10 (M, 1H), 4.3 (m, 1H), 7.00-7.30 (m, 15H).

3-ethylidene-1-[1-(*p*-cyanobenzyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one

LC: >97% (2 isomers combined).

MS: m/z 358.5 (M+1).

<sup>1</sup>H NMR (CDCl<sub>3</sub>): d 1.80 (m, 4H), 2.10-2.60 (m, 5H), 3.10 (m, 2H), 3.70 (s, 2H), 4.3 (m, 1H), 6.90-7.60 (m, 8H).

3-ethylidene-1-[1-(*p*-benzyloxybenzyl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one

MS: m/z 405.2.

3-ethylidene-1-[1-(1,2,3,4-tetrahydro-2-naphthyl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one

LC: >97% (2 isomers combined).

MS: m/z 373.5 (M+1).

<sup>1</sup>H NMR (CDCl<sub>3</sub>): d 1.70 - 3.10 (m, 18H), 4.3 (m, 1H), 7.00-7.30 (m, 9H).

3-ethylidene-1-[1-(4-propylcyclohexyl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one

LC: >97% (2 isomers combined).

MS: m/z 367.5 (M+1).

<sup>1</sup>H NMR (CDCl<sub>3</sub>): d 0.90 (m, 1H), 1.30-2.00 (m, 7H), 2.10-2.30 (m, 5H), 3.20 (m, 2H), 3.60 (s, 2H), 4.3 (m, 1H), 6.90-7.30 (m, 5H).

3-ethylidene-1-[1-(5-methylhex-2-yl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one

LC: >97% (2 isomers combined).

MS: m/z 341.4 (M+1).

<sup>1</sup>H NMR (CDCl<sub>3</sub>): d 0.90 - 2.6 (m, 24H), 2.90 (m, 2H), 4.2 (m, 1H), 6.90-7.30 (m, 3H).

3-ethylidene-1-[1-(norbornan-2-yl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one

LC: >97% (2 isomers combined).

MS: m/z 337.41 (M+1).

<sup>1</sup>H NMR (CDCl<sub>3</sub>): d 0.90 (m, 1H), 1.30-2.50 (m, 17H), 3.10 (m, 2H), 4.3 (m, 1H), 6.90-7.30 (m, 5H).

3-ethylidene-1-[1-(1,3-dihydroinden-2-yl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one

LC: >97% (2 isomers combined).

MS: m/z 359.4 (M+1).

<sup>1</sup>H NMR (CDCl<sub>3</sub>): d 1.80 - 3.10 (m, 17H), 4.20 (m, 1H), 7.10-7.30 (m, 9H).

3-ethylidene-1-[1-(cyclooctylmethyl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one

LC: >97% (2 isomers combined).

MS: m/z 367.50 (M+1).

<sup>1</sup>H NMR (CDCl<sub>3</sub>): d 1.25 (m, 3H), 1.4-1.7 (m, 21H), 2.10 - 2.50 (m, 2H), 3.10 (m, 2H), 4.3 (m, 1H), 6.90-7.60 (m, 5H).

1-[1-(3,3-Bis(phenyl)propyl)-3-(methyl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one \*

LC: 100%

MS: m/z 425.3 (M+1)

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): d 1.20 (d, 3H), 1.69 (bd, 1H), 1.95 (dt, 1H), 2.13-2.30 (m, 5H), 2.72 (bd, 1H), 2.98 (bd, 1H), 3.15 (dq, 1H), 3.50 (s, 2H), 4.03 (dt, 1H), 4.12 (t, 1H), 6.94 (d, 1H), 7.00 (t, 1H), 7.10-7.30 (m, 12H).

1-[1-(benzyl)-3-(methyl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one \*

LC: 100%

MS: m/z 321.2 (M+1)

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): d 1.20 (d, 3H), 1.70 (m, 1H), 2.10 (dt, 1H), 2.23 (m, 1H), 2.35 (dd, 1H), 2.78 (d, 1H), 3.05 (m, 1H), 3.20 (dq, 1H), 3.51 (m, 4H), 4.10 (dt, 1H), 7.00 (m, 2H), 7.25 (m, 3H), 7.38 (m, 4H).

1-[1-(4-propyl-cyclohexyl)-3-(methyl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one \*

LC: 96.2%

MS: m/z 355.2 (M+1)

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): d 0.85 (m, 3H), 1.15 (m, 3H), 1.22-1.85 (m, 13H), 2.05-2.90 (m, 6H), 2.95-3.20 (m, 2H), 3.50 (s, 2H), 4.05 (m, 1H), 7.00 (m, 2H), 7.22 (m, 2H).

1-[1-(5-methylhex-2-yl)-3-(methyl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one \*

LC: 100%

MS: m/z 329.2 (M+1)

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<sup>1</sup>H-NMR (CDCl<sub>3</sub>): d 0.85 (m, 9H), 1.1 (m, 3H), 1.20-1.75 (m, 6H), 2.25 (m, 1H), 2.45-2.75 (m, 4H), 2.88 (m, 1H), 3.10 (m, 1H), 3.50 (s, 2H), 4.05 (m, 1H), 6.98 (m, 2H), 7.25 (m, 2H).

1-[1-(decahydro-2-naphthyl)-3-(methyl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one \*

LC: 95.3%

MS: m/z 367.2 (M+1)

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): d 1.11 (d, 3H), 1.16-1.85 (m, 16H), 2.20 (m, 1H), 2.35 (m, 2H), 2.52 (m, 2H), 2.75 (m, 1H), 3.02 (m, 2H), 3.50 (s, 2H), 4.05 (m, 1H), 6.96 (m, 2H), 7.20 (m, 2H).

1-[1-(4-(1-methylethyl)cyclohexyl)-3-(methyl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one \*

LC: 96.1%

MS: m/z 355.2 (M+1)

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): d 0.80 (m, 6H), 1.15 (m, 3H), 1.22-1.48 (m, 3H), 1.50-1.90 (m, 6H), 2.15-2.90 (m, 4H), 2.95-3.25 (m, 2H), 3.50 (s, 2H), 4.10 (m, 1H), 6.95 (m, 2H), 7.22 (m, 2H).

1-[1-(cyclooctylmethyl)-3-(methyl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one \*

LC: 100%

MS: m/z 355.2 (M+1)

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): d 1.1.2 (d, 3H), 1.15-1.75 (m, 16H), 1.92-2.10 (m, 3H), 2.20 (m, 2H), 2.73 (m, 1H), 3.00 (m, 1H), 3.12 (dq, 1H), 3.50 (s, 2H), 4.05 (dt, 1H), 6.99 (m, 2H), 7.20 (m, 2H).

3-ethyl-1-[1-(3,3-Bis(phenyl)propyl)-3-(methyl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one

LC: 96.3%

MS: m/z 453.3 (M+1)

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): d (two t, 3H), 1.18 (d, 3H), 1.70 (m, 1H), 1.90-2.05 (m, 3H), 2.12-2.30 (m, 5H), 7.73 (m, 1H), 2.97 (bd, 1H), 3.10-3.30 (m, 1H), 3.38 (t, 1H), 3.90-4.05 (m, 1H), 4.12 (q, 1H), 6.90-7.00 (two d, 1H), 7.02 (t, 1H), 7.12-7.32 (m, 12H).

3-ethyl-1-[1-(4-propylcyclohexyl)-3-(methyl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one

LC: 93.2%

MS: m/z 383.3 (M+1)

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): d 0.75-0.95 (m, 6H), 1.05-1.20 (m, 5H), 1.20-1.35 (m, 4H), 1.35-1.75 (m, 6H), 1.75-1.90 (m, 2H), 1.95-2.05 (m, 2H), 2.15-2.45 (m, 3H), 2.55 (d, 0.5H), 2.75 (d, 0.5H), 2.95-3.15 (m, 2H), 3.38 (t, 1H), 3.90-4.10 (m, 1H), 6.90-7.05 (2H), 7.20-7.25 (m, 2H).

3-ethyl-1-[1-(5-methylhex-2-yl)-3-(methyl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one;

LC: 92.3%

MS: m/z 357.4 (M+1)

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): d 0.75-0.95 (m, 10H), 1.10 (d, 3H), 1.15-1.40 (m, 3H), 1.40-1.75 (m, 4H), 1.97-2.10 (m, 2H), 2.20 (m, 1H), 2.43-2.75 (m, 4H), 2.80-2.95 (m, 1H), 3.00-3.25 (m, 1H), 3.40 (t, 1H), 3.90-4.10 (m, 1H), 6.90-7.05 (m, 2H), 7.25 (m, 2H).

3-ethyl-1-[1-(4-(1-methylethyl)cyclohexyl)-3-methyl-4-piperidiny]-1,3-dihydro-2H-indole-2-one

LC: 94.7%

MS: m/z 383.4 (M+1)

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): d 0.75-1.05 (m, 8H), 1.10-1.50 (m, 7H), 1.50-1.90 (m, 7H), 1.90-2.10 (m, 2H), 2.15-2.43 (m, 3H), 2.55 (d, 0.5H), 2.75 (d, 0.5H), 2.90-3.25 (m, 3H), 3.40 (t, 1H), 3.90-4.10 (m, 1H), 6.90-7.01 (m, 2H), 7.25 (m, 2H).

3-ethyl-1-[1-(decahydro-2-naphthyl)-3-(methyl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one

LC: 94.3%

MS: m/z 395.3 (M+1)

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): d 1.75-1.90 (two t, 3H), 1.10 (d, 3H), 1.15-1.90 (m, 15H), 2.00 (m, 2H), 2.20 (bs, 1H), 2.40 (m, 2H), 2.45-1.60 (m, 2H), 2.75 (m, 1H), 2.90-3.20 (m, 2H), 3.40 (bs, 1H), 3.90-4.15 (m, 1H), 6.90-7.05 (m, 2H), 7.25 (m, 2H).

## \* REFERENCE COMPOUNDS

**[0139]** Other compounds within the scope of formula (II) or (IIA) of the present invention can be synthesized by analogous techniques.

## EXAMPLE 9

**[0140]** Nociceptin affinity at the ORL1 receptor for preferred compounds was obtained using the following assay: Membranes from recombinant HEK-293 cells expressing the human opioid receptor-like receptor (ORL-1) (Receptor Biology) were prepared by lysing cells in ice-cold hypotonic buffer (2.5 mM MgCl<sub>2</sub>, 50 mM HEPES, pH 7.4) (10ml/10 cm dish) followed by homogenization with a tissue grinder/teflon pestle. Membranes were collected by centrifugation at 30,000 x g for 15 min at 4°C and pellets resuspended in hypotonic buffer to a final concentration of 1-3 mg/ml. Protein concentrations were determined using the BioRad protein assay reagent with bovine serum albumen as standard. Aliquots of the ORL-1 receptor membranes were stored at -80°C.

Functional SGTPgS binding assays were conducted as follows. ORL-1 membrane solution was prepared by sequentially adding final concentrations of 0.066 mg/ml ORL-1 membrane protein, 10 mg/ml saponin, 3 mM GDP and 0.20 nM [<sup>35</sup>S] GTPgS to binding buffer (100 mM NaCl, 10 mM MgCl<sub>2</sub>, 20 mM HEPES, pH 7.4) on ice. The prepared membrane solution (190 ml/well) was transferred to 96-shallow well polypropylene plates containing 10 ml of 20x concentrated stock solutions of agonist prepared in DMSO. Plates were incubated for 30 min at room temperature with shaking. Reactions were terminated by rapid filtration onto 96-well Unifilter GF/B filter plates (Packard) using a 96-well tissue harvester (Brandel) and followed by three filtration washes with 200 ml ice-cold binding buffer (10 mM NaH<sub>2</sub>PO<sub>4</sub>, 10 mM Na<sub>2</sub>HPO<sub>4</sub>, pH 7.4). Filter plates were subsequently dried at 50°C for 2-3 hours. Fifty ml/well scintillation cocktail (BetaScint; Wallac) was added and plates were counted in a Packard Top-Count for 1 min/well.

Data was analyzed using the curve fitting functions in GraphPad PRISM<sup>®</sup>, v. 3.0 and the results are set forth in table 2 below:

TABLE 2	
Nociceptin Affinity	
Compound	calc K <sub>1</sub> (nM)
3-ethylidene-1-[1-(5-methylhex-2-yl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one	11.1
3-ethylidene-1-[1-(4-propylcyclohexyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one	19
3-ethylidene-1-[1-(1,2,3,4-tetrahydro-2-naphthyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one	16.7
3-ethylidene-1-[1-(1,3-dihydroinden-2-yl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one	20.7
3-ethylidene-1-[1-(naphth-2-yl-methyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one	630
3-ethylidene-1-[1-(p-benzyloxybenzyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one	516
3-ethylidene-1-[1-(benzyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one	1854
3-ethylidene-1-[1-(cyclooctymethyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one	22.3
3-ethylidene-1-[1-(3,3-diphenylpropyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one	100.7
3-ethylidene-1-[1-(norboman-2-yl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one	922
3-ethylidene-1-[1-(p-cyanobenzyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one	7652
3-ethyl-1-[1-(5-methylhex-2-yl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one	4
3-ethyl-1-[1-[4-(1-methylethyl)-cyclohexyl]-4-piperidinyl]-1,3-dihydro-2H-indole-2-one	.86
3-ethyl-1-[1-(4-ptopylcyclohexyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one	40
3-ethyl-1-[1-(1,2,3,4-tetrahydro-2-naphthyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one	124
3-ethyl-1-[1-(decahydro-2-naphthyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one	3.6
3-ethyl-1-[1-(1,3-dihydroinden-2-yl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one	43
3-ethyl-1-[1-(cyclooctylmethyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one	9
3-ethyl-1-[1-(norboman-2-yl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one	82.7
1-[1-(naphth-1-ylmethyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one*	92
1-[1-(naphth-2-yl-methyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one*	107
1-[1-(p-phenylbenzyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one*	1362

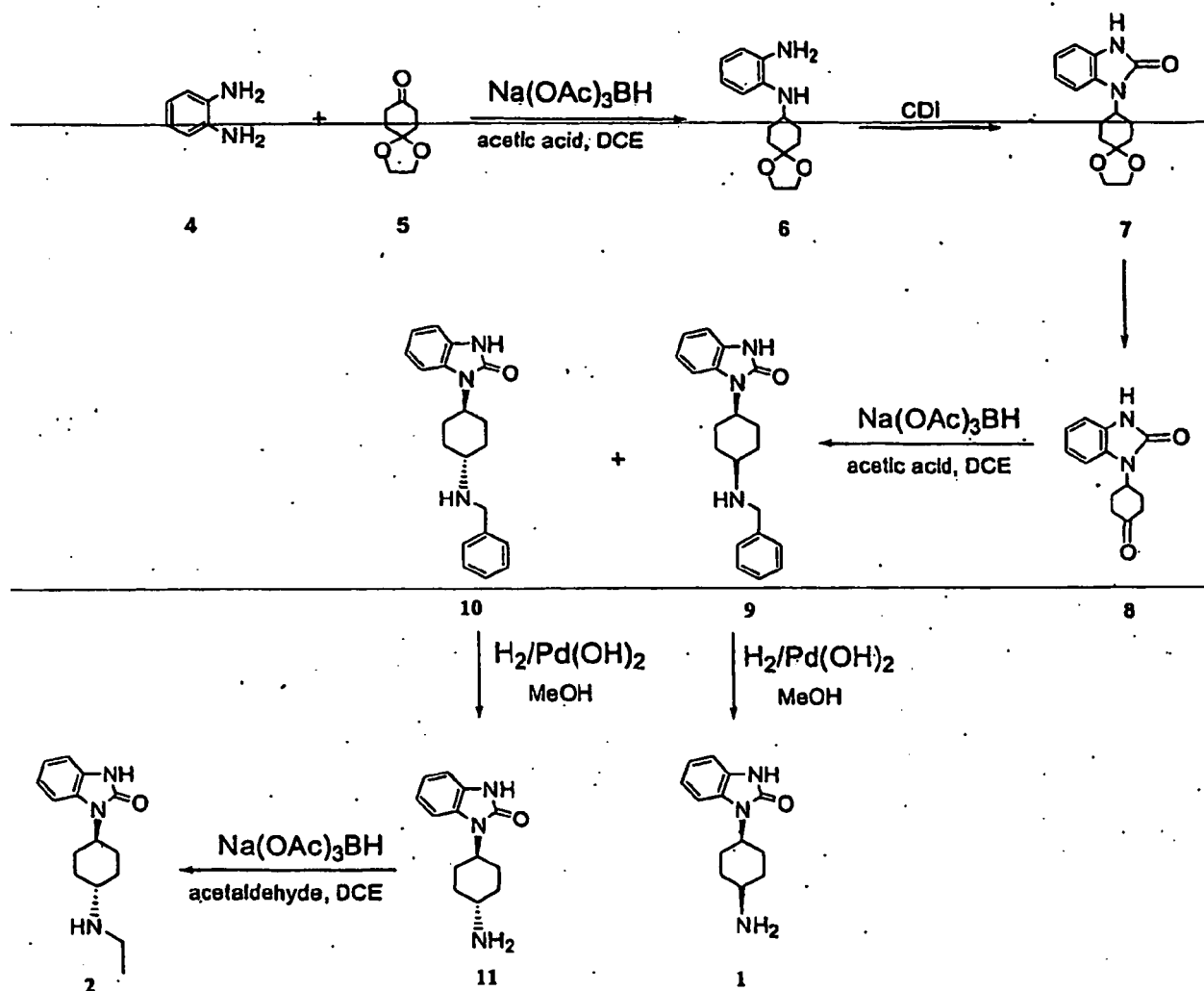
(continued)

TABLE 2	
Nociceptin Affinity	
Compound	calc K <sub>1</sub> (nM)
1-[1-(3,3-Bis(phenyl)propyl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one*	12.5
1-[1-( <i>p</i> -cyanobenzyl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one*	1267
1 [1( <i>p</i> -benzyloxybenzyl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one*	32
1-[1-(1,2,3,4-tetrahydronaphth-2-yl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one*	28.7
1-[1-(5-methylhex-2-yl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one*	7.4
1-[1-(norbornan-2-yl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one*	215
1-[1-(1,3-dihydroinden-2-yl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one*	18.7
1-[1-(cyclooctylmethyl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one*	54.3
1-[1-(benzyl)-3-(methyl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one*	> 10,000
1-[1-(4-propyl-cyclohexyl)-3-(methyl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one*	2435
1-[1-(5-methylhex-2-yl)-3-(methyl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one*	4335
1-[1-(decahydro-2-naphthyl)-3-(methyl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one*	366
1-[1-(4-(1-methylethyl)-cyclohexyl)-3-(methyl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one*	167
1-[1-(cyclooctylmethyl)-3-(methyl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one*	189
*REFERENCE COMPOUNDS	

## REFERENCE EXAMPLE 10

## SYNTHESIS OF CERTAIN HEAD GROUPS.

[0141]

**SCHEME 1:**Procedure:

**[0142]** To a mixture of 4 (21.6 g, 0.2 mole), 5 (15.6 g, 0.1 mole), acetic acid (6 g, 0.1 mole) in 500 ml of dichloroethane, 29.7 g of sodium triacetoxyborohydride (0.14 mol, 1.4 eq) was added in one portion. Gas evolves between 30 min and 1 hr. The mixture was stirred over night. TLC indicated the reaction is complete. 1 N NaOH (500 ml) was added to quench the reaction. The organic layer was separated and the aqueous layer was extracted by EtOAc (300 ml x2). The combined organics were dried over potassium carbonate and the solvent evaporated to give a red oil which was column filtrated (5%Et3N, 25%EtOAc and 70%Hexane) to give 14 g of product 6 as a white solid (54%).

**Compound 6**

**[0143]** MS: m/z 249.3 (M+1).

$^1\text{H}$  NMR ( $\text{CDCl}_3$ ): d 1.50 -1.90 (m, 6H), 2.05 (m, 2H), 3.30 (m, 4H), 3.95 (s, 4H), 6.60 -6.80 (m, 4H).

**[0144]** To a solution of 13.5 g of 6 (54.4 mmol) in 50 ml of acetonitrile, 11.02 g of carbonyldiimidazole was added in one portion. The mixture was stirred over night. Solid precipitated out of solution which was filtered and washed by  $\text{H}_2\text{O}$  and TBUG to give 7.5 g of product. The filtrate was evaporated and the crude material was dissolved in EtOAc, washed with water and saturated potassium carbonate solution. The organics were dried over potassium carbonate. The solvent was evaporated to give a second batch of solid with a pink color which was column filtrated (10%Et3N, 40%EtOAc and

50%Hexane) to give another 4.5 g of product 7 (81%, combined).

#### Compound 7

5 [0145] MS: m/z 274.7 (M+1).

<sup>1</sup>H NMR (CDCl<sub>3</sub>): d 1.50 -1.90 (m, 7H), 2.50 (m, 2H), 4.00 (m, 4H), 4.50 (m, 1H), 7.10 (m, 3H), 7.25 (m, 1H).

[0146] A mixture of 7 (7.5 g, 27.4 mmole) and 8.26 g of PPTS in 50 ml of acetone and H<sub>2</sub>O (10:1) was stirred in refluxed over night. The mixture was cooled to room temperature and acetone was evaporated. Addition of water to the mixture initiated crystalization to give 3 g of product 8 (47.4%).

#### Compound 8

[0147] MS: m/z 231 (M+1).

<sup>1</sup>H NMR (CDCl<sub>3</sub>): d 2.20 (m, 2H), 2.60 (m, 2H), 4.50 (m, 1H), 7.10 (m, 4H), 9.5 (br, 1H).

15 [0148] To a mixture of 8 (7.75 g, 33.65 mmole), benzylamine (3.61 g, 33.65 mmole), acetic acid (2.0 g, 33.65 mmole) in 150 ml of dichloroethane, 10.3 g of sodium triacetoxyborohydride (47.1 mmol, 1.4 eq) was added in one portion. Gas evolves between 30 min and 1 hr. The mixture was stirred over night. TLC indicated the reaction was complete. 1N NaOH (500 ml) was added to quench the reaction. The organic layer was separated and the aqueous layer was extracted with EtOAc (300 ml x2). The combined organics were dried over potassium carbonate and the solvent was evaporated to give a brown solid, which was column filtrated (5%Et<sub>3</sub>N, 25%EtOAc and .70%Hexane to 10%Et<sub>3</sub>N, 40%EtOAc and 50%Hexane) to give 4.7 g of product 10 as a white solid (53.4%) and 3.01 g of product 9 as a white solid (34.2%).

#### Compound 9

25 [0149] MS: m/z 322 (M+1).

<sup>1</sup>H NMR (CDCl<sub>3</sub>): d 1.40 (m, 2H), 1.80-2.35 (m, 61-1), 2.-70 (m, 1H), 3.86 (s, 2H), 4.30 (m, 1H), 7.10 -7.50 (m, 9H), 9.6 (br, 1H).

#### Compound 10

30 [0150] MS: m/z 322 (M+1).

<sup>1</sup>H NMR (CDCl<sub>3</sub>): d 1.60 (m, 4H), 1.90 (m, 2H), 2.60 (m, 2H), 3,10 (m, 1H), 3.84 (s, 2H), 4.50 (m, 1H), 7.10-7.50 (m, 9H), 9.6 (br, 1H).

35 [0151] 2 g of Pd(OH)<sub>2</sub> was added into a solution of 30 ml of methanol containing 4.7 g of compound 10. The resulting suspension was hydrogenated at 50 psi for 12 hrs at room temperature. TLC indicated the reaction was complete over night. The solution was filtered through a pad of celite to remove the catalyst The celite was washed with methanol twice (20 ml). The organics were combined and solvent was removed to give a pale solid which was purified by chromatography (10% MeOH, 90% EtOAc) to give an off white product 11 (1.79 g, 50.7%).

#### Compound 11

40 [0152] MS: m/z 232 (M+1).

<sup>1</sup>H NMR (CDCl<sub>3</sub>): d1.50-1.85 (m,8H), 2.60 (m, 2H), 4.30 (m,1H), 7.10 (m, 3H), 7.30 (m,1H).

45 [0153] To a mixture of 11 (1.7 g, 7.4 mmole), acetaldehyde (0.33 g, 7.4 mmole) in 50 ml of dichloroethane, 2.2 g of sodium triacetoxyborohydride (10.36 mmol, 1.4 eq) was added in one portion. Gas evolves between 30 min and 1 hr. The mixture was stirred over night. TLC indicated the reaction was complete. 1N NaOH (500 ml) was added to quench the reaction. The organic layer was separated and the aqueous layer was extracted with EtOAc (300 ml x2). The combined organics were dried over potassium carbonate and the solvent was evaporated to give a brown oil which was chromatographed (10%Et<sub>3</sub>N, 40%EtOAc and 50%Hexane) to give 1.5 g of product 2 as a sticky oil which recrystallized from TBME to give a white solid (78%).

#### Compound 2

55 [0154] MS: m/z 259.7 (M+1).

<sup>1</sup>H NMR (CDCl<sub>3</sub>): d1.15(t,3H), 1.50-1.95(m,6H), 2.40-2.75(m, 4H). 2.95(m,1H), 4.35 (m; 1H), 7.10 (m, 3H), 7.35 (m, 1H).

[0155] 1.5 g of Pd(OH)<sub>2</sub> was added into a solution of 30 ml ofmethanol containing 3.01 g of compound 9. The resulting suspension was hydrogenated at 50 psi for 12 hrs at room temperature. TLC indicated the reaction was complete over night. The solution was filtered through a pad of celite to remove the catalyst. The celite was washed with methanol

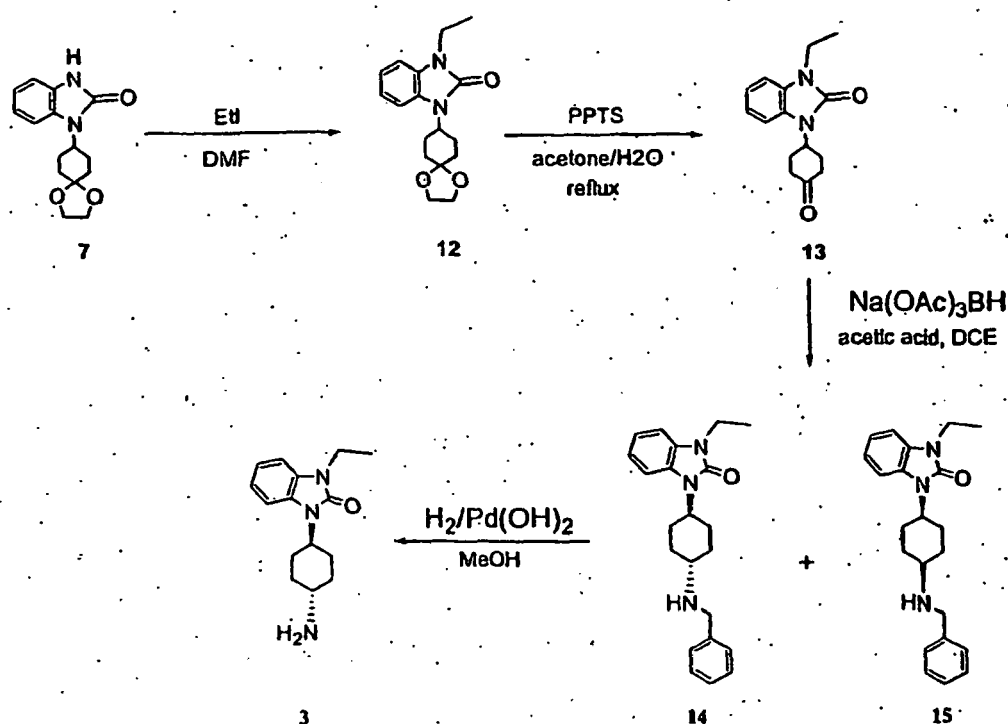
twice (20 ml). The organics were combined and solvent was removed to give a pale solid which was purified by chromatography (10% MeOH, 90% EtOAc) to give an off white product 1 (1.68 g 77.4%).

### Compound 1

[0156] MS: m/z 232 (M+1).

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 1.50 (m, 2H), 1.90-2.35 (m, 6H), 3.00 (m, 1H), 4.30 (m, 1H), 7.10-7.30 (m, 4H).

### SCHEME 2:



### Procedure:

[0157] About 2.5 g of NaH was washed by THF twice, suspended in 100 ml of DMF, then 8.15 g of 7 (38 mmole) was added to the mixture. Gas evolves, and after 5 minutes, 7.13 g of ethyl iodide (45.7 mole) was added. The mixture was stirred over night. LC/MS indicated that the starting material was completely consumed. The reaction was cooled down and H<sub>2</sub>O was added to the mixture. The product started to precipitated out of solution. The crystals was collected by filtration to give 9.7 g of 12 (84.7%).

### Compound 12

[0158] MS: m/z 303.3 (M+1).

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 1.30 (t, 3H), 1.70-1.90 (m, 6H), 2.50 (m, 2H), 3.85-4.00 (m, 6H), 4.50 (m, 1H), 7.05 (m, 3H), 7.25 (m, 1H).

[0159] A mixture of 12 (9.7 g, 32.2 mmole) and 9.72 g of EPPTS in 50 ml of acetone and H<sub>2</sub>O (10:1) was refluxed over night. The mixture was cooled to room temperature and acetone was evaporated. Addition of water to the mixture initiated crystallization to give 6.85 g of product 13 (82.3%).



**Compound 13**

[0160] MS: m/z 259 (M+1).

<sup>1</sup>H NMR (CDCl<sub>3</sub>): d 1.35 (t, 3H), 2.20 (m, 2H), 2.60 (m, 6H), 3.95 (q, 2H), 4.85 (m, 1H), 7.10 (m, 4H).

[0161] To a mixture of 13 (6.85 g, 26.5 mmole), benzylamine (2.84 g, 26.5 mmole), acetic acid (1.59 g, 26.5 mmole) in 150 ml of dichloroethane, 7.86 g of sodium tracetoxymethylborohydride (37.1 mmol, 1.4 eq) was added in one portion. Gas evolves between 30 min and 1 hr. The mixture was stirred over night. TLC indicated the reaction was complete. 1N NaOH (500 ml) was added to quench the reaction. The organic layer was separated and the aqueous layer was extracted with EtOAc (300 ml x2). The combined organics were dried over potassium carbonate and the solvent was evaporated to give a brown solid, which was column filtrated (5%Et<sub>3</sub>N; 25%EtOAc and 70%Hexane to 10%Et<sub>3</sub>N, 40%EtOAc and 50%Hexane) to give 1.52g of product 14 as a white solid and 1.08 g of product 15 as a white solid.

**Compound 14**

[0162] MS: m/z 350 (M+1).

<sup>1</sup>H NMR (CDCl<sub>3</sub>): d 1.35 (t, 3H), 1.50 (m, 2H), 1.65 (m, 4H), 1.95 (m, 2H), 2.60 (m, 2H), 3.02 (m, 1H), 3.83 (s, 2H), 3.95 (ddd, 2H), 4.45 (m, 1H), 7.00-7.50 (m, 9H).

**Compound 15**

[0163] MS: m/z 350 (M+1).

<sup>1</sup>H NMR (CDCl<sub>3</sub>): d 1.35 (m, 5H), 1.90 (m, 2H), 2.10-2.35 (m, 4H), 2.70 (m, 1H), 3.83 (s, 2H), 3.95 (ddd, 2H), 4.40 (m, 1H), 7.00-7.50 (m, 9H).

[0164] 0.3 g of Pd(OH)<sub>2</sub> was added into a solution of 20 ml of methanol containing 0.5 g of compound 14. The resulting suspension was hydrogenated at 50 psi for 12 hr at room temperature. TLC indicated the reaction was complete over night. The solution was filtered through a pad of celite to remove the catalyst. The celite was washed with methanol twice (20 ml). The organics were combined and solvent was removed to give a pale solid which was purified by chromatography (10% MeOH, 90% EtOAc) to give an off white product 3 (300 mg, 50%).

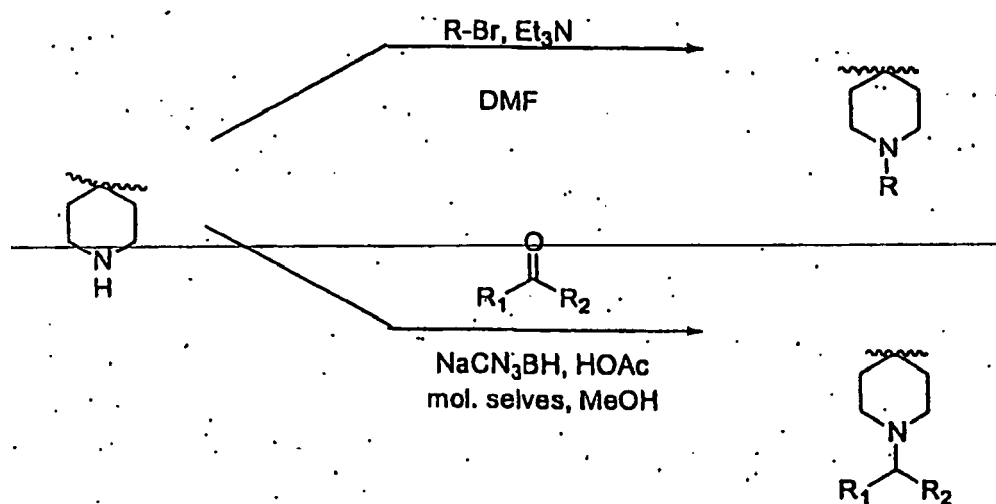
**Compound 3**

[0165] MS: m/z 232 (M+1).

<sup>1</sup>H NMR (CDCl<sub>3</sub>): d 1.35 (t, 3H), 1.50-1.85 (m, 8H); 2.60 (m, 2H), 3.20 (m, 1H), 3.95 (ddd, 2H), 4.30 (m, 1H), 7.10 (m, 3H), 7.30 (m, 1H).

**REFERENCE EXAMPLE 11****ATTACHMENT OF TAIL GROUPS**

[0166] Tail groups were attached to the head groups according to the following procedures:



**General procedure for alkylation:**

**[0167]** To a solution of the amine (1 eq) and triethylamine (1 eq) in dimethylformamide, was added 1 eq of alkyl bromide or chloride in one portion. The mixture was stirred and heated at 80°C over night. TLC indicated the reaction was complete. The reaction was quenched by the addition of water followed by 1 N NaOH to pH 10. The mixture was extracted 2x with Et<sub>2</sub>O. The combined organic extracts were dried over potassium carbonate and the solvent evaporated, followed by chromatography to give the pure product.

**General procedure for reductive amination:**

**[0168]** To a mixture of ketone or aldehyde (1 eq), amine (1 eq), and acetic acid (1 eq) in methanol, was added sodium cyanoborohydride (1.4 eq) in one portion. The mixture was stirred over night at room temperature. TLC indicated the reaction was complete. The reaction was quenched by the addition of water followed by 1 N NaOH to pH 10. The mixture was extracted 2x with Et<sub>2</sub>O. The combined organic extracts were dried over potassium carbonate and the solvent evaporated, followed by chromatography to give the pure product.

**[0169]** The following reference compounds were prepared by attaching the tail groups using the general procedures described:

1-[4-(benzylamino)-cyclohexyl]-3-ethyl-1,3-dihydro-2H-benzimidazol-2-one

1-[4-(benzylamino)-cyclohexyl]-3-ethyl-1,3-dihydro-2H-benzimidazol-2-one

1-[4-[(naphth-2-yl-methyl)ethylamino]-cyclohexyl]-1,3-dihydro-2H-benzimidazol-2-one  
MS: m/z 400.2 (M+1)

1-[4-(norboman-2-ylamino)-cyclohexyl]-1,3-dihydro-2H-benzimidazol-2-one  
MS: m/z 326.3 (M+1)

1-[4-[4-(1-methylethyl)-cyclohexyl]amino]-cyclohexyl]-1,3-dihydro-2H-benzimidazol-2-one  
MS: m/z 356.4 (M+1)

1-[4-[(decahydro-2-naphthyl)amino]-cyclohexyl]-1,3-dihydro-2H-benzimidazol-2-one  
MS: m/z 368.2 (M+1)

1-[4-(ethylamino)-cyclohexyl]-1,3-dihydro-2H-benzimidazol-2-one

1-[4-(benzylamino)-cyclohexyl]-1,3-dihydro-2H-benzimidazol-2-one

1-[4-(benzylamino)-cyclohexyl]-1,3-dihydro-2H-benzimidazol-2-one

1-[4-[(indan-2-yl)benzylamino]-cyclohexyl]-3-ethyl-1,3-dihydro-2H-benzimidazol-2-one  
MS: m/z 466.3 (M+1)

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): δ 1.30 (t, 3H), 1.50-1.75 (m, 2H), 1.90 (b, 2H), 2.02 (b, 2H), 2.20 (m, 2H), 2.80 (m, 1H), 2.99 (m, 4H), 3.75 (s, 2H), 3.90 (m, 3H), 4.25 (m, 1H), 6.95-7.45 (m, 13H).

1-[4-[(cyclooctylmethyl)amino]-cyclohexyl]-3-ethyl-1,3-dihydro-2H-benzimidazol-2-one  
LC: 99%

MS: m/z 384.5

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 1.40-1.90 (m, 24H), 2.30 (m, 2H), 2.50 (m, 2H), 2.90 (m, 1H), 3.90 (ddd, 2H), 4.20 (m, 1H), 7.10 (m, 3H), 7.30 (m, 1H).

1-[4-[(naphth-2-yl)aminol-cyclohexyl]-3-ethyl-1,3-dihydro-2H-benzimidazol-2-one  
LC: 97%

MS: m/z 399 :

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 1.50 (t, 3H), 1.80 (m, 5H), 2.0 (m, 2H), 2.70 (m, 2H), 3.10 (m, 1H), 3.90 (m, 2H), 4.0 (m, 2H), 4.40 (m, 1H), 7.10 (m, 3H), 7.50 (m, 4H), 7.90 (m, 4H).

1-[4-[(p-benzyloxybenzyl)amino]-cyclohexyl]-3-ethyl-1,3-dihydro-2H-benzimidazol-2-one

LC: 97%

MS: m/z 455

<sup>1</sup>H NMR (CDCl<sub>3</sub>): d 1.40 (t, 3H), 1.70 (m, 2H), 1.90 (m, 3H), 2.60(m, 4H), 3.10(m, 1H), 3.80(s, 2H), 4.0(m, 2H), 4.50 (m, 1H), 5.10(s, 2H), 7.10(m, 6H), 7.50(m, 6H), 7.90(m, 1H).

1-[4-[(cyclooctylmethyl)amino]-cyclohexyl]-3-ethyl-1,3-dihydro-2H-benzimidazol-2-one

TLC:99%

MS: m/z 369

<sup>1</sup>H NMR (CDCl<sub>3</sub>): d 1.40 (t, 3H), 1.70(m, 5H), 1.90(m, 12H), 2.10(m,3H), 2.40(m, 2H), 2.50(d, 2H), 3.30(m, 1H), 3.90 (m, 2H), 4.20(m, 1H), 7.10(m, 1H), 7.30(m, 3H).

1-[4-[(decahydro-2-naphthyl)amino]-cyclohexyl]-3-ethyl-1,3-dihydro-2H-benzimidazol-2-one

LC:99%

MS: m/z 395

<sup>1</sup>H NMR (CDCl<sub>3</sub>): d 1.40 (t, 3H), 1.70(m, 3H), 1.80(m, 3H), 1.90(m, 12H), 2.20(m, 2H), 2.30(m, 3H), 2.50(q, 2H), 3.10 (m, 1H), 3.90(m, 2H), 4.20(m, 1H), 4.30(m, 1H), 7.0(m, 1H), 7.30(m, 3H).

1-[4-[(p-phenylbenzyl)amino]-cyclohexyl]-5-carbamoyl-1,3-dihydro-2H-benzimidazol-2-one

LC:100%

MS: m/z 440.8 (M+1)

<sup>1</sup>H-NMR (MeOH-d<sub>4</sub>): d 1.75 (m, 2H), 2.00 (m, 2H), 2.40-2.55 (m, 4H), 3.35-3.52 (m, 2H), 4.35 (s, 2H), 7.40 (m, 2H), 7.59 (t, 2H), 7.60-7.72 (m, 6H), 7.78 (d, 2H).

1-[4-[(1,2,3,4-tetrahydronaphthyl)amino]-cyclohexyl]-5-carbamoyl-1,3-dihydro-2H-benzimidazol-2-one

LC:93.9%

MS: m/z 405.7 (M+1)

<sup>1</sup>H-NMR (MeOH-d<sub>4</sub>): d 1.70 (m, 2H), 1.85 (m, 1H), 2.02 (m, 2H), 2.39 (b, 3H), 2.50 (m, 2H), 2.90 (m, 1H), 3.00 (b, 2H), 3.35 (m, 1H), 3.60 (m, 1H), 3.72 (b, 1H), 4.35 (m, 1H), 7.15 (b, 4H), 7.40 (d, 1H), 7.60 (s, 1H), 7.65 (d, 1H).

1-[4-[(4-propyl-cyclohexyl)amino]-cyclohexyl]-5-carbamoyl-1,3-dihydro-2H-benzimidazol-2-one

TLC:100%

MS: m/z 399.6 (M+1)

<sup>1</sup>H-NMR (MeOH-d<sub>4</sub>): d 0.95 (t, 3H), 1.10 (m, 1H), 1.20-1.60 (m, 6H), 1.70 (b, 5H), 1.80-2.00 (m, 4H), 2.10 (m, 1H), 2.30 (b, 2H), 2.45 (m, 2H), 3.25 (m, 1H), 3.50 (m, 1H), 4.40 (m, 1H), 7.40 (d, 1H), 7.60 (s, 1H), 7.65 (d, 1H).

1-[4-[(5-methylhex-2-yl)amino]-cyclohexyl]-5-carbamoyl-1,3-dihydro-2H-benzimidazol-2-one

LC: 100%

MS: m/z 373.5 (M+1)

<sup>1</sup>H-NMR(MeOH-d<sub>4</sub>): d 0.95 (d, 6H), 1.25-1.40 (m, 5H), 1.50-1.75 (m, 4H), 1.85 (m, 1H), 1.95 (b, 2H), 2.30 (m, 2H), 2.40-2.55 (m, 2H), 3.35-3.55 (m, 2H), 4.38 (m, 1H), 7.40 (d, 1H), 7.60 (s, 1H), 7.70 (d, 1H).

1-[4-[(decahydro-2-naphthyl)amino]-cyclohexyl]-5-carbamoyl-1,3-dihydro-2H-benzimidazol-2-one

LC:100%

MS: m/z 411.7 (M+1)

<sup>1</sup>H-NMR (MeOH-d<sub>4</sub>): d 0.90-2.10 (m, 18H), 2.10-2.50 (m, 5H), 2.82 (m, 1H), 3.50 (m, 2H), 4.35 (m, 1H), 7.42 (d, 1H), 7.60 (s, 1H), 7.70 (d, 1H).

1-[4-(cyclooctylamino)-cyclohexyl]-5-carbamoyl-1,3-dihydro-2H-benzimidazol-2-one;

LC: 95.4%

MS: m/z 385.7 (M+1).

<sup>1</sup>H-NMR (MeOH-d<sub>4</sub>): d 1.50-2.10 (m, 13H), 2.30(m, 2H), 2.40-2.52 (m, 3H), 2.80-2.95 (m, 3H), 3.45 (m, 2H), 3.70 (m, 1H), 4.38 (m, 1H), 7.40 (d, 1H), 7.63 (s, 1H), 7.70 (d, 1H).

1-[4-[(indan-2-yl)amino]-cyclohexyl]-5-carbamoyl-1,3-dihydro-2H-benzimidazol-2-one

LC:100%

MS: m/z 391.6 (M+1)

<sup>1</sup>H-NMR (MeOH-d<sub>4</sub>): d 1.70 (m, 2H), 2.00 (m, 2H), 2.40-2.60 (m, 4H), 3.10-3.20 (m, 2H), 3.50 (m, 3H), 4.30-4.45 (m, 2H), 7.25 (m, 2H), 7.35 (m, 2H), 7.42 (d, 1H), 7.60 (s, 1H), 7.72 (d, 1H).

1-[4-(benzylamino)-cyclohexyl]-5-carbamoyl-1,3-dihydro-2H-benzimidazol-2-one

LC: 100%

MS: m/z 399.5 (M+1)

<sup>1</sup>H-NMR (MeOH-d<sub>4</sub>): δ 1.40-1.85 (m, 15H), 2.00 (m, 4H), 2.25-2.50 (m, 4H), 2.93 (d, 2H), 3.30 (m, 1H), 4.30 (m, 1H), 7.36 (d, 1H), 7.60 (s, 1H), 7.65 (d, 1H).

1-[4-[(4-phenyl-cyclobexyl)amino]-cyclohexyl]-5-carbamoyl-1,3-dihydro-2H-benzimidazol-2-one

LC:100%

MS: m/z 433.7 (M+1)

<sup>1</sup>H-NMR(MeOH-d<sub>4</sub>): δ 1.65 (m, 2H), 1.85-2.20 (m, 8H), 2.25-2.50 (m, 5H), 3.90 (m, 1H), 3.50 (m, 2H), 3.58 (m, 1H), 4.30 (m, 1H), 7.15-7.40 (m, 6H), 7.60 (s, 1H), 7.65 (d, 1H).

1-[4-(dibenzylamino)-cyclohexyl]-5-carbamoyl-1,3-dihydro-2H-benzimidazol-2-one

LC: 100%

MS: m/z 455.6 (M+1)

<sup>1</sup>H-NMR (MeOH-d<sub>4</sub>): δ 2.00-2.25 (m, 4H), 2.40 (m, 4H), 3.52 (m, 2H), 4.25-4.65 (m, 4H), 7.30 (d, 1H), 7.45-7.58 (m, 10H), 7.60 (s, 1H), 7.65 (d, 1H).

1-[4-[(5-methylhex-2-yl)amino]-cyclohexyl]-7-carbamoyl-1,3-dihydro-2H-benzimidazol-2-one

LC: 99.1 %

MS: m/z 373.3 (M+1)

<sup>1</sup>H-NMR (MeOH-d<sub>4</sub>): δ 0.95 (d, 6H), 1.30 (d, 3H), 1.45-1.68 (m, 5H), 1.75 (m, 1H), 2.00 (m, 2H), 2.18-2.32 (m, 3H), 2.60 (m, 2H), 3.20-3.40 (m, 2H), 4.30 (m, 1H), 7.05-7.20 (m, 3H).

## REFERENCE EXAMPLE 12

**[0170]** Nociceptin affinity at the ORL1 receptor for preferred compounds was obtained using the following assay:

Membranes from recombinant HEK-293 cells expressing the human opioid receptor-like receptor (ORL-1) (Receptor Biology) were prepared by lysing cells in ice-cold hypotonic buffer (2.5 mM MgCl<sub>2</sub>, 50 mM HEPES, pH 7.4) (10 ml/10 cm dish) followed by homogenization with a tissue grinder/teflon pestle. Membranes were collected by centrifugation at 30,000 x g for 15 min at 4°C and pellets resuspended in hypotonic buffer to a final concentration of 1-3 mg/ml. Protein concentrations were determined using the BioRad protein assay reagent with bovine serum albumen as standard. Aliquots of the ORL-1 receptor membranes were stored at -80°C.

Functional SGTPgS binding assays were conducted as follows. ORL-1 membrane solution was prepared by sequentially adding final concentrations of 0.066 mg/ml ORL-1 membrane protein, 10 mg/ml saponin, 3 mM GDP and 0.20 nM [<sup>35</sup>S]GTPgS to binding buffer (100 mM NaCl, 10 mM MgCl<sub>2</sub>, 20 mM HEPES, pH 7.4) on ice. The prepared membrane solution (190 ml/well) was transferred to 96-shallow well polypropylene plates containing 10 ml of 20x concentrated stock solutions of agonist prepared in DMSO. Plates were incubated for 30 min at room temperature with shaking. Reactions were terminated by rapid filtration onto 96-well Unifilter GFB filter plates (Packard) using a 96-well tissue harvester (Brandel) and followed by three filtration washes with 200 ml ice-cold binding buffer (10 mM NaH<sub>2</sub>PO<sub>4</sub>, 10 mM Na<sub>2</sub>HPO<sub>4</sub>, pH 7.4). Filter plates were subsequently dried at 50°C for 2-3 hours. Fifty ml/well scintillation cocktail (BetaScint; Wallac) was added and plates were counted in a Packard Top-Count for 1 min/well.

**[0171]** Data was analyzed using the curve fitting functions in GraphPad PRISM<sup>®</sup>, v. 3.0 and the results are set forth in table 3 below:

TABLE 3	
Nociceptin Affinity	
REFERENCE Compound	calc K <sub>1</sub> (nM)
3-ethyl-1-( <i>p</i> -phenylbenzyl)-1,3-dihydro-2H-benzimidazol-2-one	509
3-ethyl-1-(5-methylhex-2-yl)-1,3-dihydro-2H-benzimidazol-2-one	23
3-ethyl-1-(4-propylcyclohexyl)-1,3-dihydro-2H-benzimidazol-2-one	68
3-ethyl-1-(decahydro-2-naphthyl)-1,3-dihydro-2H-benzimidazol-2-one	1.6

(continued)

TABLE 3

## Nociceptin Affinity

## REFERENCE Compound

calc K<sub>1</sub>(nM)

3-ethyl-1-(naphth-2-yl-methyl)-1,3-dihydro-2H-benzimidazol-2-one

198

1-(*p*-benzyloxybenzyl)-3-ethyl-1,3-dihydro-2H-benzimidazol-2-one

438

1-benzyl-3-ethyl-1,3-dihydro-2H-benzimidazol-2-one

296

1-[4-(benzylamino)-cyclohexyl]-3-ethyl-1,3-dihydro-2H-benzimidazol-2-one

trans: 112  
cis: >10,000

3-ethyl-1-(naphthylmethyl)-1,3-dihydro-2H-benzimidazol-2-one

39

3-ethyl-1-[5-(3-fluorophenyl)-5-(4-fluorophenyl)-hexyl]-1,3-dihydro-2H-benzimidazol-2-one

148

1-[4-[(naphth-2-yl-methyl)ethylamino]-cyclohexyl]-1,3-dihydro-2H-benzimidazol-2-one

3598

1-[4-(norbornan-2-ylamino)-cyclohexyl]-1,3-dihydro-2H-benzimidazol-2-one

&gt;10000

1-[4-[[4-(1-methylethyl)-cyclohexyl]amino]-cyclohexyl]-1,3-dihydro-2H-benzimidazol-2-one

&gt;10000

1-[4-[(decahydro-2-naphthyl)amino]-cyclohexyl]-1,3-dihydro-2H-benzimidazol-2-one

&gt;10000

1-[4-(ethylamino)-cyclohexyl]-1,3-dihydro-2H-beuzimidazol-2-one

9179

1-[4-(benzylamino)-cyclohexyl]-1,3-dihydro-2H-benzimidazol-2-one

trans: 273  
cis: >10000

1-[4-[(indan-2-yl)benzylamino]-cyclohexyl]-3-ethyl-1,3-dihydro-2H-benzimidazol-2-one

&gt;10000

1-[4-[(cyclooctylmethyl)amino]-cyclohexyl]-3-ethyl-1,3-dihydro-2H-benzimidazol-2-one

115

1-[4-[(naphth-2-yl)amino]-cyclohexyl]-3-ethyl-1,3-dihydro-2H-benzimidazol-2-one

961

1-[4-[(*p*-benzyloxybenzyl)amino]-cyclohexyl]-3-ethyl-1,3-dihydro-2H-benzimidazol-2-one

2935

1-[4-[(cyclooctylmethyl)amino]-cyclohexyl]-3-ethyl-1,3-dihydro-2H-benzimidazol-2-one

286

1-[4-[(decahydro-2-naphthyl)amino]-cyclohexyl]-3-ethyl-1,3-dihydro-2H-benzimidazol-2-one

288

1-[4-(benzylamino)-cyclohexyl]-5-carbamoyl-1,3-dihydro-2H-benzimidazol-2-one

&gt;10000

1-[4-(dibenzylamino)-cyclohexyl]-5-carbamoyl-1,3-dihydro-2H-benzimidazol-2-one

&gt;10000

1-[4-[(*p*-phenylbenzyl)amino]-cyclohexyl]-5-carbamoyl-1,3-dihydro-2H-benzimidazol-2-one

&gt;10000

1-[4-[(1,2,3,4-tetrahydronaphthyl)amino]-cyclohexyl]-5-carbamoyl-1,3-dihydro-2H-benzimidazol-2-one

&gt;10000

1-[4-[(4-propyl-cyclohexyl)amino]-cyclohexyl]-5-carbamoyl-1,3-dihydro-2H-benzimidazol-2-one

&gt;10000

1-[4-[(5-methylhex-2-yl)amino]-cyclohexyl]-5-carbamoyl-1,3-dihydro-2H-benzimidazol-2-one

&gt;10000

1-[4-[(decahydro-2-naphthyl)amino]-cyclohexyl]-5-carbamoyl-1,3-dihydro-2H-benzimidazol-2-one

&gt;10000

1-[4-(cyclooctylamino)-cyclohexyl]-5-carbamoyl-1,3-dihydro-2H-benzimidazol-2-one

&gt;10000

1-[4-[(indan-2-yl)amino]-cyclohexyl]-5-carbamoyl-1,3-dihydro-2H-benzimidazol-2-one

&gt;10000

1-[4-[(4-phenyl-cyclohexyl)amino]-cyclohexyl]-5-carbamoyl-1,3-dihydro-2H-benzimidazol-2-one

&gt;10000

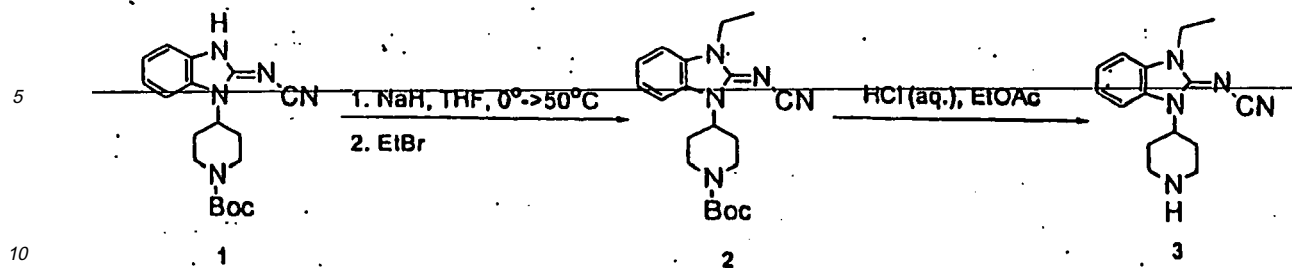
1-[4-[(5-methylhex-2-yl)amino]-cyclohexyl]-7-carbamoyl-1,3-dihydro-2H-benzimidazol-2-one

&gt;10000

## REFERENCE EXAMPLE 13

## SYNTHESIS OF SUBSTITUTED BENZIMIDAZOLE HEAD GROUPS.

[0172]



# Procedure:

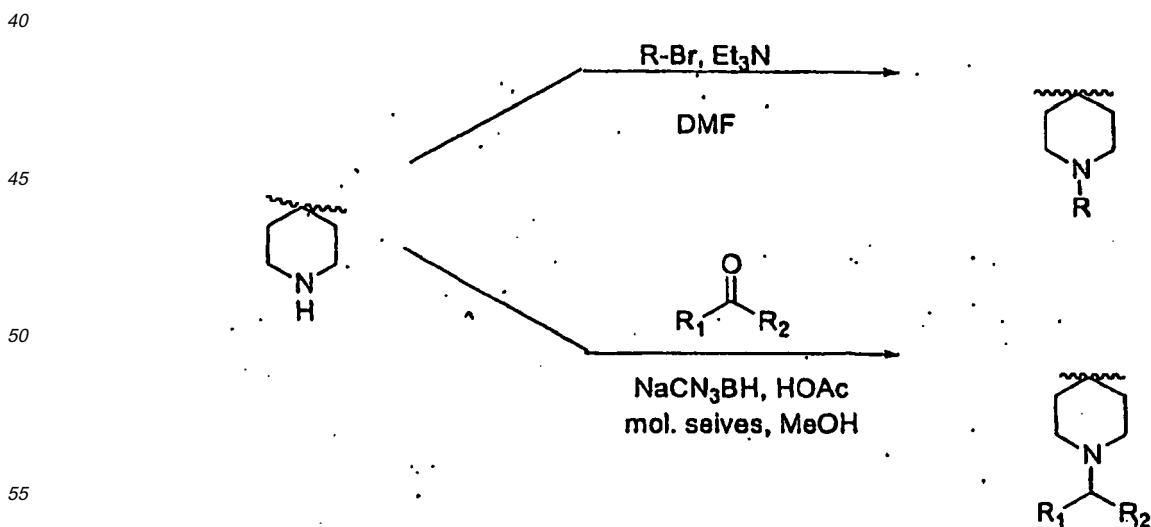
15 **[0173]** Sodium hydride 60% dispersion in mineral oil (0.67 g, 16.7 mmol) was washed with dry pentane and then suspended in 80 mL of dry THF under N<sub>2</sub>. Compound 1 (European patent 0029707) (3.80 g, 11.1 mmol) was added, the mixture stirred at room temperature for 15 min and then warmed to 50°C. Ethyl bromide (1.06 mL, 13.3 mmol) was added and the resulting mixture stirred at 50°C for 18 hr. TLC (SiO<sub>2</sub>, CH<sub>2</sub>Cl<sub>2</sub>:MeOH 96:4) showed that the reaction was ca 40% complete. Additional sodium hydride (0.67 g) and ethyl bromide (1.06 mL) were added. After heating at 50°C for an additional 24 hr the reaction mixture was cooled to room temperature and quenched with water. The layers were separated and the aqueous layer extracted with ethyl acetate (1x). The combined organic extracts were washed with aqueous sodium bicarbonate solution (1x), dried over MgSO<sub>4</sub> and the solvent was evaporated to give the crude product as a yellow solid. Trituration with diethyl ether gave pure 2 as a white solid (3.38 g, 82%). <sup>1</sup>H-NMR (CDCl<sub>3</sub>): δ 1.45-1.55 (m; 12H), 1.82 (bs, 2H), 2.30 (m, 2H), 2.87 (m, 2H), 4.30 (bs, 2H), 4.41 (q, 2H), 4.82 (m, 1H), 7.10-7.30 (m, 4H).

25 **[0174]** To a solution of 2 (3.60 g, 9.74 mmol) in 100 mL of ethyl acetate was added a 25 mL of a 1:1 mixture of ethyl acetate and concentrated HCl. The mixture was stirred vigorously at room temperature for 2 hr. and evaporated to dryness. The residue was neutralized with 50 mL of methanolic ammonia 10:1 and again evaporated to dryness. The residue was suspended in 100 mL a 1:1 mixture of MeOH and CH<sub>2</sub>Cl<sub>2</sub>, filtered and the filtrate evaporated to dryness to leave an off-white solid. Flash chromatography on silica gel, eluting with CH<sub>2</sub>Cl<sub>2</sub>:MeOH:NH<sub>3</sub> (300:10:1) gave pure 3 as a white crystalline solid (1.98 g, 76%). <sup>1</sup>H-NMR (CDCl<sub>3</sub>): δ 1.45 (t, 3H), 1.82 (bs, 2H), 2.33 (m, 2H), 2.80 (m, 2H), 4.40 (q, 2H), 4.80 (m, 1H), 7.10-7.30 (m, 3H), 7.45 (d, 1H).

## REFERENCE EXAMPLE 14

### ATTACHMENT OF TAIL GROUPS

**[0175]** Tail groups were attached to the head groups according to the following procedures:



**General procedure for alkylation:**

**[0176]** To a solution of the amine (1 eq) and triethylamine (1 eq) in dimethylformamide, was added 1 eq of alkyl bromide or chloride in one portion. The mixture was stirred and heated at 80°C over night. TLC indicated the reaction was complete. The reaction was quenched by the addition of water followed by 1 N NaOH to pH 10. The mixture was extracted 2x with Et<sub>2</sub>O. The combined organic extracts were dried over potassium carbonate and the solvent evaporated, followed by chromatography to give the pure product.

**General procedure for reductive amination:**

**[0177]** To a mixture of ketone or aldehyde (1 eq), amine (1 eq), and acetic acid (1 eq) in methanol, was added sodium cyanoborohydride (1.4 eq) in one portion. The mixture was stirred over night at room temperature. TLC indicated the reaction was complete. The reaction was quenched by the addition of water followed by 1N NaOH to pH 10. The mixture was extracted 2x with Et<sub>2</sub>O. The combined organic extracts were dried over potassium carbonate and the solvent evaporated, followed by chromatography to give the pure product.

**[0178]** The following reference compounds were prepared by attaching the tail groups using the general procedures described:

2-cyanoimino-3-ethyl-1-[1-(*p*-phenylbenzyl)-4-piperidiny]-1,3-dihydro-2H-benzimidazole <sup>1</sup>H-NMR (CDCl<sub>3</sub>): δ 1.50 (t, 3H), 1.88 (m, 2H), 2.28 (m, 2H), 2.62 (m, 2H), 3.12 (m, 2H), 3.65 (s, 2H), 4.48 (q, 2H), 4.80 (m, 1H), 7.15-7.70 (m, 13H).

2-cyanoimino-3-ethyl-1-[1-(*p*-benzyloxybenzyl)-4-piperidiny] 1,3-dihydro-2H-benzimidazole  
LC: 96.5%

MS: m/z 466.5 (M+1)

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): δ 1.55 (t, 3H), 1.82 (m, 2H), 2.25 (m, 2H), 2.50 (m, 2H), 3.10 (m, 2H), 3.55 (s, 2H), 4.48 (q, 2H), 4.78 (m, 1H), 5.20 (s, 2H), 7.00 (d, 2H), 7.15-7.65 (m, 11H).

2-cyanoimino-3-ethyl-1-[1-(naphth-2-yl-methyl)-4-piperidiny] 1,3-dihydro-2H-benzimidazole  
LC: 93.9%

MS: m/z

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): δ 1.55 (t, 3H), 1.80 (m, 2H), 2.30 (t, 2H), 2.52 (m, 2H), 3.18 (bd, 2H), 3.78 (s, 2H), 4.50 (q, 2H), 4.80 (m, 1H), 7.20-7.90 (m, 11H).

2-cyanoimino-3-ethyl-1-[1-(4-propylcyclohexyl)-4-piperidiny]-1,3-dihydro-2H-benzimidazole  
MS: m/z 394.4 (M+1)

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): δ 0.90-2.28 (m, 21H), 3.10 (m, 4H), 3.62 (m, 2H), 4.42 (q, 2H), 5.15 (m, 1H), 7.20 (d, 1H), 7.30 (m, 1H), 7.50 (t, 1H), 7.80 (b, 1H).

2-cyanoimino-3-ethyl-1-[1-[4-(2-propyl)-cyclohexyl]-4-piperidiny]-1,3-dihydro-2H-benzimidazole  
LC: 100%

MS: m/z 394.5 (M+1)

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): δ 0.90 (d, 3H), 0.98 (d, 3H), 1.15-2.35 (m, 14H), 3.10 (m, 5H), 3.70 (m, 2H), 3.92 (bs, 1H), 4.40 (q, 2H), 5.20 (m, 1H), 7.20 (d, 1H), 7.38 (d, 1H), 7.52 (t, 1H), 7.80 (m, 1H).

2-cyanoimino-3-ethyl-1-[1-(decahydro-2-naphthyl)-4-piperidiny]-1,3-dihydro-2H-benzimidazole  
LC: 93.9%

MS: m/z 406.6 (M+1)

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): δ 1.25-2.35 (m, 24H), 1.15 (m, 4H), 3.60 (m, 2H), 4.40 (m, 2H), 4.20 (m, 1H), 7.20-7.80 (m, 4H).

2-cyanoimino-3-ethyl-1-[1-(cyclooctyl)-4-piperidiny]-1,3-dihydro-2H-benzimidazole  
LC: 100%

MS: m/z 380.3 (M+1)

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): δ 1.50-1.80 (m, 13H), 1.90 (m, 2H), 2.10 (m, 4H), 3.05 (m, 3H), 3.30 (m, 1H), 3.45 (m, 2H), 3.90 (m, 1H), 4.42 (q, 2H), 5.15 (m, 1H), 7.20 (d, 1H), 7.35 (d, 1H), 7.78 (m, 1H).

2-cyanoimino-3-ethyl-1-[1-(10,11-dihydro-5H-dibenzo[a,d]-cyclohepten-5-yl)-4-piperidiny]-1,3-dihydro-2H-benzimidazole

LC:94.5%

MS: m/z 462.2 (M+1)

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): d 1.40 (t, 3H), 1.70 (bs, 2H), 2.01 (m, 2H), 2.28 (m, 2H), 2.80 (m, 4H), 3.95 (s, 1H), 4.02 (m, 2H), 4.32 (q, 2H), 4.65 (m, 1H), 7.00-7.32 (m, 12H).

5

2-cyanoimino-3-ethyl-1-[1-(3,3-Bis(phenyl)propyl)-4-piperidinyl]-1,3-dihydro-2H-benzimidazole

MS: m/z 464.2 (M+1)

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): d 1.40 (t, 3H), 1.73 (bs, 2H), 2.09 (m, 2H), 2.18-2.45 (m, 6H), 2.98 (b, 2H), 3.93 (t, 1H), 4.35 (q, 2H), 4.63 (m, 1H), 7.10-7.30 (m, 13H), 7.40 (d, 1H).

10

2-cyanoimino-3-ethyl-1-[1-(1,2,3,4-tetrahydronaphthyl)-4-piperidinyl]-1,3-dihydro-2H-benzimidazole

LC:94.0%

MS:m/z400.2(M+1)

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): d 1.30-1.70 (m, 6H), 1.85 (m, 2H), 2.05 (m, 1H), 2.45 (m, 3H), 2.85 (m, 4H), 3.10 (m, 2H), 4.35 (q, 2H), 4.71 (m, 1H); 7.00-7.60 (m, 8H).

15

2-cyanoimino-3-ethyl-1-[1-(5-methylhex-2-yl)-4-piperidinyl]-1,3-dihydro-2H-benzimidazole

LC: 94.9%

MS: m/z 368.3 (M+1)

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): d 0.85 (d, 6H), 0.95 (d, 3H), 1.12-1.65 (m, 8H), 1.80 (m, 2H), 2.27-2.60 (m, 5H), 2.85 (m, 2H), 4.38 (m, 2H), 4.62 (m, 1H), 7.08-7.30 (m, 3H), 7.45 (m, 1H).

20

2-cyanoimino-3-ethyl-1-[1-(norbornan-2-yl)-4-piperidinyl]-1,3-dihydro-2H-benzimidazole

LC: 99.2%

MS: m/z 364.7 (M+1)

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): d 1.10-2.10 (m, 13H), 2.35 (m, 1H), 2.50-2.70 (m, 3H), 2.70-2.90 (m, 3H), 3.50 (m, 2H), 4.50 (q, 2H), 4.80 (m, 1H), 7.35 (m, 2H), 7.48 (m, 1H), 7.75 (m, 1H).

25

2-cyanoimino-3-ethyl-1-[1-(1,3-dihydroinden-2-yl)-4-piperidinyl]-1,3-dihydro-2H-benzimidazole

LC: 92.1 %

MS: m/z 386.2 (M+1)

<sup>1</sup>H-NMR (CDCl<sub>3</sub>): d 1.42 (t, 3H), 1.82 (m, 2H), 2.21 (m, 2H), 2.43 (m, 2H), 2.88 (m, 2H), 3.02-3.19 (m, 4H), 3.23 (m, 1H), 4.38 (q, 2H), 4.80 (m, 1H), 7.08-7.30 (m, 7H), 7.45 (d, 1H).

30

2-cyanoimino-3-ethyl-1-[1-(cyclooctylmethyl)-4-piperidinyl]-1,3-dihydro-2H-benzimidazole

LC: 100% .

MS: m/z 394.7 (M+1)

<sup>1</sup>H-NMR (MeOH): d 1.35-2.00 (m, 20H), 2.60-2.85 (m, 6H), 3.40 (m, 2H), 2.52 (q, 2H), 4.90 (m, 1H), 7.35 (m, 2H), 7.48 (m, 1H), 7.70 (m, 1H).

35

2-cyanoimino-3-(2-hydroxy)ethyl-1-[1-(cyclooctyl)-4-piperidinyl]-1,3-dihydro-2H-benzimidazole

TLC:100%

MS: m/z 396.3 (M+1)

<sup>1</sup>H-NMR (DMSO): 7.52 (dt, 1H), 7.45 (dt, 1H), 7.21 (m, 2H), 4.97 (t, 1H), 4.55 (m, 1H), 4.38 (t, 2H), 3.76 (q, 2H), 2.88 (m, 2H), 2.61 (bt, 1H), 2.33 (m, 4H), 1.76-1.37 (m, 16H).

40

45

2-cyanoimino-3-methoxycarbonylmethyl-1-[1-(cyclooctyl)-4-piperidinyl]-1,3-dihydro-2H-benzimidazole

LC: 98.3%

MS: m/z 424.2 (M+1)

<sup>1</sup>H-NMR (DMSO): 7.56 (dd, 1H), 7.51 (dd, 1H), 7.25 (m, 2H), 5.26 (s, 2H), 4.56 (m, 1H), 3.72 (s, 3H), 3.34 (m, 2H), 2.78 (m, 2H), 2.62 (bt, 1H), 2.32 (m, 4H), 1.80-1.35 (m, 16H).

50

2-cyanoimino-3-cyanomethyl-1-[1-(cyclooctyl)-4-piperidinyl]-1,3-dihydro-2H-benzimidazole

LC: 100%

MS: m/z 391.2 (M+1)

<sup>1</sup>H-NMR (DMSO): 7.60 (m, 2H), 7.31 (m, 2H), 5.48 (s, 2H), 4.77 (m, 1H), 3.33 (d, 2H), 2.88 (m, 2H), 2.62 (bt, 1H), 2.33 (m, 4H), 1.86-1.37 (m, 16H).

55



2-cyanoimino-3-butyl-1-[1-(cyclooctyl)-4-piperidinyl]-1,3-dihydro-2H-benzimidazole

LC:95.4%

MS: m/z 352.2 (M+1)

<sup>1</sup>H-NMR (DMSO): 7.58 (dd, 1H), 7.49 (dd, 1H), 7.24 (m, 2H), 6.55 (s, 2H), 4.59 (m, 1H), 4.34 (t, 2H), 2.97 (m, 2H), 2.80 (m, 1H), 2.55 (m, 2H), 2.38 (m, 2H), 1.80-1.30 (m, 18H), 0.90 (t, 3H).

2-cyanoimino-3-(2-methanesulfonamido)ethyl-1-[1-(cyclooctyl)-4-piperidinyl]-1,3-dihydro-2H-benzimidazole

LC:100%

MS:m/z473.2(M+1)

<sup>1</sup>H-NMR (DMSO): 7.53 (dd, 1H), 7.44 (dd, 1H), 7.23 (m, 2H), 4.60 (m, 1H), 4.35 (t, 2H), 3.37 (t, 2H), 2.87 (m, 2H), 2.82 (s, 3H), 2.60 (bt, 1H), 2.31 (m, 4H), 1.76-1.37 (m, 15H).

2-cyanoimino-3-acetomido-1-[1-(cyclooctyl)-4-piperidinyl]-1,3-dihydro-2H-benzimidazole

LC: 100%

MS: m/z 409.2 (M+1)

<sup>1</sup>H-NMR (DMSO): 7.75 (s, 1H), 7.52 (dd, 1H), 7.37 (s, 1H), 7.30 (dd, 1H), 7.20 (m, 2H), 4.96 (s, 2H), 4.55 (m, 1H), 3.33 (d, 2H), 2.88 (m, 2H), 2.62 (bt, 1H), 2.30 (m, 4H), 1.80-1.37 (m, 15H).

2-cyanoimino-3-carboxymethyl-1-[1-(cyclooctyl)-4-piperidinyl]-1,3-dihydro-2H-benzimidazole

LC: 97.5%

MS: m/z 409.9 (M+1)

<sup>1</sup>H-NMR (DMSO): 7.45 (dd, 1H), 7.14 (m, 3H), 4.57 (s, 2H), 4.50 (m, 1H), 2.87 (m, 2H), 2.61 (bt, 1H), 2.33 (m, 4H), 1.75-1.37 (m, 15H).

2-cyanoimino-3-(2-dimethylamino)ethyl-1-[1-(cyclooctyl)-4-piperidinyl]-1,3-dihydro-2H-benzimidazole

LC: 100%

MS: m/z 423.3 (M+1)

<sup>1</sup>H-NMR (DMSO): 7.60-6.96 (m, 4H), 6.54 (2H, s), 4.65 (m, 1H), 4.40 (t, 2H), 3.90 (t, 2H), 3.05 (m, 4H), 2.90 (m, 1H), 2.63 (m, 3H), 2.56-2.37 (m, 4H), 1.85-1.35 (m, 15H).

2-cyanoimino-1-[1-(cyclooctyl)-3-hydroxymethyl-4-piperidinyl]-1,3-dihydro-2H-benzimidazole

2-cyanoimino-1-[1-(cyclooctyl)-4-piperidinyl]-1,3-dihydro-2H-7-azabenzimidazole;

2-cyanoimino-1-[1-(cyclooctyl)-2,6-ethano-4-one-4-piperidinyl]-1,3-dihydro-2H-benzimidazole

## REFERENCE EXAMPLE 15

**[0179]** Nociceptin affinity at the ORL1 receptor for preferred compounds was obtained using the following assay:

Membranes from recombinant HEK-293 cells expressing the human opioid receptor-like receptor (ORL-1) (receptor Biology) were prepared by lysing cells in ice-cold hypotonic buffer (2.5 mM MgCl<sub>2</sub>, 50 mM HEPES, pH 7.4) (10 ml/10 cm dish) followed by homogenization with a tissue grinder/teflon pestle. Membranes were collected by centrifugation at 30,000 x g for 15 min at 4°C and pellets resuspended in hypotonic buffer to a final concentration of 1-3 mg/ml. Protein concentrations were determined using the BioRad protein assay reagent with bovine serum albumen as standard. Aliquots of the ORL-1 receptor membranes were stored at -80°C.

Functional SGTPgS binding assays were conducted as follows. ORL-1 membrane solution was prepared by sequentially adding final concentrations of 0.066 mg/ml ORL-1 membrane protein, 10 mg/ml saponin, 3 mM GDP and 0.20 nM [<sup>33</sup>S]GTPgS to binding buffer (100 mM NaCl, 10 mM MgCl<sub>2</sub>, 20 mM HEPES, pH 7.4) on ice. The prepared membrane solution (190 ml/well) was transferred to 96-shallow well polypropylene plates containing 10 ml of 20x concentrated stock solutions of agonist prepared in DMSO. Plates were incubated for 30 min at room temperature with shaking. Reactions were terminated by rapid filtration onto 96-well Unifilter GF/B filter plates (Packard) using a 96-well tissue harvester (Brandel) and followed by three filtration washes with 200 ml ice-cold binding buffer (10 mM NaH<sub>2</sub>PO<sub>4</sub>, 10 mM Na<sub>2</sub>HPO<sub>4</sub>, pH 7.4). Filter plates were subsequently dried at 50°C for 2-3 hours. Fifty ml/well scintillation cocktail (BetaScint; Wallac) was added and plates were counted in a Packard Top-Count for 1 min/well.

**[0180]** Data was analyzed using the curve fitting functions in GraphPad PRISM<sup>®</sup>, v. 3.0 and the results are set forth in table 4 below:

TABLE 45

## Nociceptin Affinity

## REFERENCE Compound

calc K<sub>1</sub>(nM)

2-cyanoimino-3-ethyl-1-[1-( <i>p</i> -phenylbenzyl)-4-piperidiny]-1,3-dihydro-2H-benzimidazole	5558
2-cyanoimino-3-ethyl-1-[1-( <i>p</i> -benzyloxybenzyl)-4-piperidiny]-1,3-dihydro-2H-benzimidazole	1660
2-cyanoimino-3-ethyl-1-[1-(naphth-2-yl-methyl)-4-piperidiny]-1,3-dihydro-2H-benzimidazole	882
2-cyanoimino-3-ethyl-1-[1-(4-propylcyclohexyl)-4-piperidiny]-1,3-dihydro-2H-benzimidazole	241
2-cyanoimino-3-ethyl-1-[1-[4-(2-propyl)-cyclohexyl]-4-piperidiny]-1,3-dihydro-2H-benzimidazole	6.9
2-cyanoimino-3-ethyl-1-[1-(decahydro-2-naphthyl)-4-piperidiny]-1,3-dihydro-2H-benzimidazole	6.6
2-cyanoimino-3-ethyl-1-[1-(cyclooctyl)-4-piperidiny]-1,3-dihydro-2H-benzimidazole	5.57
2-cyanoimino-3-ethyl-1-[1-(10, 11-Dihydro-5H-dibenzo[a,d]-cyclohepten-5-yl)-4-piperidiny]-1,3-dihydro-2H-benzimidazole;	> 10,000
2-cyanoimino-3-ethyl-1-[1-(3,3-Bis(phenyl)propyl)-4-piperidiny]-1,3-dihydro-2H-benzimidazole;	80
2-cyanoimino-3-ethyl-1-[1-(1,2,3,4-tetrahydronaphthyl)-4-piperidiny]-1,3-dihydro-2H-benzimidazole;	157
2-cyanoimino-3-ethyl-1-[1-(5-methylhex-2-yl)-4-piperidiny]-1,3-dihydro-2H-benzimidazole;	76
2-cyanoimino-3-ethyl-1-[1-(norbornan-2-yl)-4-piperidiny]-1,3-dihydro-2H-benzimidazole;	323
2-cyanoimino-3-ethyl-1-[1-(1,3-dihydroinden-2-yl)-4-piperidiny]-1,3-dihydro-2H-benzimidazole; and	89
2-cyanoimino-3-ethyl-1-[1-(cyclooctylmethyl)-4-piperidiny]-1,3-dihydro-2H-benzimidazole.	7.1
2-cyanoimino-3-(2-hydroxy)ethyl-1-[1-(cyclooctyl)-4-piperidiny]-1,3-dihydro-2H-benzimidazole	6.4
2-cyanoimino-3-methoxycarbonylmethyl-1-[1-(cyclooctyl)-4-piperidiny]-1,3-dihydro-2H-benzimidazole	3.3
2-cyanoimino-3-cyanomethyl-1-[1-(cyclooctyl)-4-piperidiny]-1,3-dihydro-2H-benzimidazole	.97
2-cyanoimino-3-butyl-1-[1-(cyclooctyl)-4-piperidiny]-1,3-dihydro-2H-benzimidazole	1.36
2-cyanoimino-3-(2-methanesulfonamido)ethyl-1-[1-(cyclooctyl)-4-piperidiny]-1,3-dihydro-2H-benzimidazole	78
2-cyanoimino-3-acetomido-1-[1-(cyclooctyl)-4-piperidiny]-1,3-dihydro-2H-benzimidazole	11
2-cyanoimino-3-carboxymethyl-1-[1-(cyclooctyl)-4-piperidiny]-1,3-dihydro-2H-benzimidazole	201
2-cyanoimino-3-(2-dimethylamino)ethyl-1-[1-(cyclooctyl)-4-piperidiny]-1,3-dihydro-2H-benzimidazole	18
2-cyanoimino-1-[1-(cyclooctyl)-3-hydroxymethyl-4-piperidiny]-1,3-dihydro-2H-benzimidazole	473
2-cyanoimino-1-[1-(cyclooctyl)-4-piperidiny]-1,3-dihydro-2H-7-azabenzimidazole	3743
2-cyanoimino-1-[1-(cyclooctyl)-2,6-ethano-4-one-4-piperidiny]-1,3-dihydro-2H-benzimidazole	19

## Example 16

[0181] Affinity at the  $\mu$  receptor for compounds was obtained according to the following assay: Mu opioid receptor membrane solution was prepared by sequentially adding final concentrations of 0.075  $\mu$ g/ $\mu$ l of the desired membrane protein, 10  $\mu$ g/ml saponin, 3  $\mu$ M GDP and 0.20 nM [<sup>35</sup>S]GTP $\gamma$ S to binding buffer (100 mM NaCl, 10 mM MgCl<sub>2</sub>, 20 mM HEPES, pH 7.4) on ice. The prepared membrane solution (190  $\mu$ l/well) was transferred to 96-shallow well polypropylene plates containing 10  $\mu$ l of 20x concentrated stock solutions of agonist prepared in DMSO. Plates were incubated for 30 min at room temperature with shaking. Reactions were terminated by rapid filtration onto 96-well Unifilter GF/B filter plates (Packard) using a 96-well tissue harvester (Brandel) and followed by three filtration washes with 200  $\mu$ l ice-cold binding buffer (10 mM NaH<sub>2</sub>PO<sub>4</sub>, 10 mM Na<sub>2</sub>HPO<sub>4</sub>, pH 7.4). Filter plates were subsequently dried at 50° C for 2-3 hours.

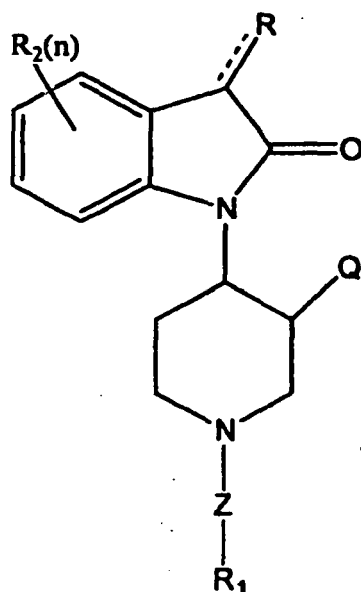
Fifty  $\mu$ l/well scintillation cocktail (MicroScint20, Packard) was added and plates were counted in a Packard Top-Count for 1 min/well.

[0182] Data were analyzed using the curve fitting functions in GraphP ad PRISM™, v. 3.0 and the results for several compounds are set forth in table 5 below:

TABLE 5	
Mu Receptor Affinity	
Compound	calc K <sub>1</sub> (nM)
3-[1-(naphth-1-yl-methyl)-4-piperidiny]-2H-benzoxazol-2-one*	340
3-[1-(3,3-diphenylpropyl)-4-piperidiny]-2H-benzoxazol-2-one*	726
3-[1-(1,2,3,4-tetrahydro-2-naphthyl)-4-piperidiny]-2H-benzolazol-2-one*	343
3-[1-(4-propyl-cyclohexyl)-4-piperidiny]-2H-benzoxazol-2-one*	145
3-ethylidene-1-[1-(1,2,3,4-tetrahydro-2-naphthyl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one	23.3
3-ethylidene-1-[1-(naphth-2-yl-methyl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one	137
3-ethylidene-1-[1-(p-benzyloxybenzyl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one	1150
3-ethylidene-1-[1-(3,3-diphenylpropyl)-4-piperidiny]-1,3-dihydro-2H-indole-2-one	24
1-[4-[(naphth-2-yl)amino]-cyclohexyl]-3-ethyl-1,3-dihydro-2H-benzimidazol-2-one*	2.1
2-cyanoimino-3-ethyl-1-[1-(4-propylcyclohexyl)-4-piperidiny]-1,3-dihydro-2H-benzimidazole*	46
2-cyanoimino-3-ethyl-1-[1-(1,2,3,4-tetrahydronaphthyl)-4-piperidiny]-1,3-dihydro-2H-benzimidazole*	458
2-cyanoimino-3-ethyl-1-[1-(5-methylhex-2-yl)-4-piperidiny]-1,3-dihydro-2H-benzimidazole*	15
2-cyanoimino-3-ethyl-1-[1-(norbornan-2-yl)-4-piperidiny]-1,3-dihydro-2H-benzimidazole*	1653
*REFERENCE COMPOUNDS	

## Claims

1. A compound of the formula (IIA):



(IIA)

wherein

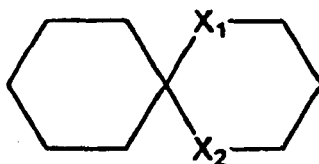
the dotted line represents an optional double bond;

Z is selected from the group consisting of a bond,  $-\text{CH}_2-$ ,  $-\text{NH}-$ ,  $-\text{CH}_2\text{O}-$ ,  $-\text{CH}_2\text{CH}_2-$ ,  $-\text{CH}_2\text{NH}-$ ,  $-\text{CH}_2\text{N}(\text{CH}_3)-$ ,  $-\text{NHCH}_2-$ ,  $-\text{CH}_2\text{CONH}-$ ,  $-\text{NHCH}_2\text{CO}-$ ,  $-\text{CH}_2\text{CO}-$ ,  $-\text{COCH}_2-$ ,  $-\text{CH}_2\text{COCH}_2-$ ,  $-\text{CH}(\text{CH}_3)-$ ,  $-\text{CH}=\text{}$ , and  $-\text{HC}=\text{CH}-$ , wherein the carbon and/or nitrogen atoms are unsubstituted or substituted with a lower alkyl, halogen, hydroxy or alkoxy group;

R and Q are the same or different and R is selected from the group consisting of halogen,  $\text{C}_{1-10}$  alkyl,  $\text{C}_{1-10}$  alkenyl,  $\text{C}_{1-10}$  alkylidene,  $\text{C}_{3-12}$  cycloalkyl,  $\text{C}_{1-10}$  alkoxy, oxo and Q is selected from the group consisting of hydrogen, halogen,  $\text{C}_{1-10}$  alkyl,  $\text{C}_{1-10}$  alkenyl,  $\text{C}_{1-10}$  alkylidene,  $\text{C}_{3-12}$  cycloalkyl,  $\text{C}_{1-10}$  alkoxy, and oxo;

n is an integer from 0 to 3;

$\text{R}_1$  is selected from the group consisting of hydrogen,  $\text{C}_{1-10}$  alkyl,  $\text{C}_{3-20}$  cycloalkyl,  $\text{C}_{2-10}$  alkenyl, amino,  $\text{C}_{1-10}$  alkylamino,  $\text{C}_{3-12}$  cycloalkylamino, benzyl,  $\text{C}_{3-12}$  cycloalkenyl, a monocyclic, bicyclic or tricyclic aryl or heteroaryl ring, a heteromonocyclic ring, a bicyclic ring system, and a spiro ring system of the formula (V):



(V)

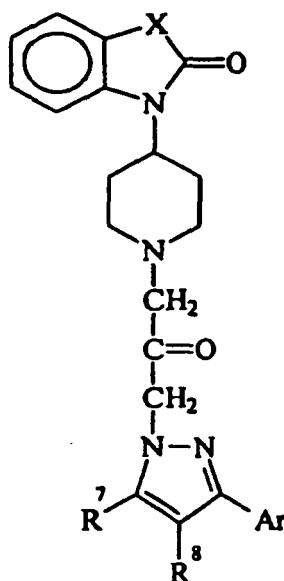
wherein  $\text{X}_1$  and  $\text{X}_2$  are independently selected from the group consisting of  $\text{NH}$ ,  $\text{O}$ ,  $\text{S}$  and  $\text{CH}_2$ ;

wherein said alkyl, cycloalkyl, alkenyl,  $\text{C}_{1-10}$  alkylamino,  $\text{C}_{3-12}$  cycloalkylamino, or benzyl is optionally substituted with 1-3 substituents selected from the group consisting of halogen,  $\text{C}_{1-10}$  alkyl,  $\text{C}_{1-10}$  alkoxy, nitro, trifluoromethyl, cyano, phenyl, benzyl, benzyloxy, said phenyl, benzyl, and benzyloxy optionally being substituted with 1-3 substituents selected from the group consisting of halogen,  $\text{C}_{1-10}$  alkyl,  $\text{C}_{1-10}$  alkoxy, and cyano;

wherein said C<sub>3-12</sub> cycloalkyl, C<sub>3-12</sub> cycloalkenyl, monocyclic, bicyclic or tricyclic aryl, heteroaryl ring; heterom-  
onocyclic ring, heterobicyclic ring system; and spiro ring system of the formula (V) are optionally substituted  
with 1-3 substituents selected from the group consisting of halogen, C<sub>1-10</sub>alkyl, C<sub>1-10</sub>alkoxy, nitro, trifluoromethyl,  
phenyl, benzyl, phenyloxy and benzyloxy, wherein said phenyl, benzyl, phenyloxy and benzyloxy are optionally  
substituted with 1-3 substituents selected from the group consisting of halogen, C<sub>1-10</sub> alkyl, C<sub>1-10</sub> alkoxy, and  
cyano;

R<sub>2</sub> is selected from the group consisting of hydrogen, C<sub>1-10</sub> alkyl, C<sub>3-12</sub>cycloalkyl and halogen, said alkyl optionally  
substituted with an oxo group

but not a compound of the following formula



wherein X is CHR<sup>41</sup> and R<sup>41</sup> is C<sub>1-5</sub> alkyl and wherein Ar is a monocyclic aryl ring optionally substituted with halogen,  
C<sub>1-5</sub>alkoxy, C<sub>1-5</sub>alkyl and cyano and wherein R<sup>7</sup> and R<sup>8</sup> independently are hydrogen, C<sub>1-5</sub> alkyl and C<sub>1-5</sub> alkoxy or  
halogen; alternatively, R<sup>7</sup> and R<sup>8</sup> can be taken together to form an optionally substituted 5- to 7- membered carbocyclic  
or heterocyclic ring, which ring may be saturated, unsaturated or aromatic;  
or a pharmaceutically acceptable salt thereof.

2. A compound of claim 1, wherein Q is hydrogen or methyl.
3. A compound of claim 1, wherein R is methyl, ethyl, or ethylidene.
4. A compound of claim 1, wherein R<sub>1</sub> is alkyl selected from the group consisting of methyl, ethyl, propyl, butyl, pentyl  
and hexyl.
5. A compound of claim 1, wherein R<sub>1</sub> is cycloalkyl selected from the group consisting of cyclohexyl, cycloheptyl,  
cyclooctyl, cyclononyl, cyclodecyl, and norbornyl.
6. A compound of claim 1, wherein R<sub>1</sub> is tetrahydronaphthyl, decahydronaphthyl or dibenzocycloheptyl.
7. A compound of claim 1, wherein R<sub>1</sub> is phenyl or benzyl.
8. A compound of claim 1, wherein R<sub>1</sub> is a bicyclic aromatic ring.
9. A compound of claim 8, wherein said bicyclic aromatic ring is indenyl, quinoline or naphthyl.
10. A compound of claim 1, wherein Z is a bond, methyl, or ethyl.

11. A compound of claim 1, wherein n is 0.

12. A compound of claim 1, wherein X, and X<sub>2</sub> are both O.

5 13. A compound of claim 1, wherein the dotted line is a double bond.

14. A compound of claim 1 selected from the group consisting of:

10 3-ethylidene-1-[1-(5-methylhex-2-yl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethylidene-1-[1-(4-propylcyclohexyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethylidene-1-[1-(1,2,3,4-tetrahydro-2-naphthyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethylidene-1-[1-(1,3-dihydroinden-2-yl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethylidene-1-[1-(naphth-2-yl-methyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethylidene-1-[1-(*p*-benzyloxybenzyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 15 3-ethylidene-1-[1-(benzyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethylidene-1-[1-(cyclooctylmethyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethylidene-1-[1-(norbornan-2-yl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethylidene-1-[1-(3,3-diphenylpropyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethylidene-1-[1-(*p*-cyanobenzyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 20 3-ethyl-1-[1-(5-methylhex-2-yl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethyl-1-[1-[4-(1-methylethyl)-cyclohexyl]-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethyl-1-[1-(4-propylcyclohexyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethyl-1-[1-(1,2,3,4-tetrahydro-2-naphthyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethyl-1-[1-(decahydro-2-naphthyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 25 3-ethyl-1-[1-(1,3-dihydroinden-2-yl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethyl-1-[1-(cyclooctylmethyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethyl-1-[1-(norbornan-2-yl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethyl-1-[1-(3,3-Bis(phenyl)propyl)-3-(methyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethyl-1-[1-(4-propylcyclohexyl)-3-(methyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 30 3-ethyl-1-[1-(5-methylhex-2-yl)-3-(methyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethyl-1-[1-[4-(1-methylethyl)cyclohexyl]-3-methyl-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;  
 3-ethyl-1-[1-(decahydro-2-naphthyl)-3-(methyl)-4-piperidinyl]-1,3-dihydro-2H-indole-2-one;

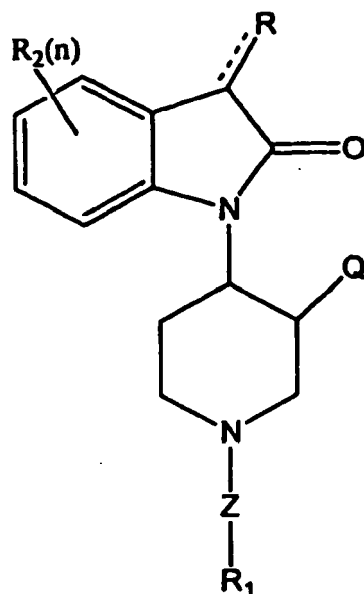
and pharmaceutically acceptable salts thereof.

35 15. A pharmaceutical composition comprising a compound of claim 1 and at least one pharmaceutically acceptable excipient.

40 16. The use of an analgesic compound according to claim 1 for the manufacture of a medicament for treating pain.

17. The use of a compound according to claim 1 for the manufacture of a medicament for modulating a pharmacological response from the ORL1 receptor.

45 18. A compound of the formula (IIA):



(IIA)

wherein

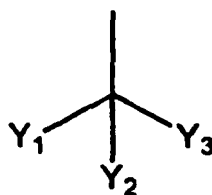
the dotted line represents an optional double bond;

R and Q are the same or different and R is selected from the group consisting of halogen, C<sub>1-10</sub> alkyl, C<sub>1-10</sub> alkenyl, C<sub>1-10</sub> alkylidene, C<sub>3-12</sub> cycloalkyl, C<sub>1-10</sub> alkoxy, oxo and Q is selected from the group consisting of hydrogen, halogen, C<sub>1-10</sub> alkyl, C<sub>1-10</sub> alkenyl, C<sub>1-10</sub> alkylidene, C<sub>3-12</sub> cycloalkyl, C<sub>1-10</sub> alkoxy, and oxo;

n is an integer from 0 to 3;

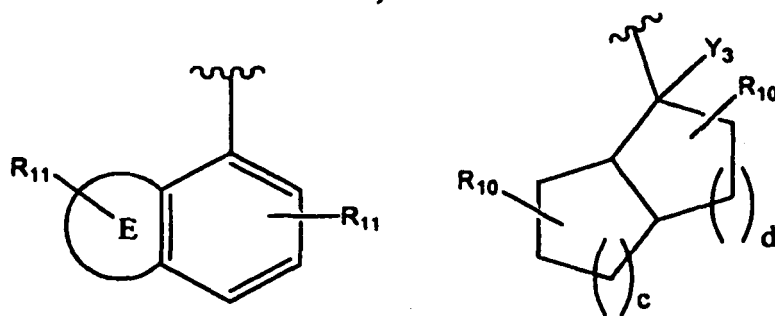
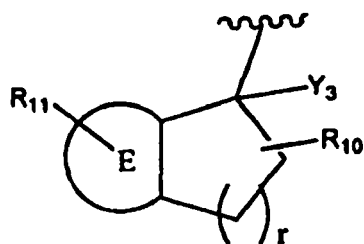
R<sub>2</sub> is selected from the group consisting of hydrogen, C<sub>1-10</sub> alkyl, C<sub>3-12</sub> cycloalkyl and halogen, said alkyl optionally substituted with an oxo group;

ZR<sub>1</sub> is the following

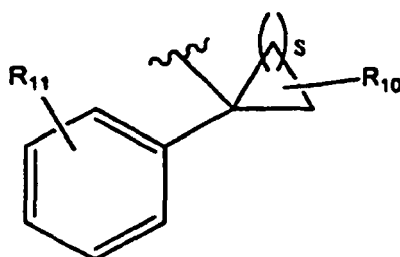


wherein

Y<sub>1</sub> is R<sub>3</sub>-(C<sub>1</sub>-C<sub>12</sub>)alkyl, R<sub>4</sub>-aryl, R<sub>5</sub>-heteroaryl, R<sub>6</sub>-(C<sub>3</sub>-C<sub>12</sub>)cyclo-alkyl, R<sub>7</sub>-(C<sub>3</sub>-C<sub>7</sub>)heterocycloalkyl, -CO<sub>2</sub>(C<sub>1</sub>-C<sub>6</sub>)alkyl, CN or -C(O)NR<sub>8</sub>R<sub>9</sub>; Y<sub>2</sub> is hydrogen or Y<sub>1</sub>; Y<sub>3</sub> is hydrogen or (C<sub>1</sub>-C<sub>6</sub>)alkyl; or Y<sub>1</sub>, Y<sub>2</sub> and Y<sub>3</sub>, together with the carbon to which they are attached, form one of the following structures:



or



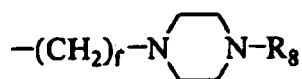
wherein  $r$  is 0 to 3;  $c$  and  $d$  are independently 1 or 2;  $s$  is 1 to 5; and ring  $E$  is a fused  $R_4$ -phenyl or  $R_5$ -heteroaryl ring;  $R_{10}$  is 1 to 3 substituents independently selected from the group consisting of H,  $(C_1-C_6)$ alkyl,  $-OR_8$ ,  $-(C_1-C_6)$ alkyl- $OR_8$ ,  $-NR_8R_9$  and  $-(C_1-C_6)$ alkyl- $NR_8R_9$ ;

$R_{11}$  is 1 to 3 substituents independently selected from the group consisting of  $R_{10}$ ,  $-CF_3$ ,  $-OCF_3$ ,  $NO_2$  and halo, or  $R_{11}$  substituents on adjacent ring carbon atoms may together form a methylenedioxy or ethylenedioxy ring;  $R_8$  and  $R_9$  are independently selected from the group consisting of hydrogen,  $(C_1-C_6)$ alkyl,  $(C_3-C_{12})$ cycloalkyl, aryl and aryl- $(C_1-C_6)$ alkyl;

$R_3$  is 1 to 3 substituents independently selected from the group consisting of H,  $R_4$ -aryl,  $R_6$ -( $C_3-C_{12}$ )cycloalkyl,  $R_5$ -heteroaryl,  $R_7$ -( $C_3-C_7$ )heterocycloalkyl,  $-NR_8R_9$ ,  $-OR_{12}$  and  $-S(O)_{0-2}R_{12}$ ;

$R_6$  is 1 to 3 substituents independently selected from the group consisting of H,  $(C_1-C_6)$ alkyl,  $R_4$ -aryl,  $-NR_8R_9$ ,  $-OR_{12}$  and  $-SR_{12}$ ;

$R_4$  is 1 to 3 substituents independently selected from the group consisting of hydrogen, halo,  $(C_1-C_6)$ alkyl,  $R_{13}$ -aryl,  $(C_3-C_{12})$ cycloalkyl,  $-CN$ ,  $-CF_3$ ,  $-OR_8$ ,  $-(C_1-C_6)$ alkyl- $OR_8$ ,  $-OCF_3$ ,  $-NR_8R_9$ ,  $-(C_1-C_6)$ alkyl- $NR_8R_9$ ,  $-NHSO_2Ra$ ,  $-SO_2N(R_{14})_2$ ,  $-SO_2R_8$ ,  $-SOR_8$ ,  $-SR_8$ ,  $-NO_2$ ,  $-CONR_8R_9$ ,  $-NR_9COR_8$ ,  $-COR_8$ ,  $-COCF_3$ ,  $-OCOR_8$ ,  $-OCO_2R_8$ ,  $-COOR_8$ ,  $-(C_1-C_6)$ alkyl- $NHCOOC(CH_3)_3$ ,  $-(C_1-C_6)$ alkyl- $NHCOCF_3$ ,  $-(C_1-C_6)$ alkyl- $NHSO_2$ -( $C_1-C_6$ )alkyl,  $-(C_1-C_6)$ alkyl- $NHCONH$ -( $C_1-C_6$ )alkyl and





wherein f is 0 to 6; or R<sub>4</sub> substituents on adjacent ring carbon atoms may together form a methylenedioxy or ethylenedioxy ring;

R<sub>5</sub> is 1 to 3 substituents independently selected from the group consisting of hydrogen, halo, (C<sub>1</sub>-C<sub>6</sub>)alkyl, R<sub>13</sub>-aryl, (C<sub>3</sub>-C<sub>12</sub>)cyloalkyl, -CN, -CF<sub>3</sub>, -OR<sub>8</sub>, -(C<sub>1</sub>-C<sub>6</sub>)alkyl-OR<sub>8</sub>, -OCF<sub>3</sub>, -NR<sub>8</sub>R<sub>9</sub>, -(C<sub>1</sub>-C<sub>6</sub>)alkyl-NR<sub>8</sub>R<sub>9</sub>, -NHSO<sub>2</sub>R<sub>8</sub>, -SO<sub>2</sub>N(R<sub>14</sub>)<sub>2</sub>, -NO<sub>2</sub>, -CONR<sub>8</sub>R<sub>9</sub>, -NR<sub>9</sub>COR<sub>8</sub>, -COR<sub>8</sub>, -OCOR<sub>8</sub>, -OCO<sub>2</sub>R<sub>8</sub> and -COOR<sub>8</sub>;

R<sub>7</sub> is H, (C<sub>1</sub>-C<sub>6</sub>)alkyl, -OR<sub>8</sub>, -(C<sub>1</sub>-C<sub>6</sub>)alkyl-OR<sub>8</sub>, -NR<sub>8</sub>R<sub>9</sub> or -(C<sub>1</sub>-C<sub>6</sub>)alkyl-NR<sub>8</sub>R<sub>9</sub>;

R<sub>12</sub> is H, (C<sub>1</sub>-C<sub>6</sub>)alkyl, R<sub>4</sub>-aryl, -(C<sub>1</sub>-C<sub>6</sub>)alkyl-OR<sub>8</sub>, -(C<sub>1</sub>-C<sub>6</sub>)alkyl-NR<sub>8</sub>R<sub>9</sub>, -(C<sub>1</sub>-C<sub>6</sub>)alkyl-SR<sub>8</sub>, or aryl (C<sub>1</sub>-C<sub>6</sub>)alkyl;

R<sub>1</sub> is 1-3 substituents independently selected from the group consisting of H, (C<sub>1</sub>-C<sub>6</sub>)alkyl, (C<sub>1</sub>-C<sub>6</sub>)alkoxy and halo;

R<sub>14</sub> is independently selected from the group consisting of H, (C<sub>1</sub>-C<sub>6</sub>)alkyl and R<sub>13</sub>-C<sub>6</sub>H<sub>4</sub>-CH<sub>2</sub>-;

or a pharmaceutically acceptable salt thereof.

19. A pharmaceutical composition comprising a compound of claim 18 and at least one pharmaceutically acceptable excipient.

20. The use of an analgesic compound according to claim 18 for the manufacture of a medicament for treating pain.

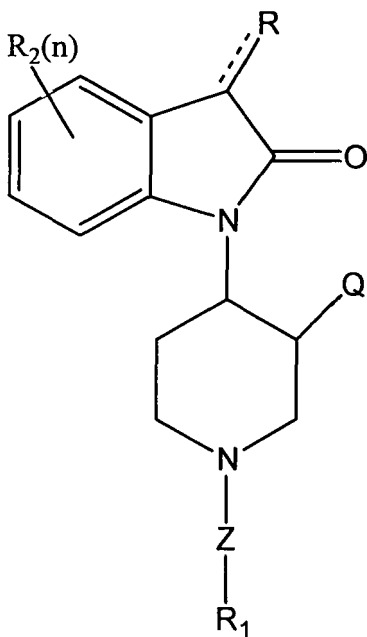
21. The use of a compound according to claim 18 for the manufacture of a medicament for modulating a pharmacological response from the ORL1 receptor.

22. The use of a compound according to claim 1 for the manufacture of a medicament for modulating a pharmacological response from an opioid receptor.

23. The use of a compound according to claim 18 for the manufacture of a medicament for modulating a pharmacological response from an opioid receptor.

## Patentansprüche

1. Eine Verbindung der Formel (IIA):



(IIA)

wobei

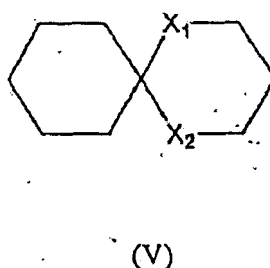
die gestrichelte Linie eine optionale Doppelbindung darstellt;

Z ausgewählt ist aus der Gruppe bestehend aus einer Bindung,  $-\text{CH}_2-$ ,  $-\text{NH}-$ ,  $-\text{CH}_2\text{O}-$ ,  $-\text{CH}_2\text{CH}_2-$ ,  $-\text{CH}_2\text{NH}-$ ,  $-\text{CH}_2\text{N}(\text{CH}_3)-$ ,  $-\text{NHCH}_2-$ ,  $-\text{CH}_2\text{CONH}-$ ,  $-\text{NHCH}_2\text{CO}-$ ,  $-\text{CH}_2\text{CO}-$ ,  $-\text{COCH}_2-$ ,  $-\text{CH}_2\text{COCH}_2-$ ,  $-\text{CH}(\text{CH}_3)-$ ,  $-\text{CH}=\text{CH}-$ , wobei die Kohlenstoff und/oder Stickstoffatome unsubstituiert oder substituiert sind mit einer niedrigen Alkyl-, Halogen-, Hydroxy- oder Alkoxy-Gruppe;

R und Q gleich oder verschieden sind und R ausgewählt ist aus der Gruppe bestehend aus Halogen,  $\text{C}_{1-10}$  alkyl,  $\text{C}_{1-10}$  alkenyl,  $\text{C}_{1-10}$  alkyliden,  $\text{C}_{3-12}$  cycloalkyl,  $\text{C}_{1-10}$  alkoxy, Oxo und Q ausgewählt ist aus der Gruppe bestehend aus Wasserstoff, Halogen,  $\text{C}_{1-10}$  alkyl,  $\text{C}_{1-10}$  alkenyl,  $\text{C}_{1-10}$  alkyliden,  $\text{C}_{3-12}$  cycloalkyl,  $\text{C}_{1-10}$  alkoxy und Oxo;

n eine ganze Zahl von 0 bis 3 ist;

$\text{R}_1$  ausgewählt ist aus der Gruppe bestehend aus Wasserstoff,  $\text{C}_{1-10}$ alkyl,  $\text{C}_{3-12}$  cycloalkyl,  $\text{C}_{2-10}$ alkenyl, Amino,  $\text{C}_{1-10}$ alkylamino-,  $\text{C}_{3-12}$ cycloalkylamino-, Benzyl,  $\text{C}_{3-12}$  Cycloalkenyl-, einem monozyklischen, bizaiklischen oder trizaiklischen Aryl- oder Heteroarylring, einem hetero-monozyklischen Ring, einem hetero-bizaiklischen Ringsystem, und einem Spiroringsystem der Formel (V):



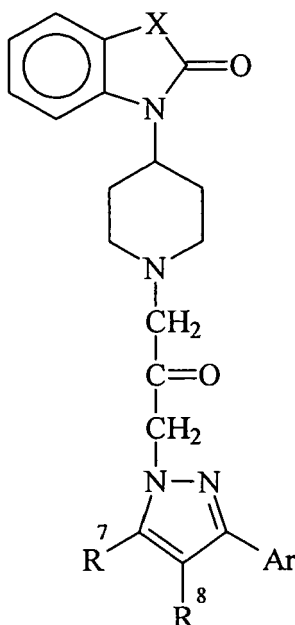
wobei  $\text{X}_1$  und  $\text{X}_2$  unabhängig ausgewählt sind aus der Gruppe bestehend aus NH, O, S und  $\text{CH}_2$ ;

wobei besagtes Alkyl, Cycloalkyl, Alkenyl,  $\text{C}_{1-10}$ alkylamino-,  $\text{C}_{3-12}$ cycloalkylamino-, oder Benzyl wahlweise substituiert ist mit 1-3 Substituenten ausgewählt aus der Gruppe bestehend aus Halogen,  $\text{C}_{1-10}$  Alkyl,  $\text{C}_{1-10}$  Alkoxy, Nitro, Trifluormethyl-, Cyano, Phenyl, Benzyl, Benzyloxy, besagtes Phenyl, Benzyl, und Benzyloxy wahlweise substituiert mit 1-3 Substituenten ausgewählt aus der Gruppe bestehend aus Halogen,  $\text{C}_{1-10}$  Alkyl-,  $\text{C}_{1-10}$  Alkoxy-, und Cyano;

wobei besagtes  $\text{C}_{3-12}$  Cycloalkyl,  $\text{C}_{3-12}$  Cycloalkenyl, monozyklisches, bizaiklisches oder trizaiklisches Aryl, Heteroarylring, hetero-monozyklischer Ring, heterobizaiklisches Ringsystem, oder Spiroringsystem der Formel (V) wahlweise substituiert ist mit 1-3 Substituenten ausgewählt aus der Gruppe bestehend aus Halogen,  $\text{C}_{1-10}$  Alkyl,  $\text{C}_{1-10}$  Alkoxy, Nitro, Trifluormethyl-, Phenyl, Benzyl, Phenylloxy und Benzyloxy, wobei besagtes Phenyl, Benzyl, Phenylloxy oder Benzyloxy wahlweise substituiert ist mit 1-3 Substituenten ausgewählt aus der Gruppe bestehend aus Halogen,  $\text{C}_{1-10}$  Alkyl,  $\text{C}_{1-10}$  Alkoxy, und Cyano;

$\text{R}_2$  ausgewählt ist aus der Gruppe bestehend aus Wasserstoff,  $\text{C}_{1-10}$  Alkyl,  $\text{C}_{3-12}$  Cycloalkyl und Halogen, besagtes Alkyl wahlweise substituiert mit einer Oxo-Gruppe;

aber keine Verbindung der folgenden Formel



wobei X CHR<sup>41</sup> ist und R<sup>41</sup> C<sub>1-5</sub> Alkyl ist und wobei Ar ein monozyklischer Arylring ist, wahlweise substituiert mit Halogen, C<sub>1-5</sub> Alkoxy, C<sub>1-5</sub> Alkyl und Cyano und wobei R<sup>7</sup> und R<sup>8</sup> unabhängig voneinander Wasserstoff, C<sub>1-5</sub> Alkyl und C<sub>1-5</sub> Alkoxy oder Halogen sind; alternativ können R<sup>7</sup> und R<sup>8</sup> so zusammen hängen, dass sie einen wahlweise substituierten 5- bis 7-gliedrigen carbozyklischen oder heterozyklischen Ring bilden, wobei dieser Ring gesättigt, ungesättigt oder aromatisch sein kann;

oder ein pharmazeutisches verträgliches Salz davon.

2. Eine Verbindung gemäß Anspruch 1, wobei Q Wasserstoff oder Methyl ist.
3. Eine Verbindung gemäß Anspruch 1, wobei R Methyl, Ethyl oder Ethyliden ist.
4. Eine Verbindung gemäß Anspruch 1, wobei R<sub>1</sub> ein Alkyl ausgewählt aus der Gruppe bestehend aus Methyl, Ethyl, Propyl, Butyl, Pentyl und Hexyl ist.
5. Eine Verbindung gemäß Anspruch 1, wobei R<sub>1</sub> ein Cycloalkyl ausgewählt aus der Gruppe bestehend aus Cyclohexyl, Cycloheptyl, Cyclooctyl, Cyclononyl, Cyclodecyl, und Norbornyl ist.
6. Eine Verbindung gemäß Anspruch 1, wobei R<sub>1</sub> Tetrahydronaphthyl, Decahydronaphthyl oder Dibenzocycloheptyl ist.
7. Eine Verbindung gemäß Anspruch 1, wobei R<sub>1</sub> Phenyl oder Benzyl ist.
8. Eine Verbindung gemäß Anspruch 1, wobei R<sub>1</sub> ein bicyklischer aromatischer Ring ist.
9. Eine Verbindung gemäß Anspruch 8, wobei besagter bicyklischer aromatischer Ring Indenyl, Quinolin oder Naphthyl ist.
10. Eine Verbindung gemäß Anspruch 1, wobei Z eine Bindung, Methyl oder Ethyl ist.
11. Eine Verbindung gemäß Anspruch 1, wobei n gleich 0 ist.
12. Eine Verbindung gemäß Anspruch 1, wobei X<sub>1</sub> und X<sub>2</sub> beide O sind.
13. Eine Verbindung gemäß Anspruch 1, wobei die gestrichelte Linie eine Doppelbindung ist.

14. Eine Verbindung gemäß Anspruch 1 ausgewählt aus der Gruppe bestehend aus

3-Ethyliden-1-[1-(5-methylhex-2-yl)-4-piperidiny]-1,3-dihydro-2H-indol-2-on;  
 3-Ethyliden-1-[1-(4-propylcyclohexyl)-4-piperidiny]-1,3-dihydro-2H-indol-2-on;  
 3-Ethyliden-1-[1-(1,2,3,4-tetrahydro-2-naphtyl)-4-piperidiny]-1,3-dihydro-2H-indol-2-on;  
 3-Ethyliden-1-[1-(1,3-dihydroinden-2-yl)-4-piperidiny]-1,3-dihydro-2H-indol-2-on;  
 3-Ethyliden-1-[1-(naphth-2-yl-methyl)-4-piperidiny]-1,3-dihydro-2H-indol-2-on;  
 3-Ethyliden-1-[1-(*p*-benzyloxybenzyl)-4-piperidiny]-1,3-dihydro-2H-indol-2-on;  
 3-Ethyliden-1-[1-(benzyl)-4-piperidiny]-1,3-dihydro-2H-indol-2-on;  
 3-Ethyliden-1-[1-(cyclooctylmethyl)-4-piperidiny]-1,3-dihydro-2H-indol-2-on;  
 3-Ethyliden-1-[1-(norbornan-2-yl)-4-piperidiny]-1,3-dihydro-2H-indol-2-on;  
 3-Ethyliden-1-[1-(3,3-diphenylpropyl)-4-piperidiny]-1,3-dihydro-2H-indol-2-on;  
 3-Ethyliden-1-[1-(*p*-cyanobenzyl)-4-piperidiny]-1,3-dihydro-2H-indol-2-on;  
 3-Ethyl-1-[1-(5-methylhex-2-yl)-4-piperidiny]-1,3-dihydro-2H-indol-2-on;  
 3-Ethyl-1-[1-[4-(1-methylethyl)-cyclohexyl]-4-piperidiny]-1,3-dihydro-2H-indol-2-on;  
 3-Ethyl-1-[1-(4-propylcyclohexyl)-4-piperidiny]-1,3-dihydro-2H-indol-2-on;  
 3-Ethyl-1-[1-(1,2,3,4-tetrahydro-2-naphtyl)-4-piperidiny]-1,3-dihydro-2H-indol-2-on;  
 3-Ethyl-1-[1-(decahydro-2-naphtyl)-4-piperidiny]-1,3-dihydro-2H-indol-2-on;  
 3-Ethyl-1-[1-(1,3-dihydroinden-2-yl)-4-piperidiny]-1,3-dihydro-2H-indol-2-on;  
 3-Ethyl-1-[1-(cyclooctylmethyl)-4-piperidiny]-1,3-dihydro-2H-indol-2-on;  
 3-Ethyl-1-[1-(norbornan-2-yl)-4-piperidiny]-1,3-dihydro-2H-indol-2-on;  
 3-Ethyl-1-[1-(3,3-Bis(phenyl)propyl)-3-(methyl)-4-piperidiny]-1,3-dihydro-2H-indol-2-on;  
 3-Ethyl-1-[1-(4-propylcyclohexyl)-3-(methyl)-4-piperidiny]-1,3-dihydro-2H-indol-2-on;  
 3-Ethyl-1-[1-(5-methylhex-2-yl)-3-(methyl)-4-piperidiny]-1,3-dihydro-2H-indol-2-on;  
 3-Ethyl-1-[1-[4-(1-methylethyl)cyclohexyl]-3-methyl-4-piperidiny]-1,3-dihydro-2H-indol-2-on;  
 3-Ethyl-1-[1-(decahydro-2-naphtyl)-3-(methyl)-4-piperidiny]-1,3-dihydro-2H-indol-2-on;

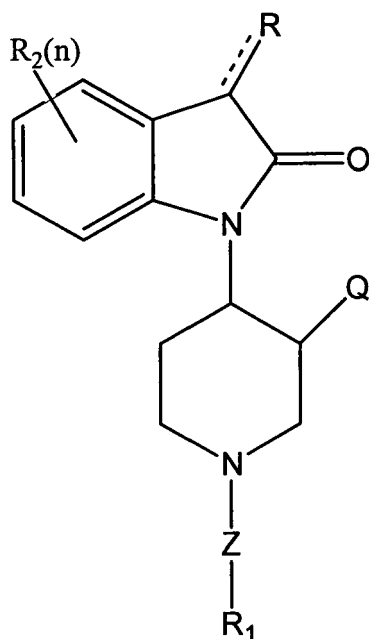
und pharmazeutisch verträgliche Salze davon.

15. Eine pharmazeutische Zusammensetzung umfassend eine Verbindung gemäß Anspruch 1 und mindestens einen pharmazeutisch verträglichen Hilfsstoff.

16. Verwendung einer analgetischen Verbindung gemäß Anspruch 1 zur Herstellung eines Medikamentes zur Behandlung von Schmerzen.

17. Verwendung einer Verbindung gemäß Anspruch 1 zur Herstellung eines Medikamentes zur Modulation einer pharmakologischen Antwort vom ORL1-Rezeptor.

18. Eine Verbindung der Formel (IIA):



(IIA)

wobei

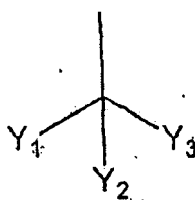
die gestrichelte Linie eine optionale Doppelbindung darstellt;

R und Q gleich oder verschieden sind und R ausgewählt ist aus der Gruppe bestehend aus Halogen, C<sub>1-10</sub> alkyl, C<sub>1-10</sub> alkenyl, C<sub>1-10</sub> alkyliden, C<sub>3-12</sub> cycloalkyl, C<sub>1-10</sub> alkoxy, Oxo und Q ausgewählt ist aus der Gruppe bestehend aus Wasserstoff, Halogen, C<sub>1-10</sub> alkyl, C<sub>1-10</sub> alkenyl, C<sub>1-10</sub> alkyliden, C<sub>3-12</sub> cycloalkyl, C<sub>1-10</sub> alkoxy und Oxo;

n eine ganze Zahl von 0 bis 3 ist;

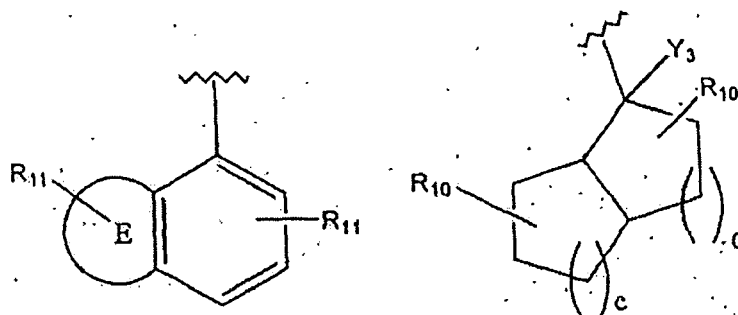
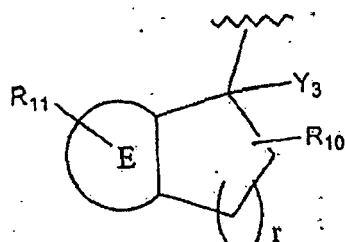
R<sub>2</sub> ausgewählt ist aus der Gruppe bestehend aus Wasserstoff, C<sub>1-10</sub> Alkyl, C<sub>3-12</sub> Cycloalkyl und Halogen, besagtes Alkyl wahlweise substituiert mit einer Oxo-Gruppe;

ZR<sub>1</sub> folgende Struktur hat

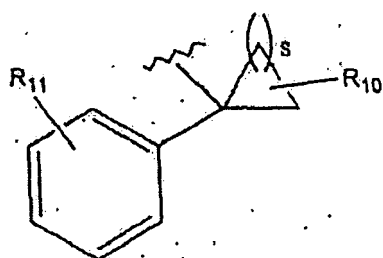


wobei

Y<sub>1</sub> R<sub>3</sub>-(C<sub>1</sub>-C<sub>12</sub>)alkyl, R<sub>4</sub>-Aryl, R<sub>5</sub>-Heteroaryl, R<sub>6</sub>-(C<sub>3</sub>-C<sub>12</sub>)cyclo-alkyl, R<sub>7</sub>-(C<sub>3</sub>-C<sub>12</sub>)heterocycloalkyl, -CO<sub>2</sub>(C<sub>1</sub>-C<sub>6</sub>) alkyl, CN oder -C(O)NR<sub>8</sub>R<sub>9</sub> ist; Y<sub>2</sub> Wasserstoff oder Y<sub>1</sub> ist; Y<sub>3</sub> Wasserstoff oder (C<sub>1</sub>-C<sub>6</sub>)alkyl ist; oder Y<sub>1</sub>, Y<sub>2</sub> und Y<sub>3</sub> zusammen mit dem Kohlenstoff an den sie gebunden sind, eine der folgenden Strukturen bilden:



oder



wobei  $r$  0 bis 3 ist;  $c$  und  $d$  unabhängig 1 oder 2 sind;  $s$  1 bis 5 ist; und Ring E ein fusionierter  $R_4$ -phenyl oder  $R_5$ -heteroarylring ist;

$R_{10}$  1 bis 3 Substituenten ist unabhängig ausgewählt aus der Gruppe bestehend aus H,  $(C_1-C_6)$ alkyl,  $-OR_8$ ,  $-(C_1-C_6)alkyl-OR_8$ ,  $-NR_8R_9$  und  $-(C_1-C_6)alkyl-NR_8R_9$ ;

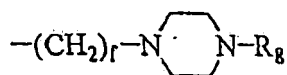
$R_{11}$  1 bis 3 Substituenten ist unabhängig ausgewählt aus der Gruppe bestehend aus  $R_{10}$ ,  $-CF_3$ ,  $-OCF_3$ ,  $NO_2$  und Halo, oder  $R_{11}$  Substituenten an benachbarten Ringkohlenstoffatomen zusammen einen Methylendioxy- oder Ethylendioxyring bilden können;

$R_8$  und  $R_9$  unabhängig ausgewählt sind aus der Gruppe bestehend aus Wasserstoff,  $(C_1-C_6)$ alkyl,  $(C_3-C_{12})$ cycloalkyl, Aryl und Aryl $(C_1-C_6)alkyl$ ;

$R_3$  1 bis 3 Substituenten ist unabhängig ausgewählt aus der Gruppe bestehend aus H,  $R_4$ -aryl,  $R_6$ -( $C_3-C_{12}$ )cycloalkyl,  $R_5$ -Heteroaryl,  $R_7$ -( $C_3-C_7$ ) Heterocycloalkyl,  $-NR_8R_9$ ,  $-OR_{12}$  und  $-S(O)_{0-2}R_{12}$ ;

$R_6$  1 bis 3 Substituenten ist unabhängig ausgewählt aus der Gruppe bestehend aus H,  $(C_1-C_6)alkyl$ ,  $R_4$ -Aryl,  $-NR_8R_9$ ,  $-OR_{12}$  und  $-SR_{12}$ ;

$R_4$  ist 1 bis 3 Substituenten unabhängig ausgewählt aus der Gruppe bestehend aus Wasserstoff, Halo,  $(C_1-C_6)alkyl$ ,  $R_{13}$ -Aryl,  $(C_3-C_{12})cycloalkyl$ ,  $-CN$ ,  $-CF_3$ ,  $-OR_8$ ,  $-(C_1-C_6)alkyl-OR_8$ ,  $-OCF_3$ ,  $-NR_8R_9$ ,  $-(C_1-C_6)alkyl$ ,  $-NR_8R_9$ ,  $-NHSO_2R_8$ ,  $-SO_2N(R_{14})_2$ ,  $-SO_2R_8$ ,  $-SOR_8$ ,  $-SR_8$ ,  $-NO_2$ ,  $-CONR_8R_9$ ,  $-NR_9COR_8$ ,  $-COR_8$ ,  $-COCF_3$ ,  $-OCOR_8$ ,  $-OCO_2R_8$ ,  $-COOR_8$ ,  $-(C_1-C_6)alkyl-NHCOOC(CH_3)_3$ ,  $-(C_1-C_6)alkyl-NHCOCF_3$ ,  $-(C_1-C_6)alkyl-NHSO_2-(C_1-C_6)alkyl$ ,  $-(C_1-C_6)alkyl-NHCONH-(C_1-C_6)alkyl$  und



wobei f 0 bis 6 ist; oder R<sub>4</sub> Substituenten an den benachbarten Ringkohlenstoffatomen zusammen einen Methylendioxy- oder Ethylendioxyring bilden können;

R<sub>5</sub> 1 bis 3 Substituenten ist unabhängig ausgewählt aus der Gruppe bestehend aus Wasserstoff, Halo, (C<sub>1</sub>-C<sub>6</sub>) alkyl, R<sub>13</sub>-Aryl, (C<sub>3</sub>-C<sub>12</sub>)cycloalkyl, -CN, -CF<sub>3</sub>, -OR<sub>8</sub>, -(C<sub>1</sub>-C<sub>6</sub>)Alkyl-OR<sub>8</sub>, -OCF<sub>3</sub>, -NR<sub>8</sub>R<sub>9</sub>, -(C<sub>1</sub>-C<sub>6</sub>)Alkyl-NR<sub>8</sub>R<sub>9</sub>, -NHSO<sub>2</sub>R<sub>8</sub>, -SO<sub>2</sub>N(R<sub>14</sub>)<sub>2</sub>, -NO<sub>2</sub>, -CONR<sub>8</sub>R<sub>9</sub>, -NR<sub>9</sub>COR<sub>8</sub>, -COR<sub>8</sub>, -OCOR<sub>8</sub>, -OCO<sub>2</sub>R<sub>8</sub> und -COOR<sub>8</sub>;

R<sub>7</sub> H, (C<sub>1</sub>-C<sub>6</sub>)alkyl, -OR<sub>8</sub>, -(C<sub>1</sub>-C<sub>6</sub>)Alkyl-OR<sub>8</sub>, -NR<sub>8</sub>R<sub>9</sub> oder -(C<sub>1</sub>-C<sub>6</sub>)alkyl-NR<sub>8</sub>R<sub>9</sub> ist;

R<sub>12</sub> H, (C<sub>1</sub>-C<sub>6</sub>)alkyl, R<sub>4</sub>-Aryl, -(C<sub>1</sub>-C<sub>6</sub>)alkyl-OR<sub>8</sub>, -(C<sub>1</sub>-C<sub>6</sub>)alkyl-NR<sub>8</sub>R<sub>9</sub>, -(C<sub>1</sub>-C<sub>6</sub>)alkyl-SR<sub>8</sub>, oder Aryl(C<sub>1</sub>-C<sub>6</sub>)alkyl ist;

R<sub>13</sub> 1-3 Substituenten ist unabhängig ausgewählt aus der Gruppe bestehend aus H, (C<sub>1</sub>-C<sub>6</sub>)alkyl, (C<sub>1</sub>-C<sub>6</sub>)alkoxy und Halo;

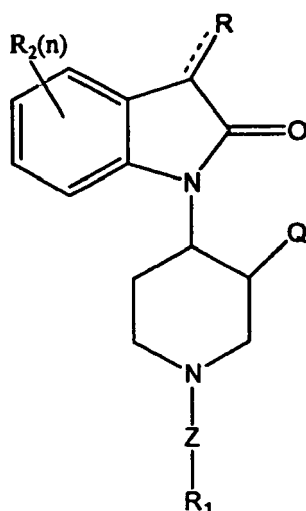
R<sub>14</sub> unabhängig ausgewählt ist aus der Gruppe bestehend aus H, (C<sub>1</sub>-C<sub>6</sub>)alkyl and R<sub>13</sub>-C<sub>6</sub>H<sub>4</sub>-CH<sub>2</sub>-;

oder ein pharmazeutisch verträgliches Salz davon.

19. Eine pharmazeutische Zusammensetzung umfassend eine Verbindung gemäß Anspruch 18 und mindestens einen pharmazeutisch verträglichen Hilfsstoff.
20. Verwendung einer analgetischen Verbindung gemäß Anspruch 18 zur Herstellung eines Medikamentes zur Behandlung von Schmerzen.
21. Verwendung einer Verbindung gemäß Anspruch 18 zur Herstellung eines Medikamentes zur Modulation einer pharmakologischen Antwort vom ORL1-Rezeptor.
22. Verwendung einer Verbindung gemäß Anspruch 1 zur Herstellung eines Medikamentes zur Modulation einer pharmakologischen Antwort von einem Opioid-Rezeptor.
23. Verwendung einer Verbindung gemäß Anspruch 18 zur Herstellung eines Medikamentes zur Modulation einer pharmakologischen Antwort von einem Opioid-Rezeptor.

## Revendications

1. Composé de formule (IIA) :



(IIA)

dans laquelle

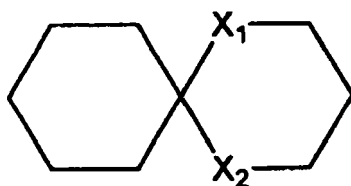
la ligne pointillée représente une double liaison optionnelle :

Z est sélectionné dans le groupe comprenant une liaison, -CH<sub>2</sub>-, -NH-, -CH<sub>2</sub>O-, -CH<sub>2</sub>CH<sub>2</sub>-, -CH<sub>2</sub>NH-, -CH<sub>2</sub>N(CH<sub>3</sub>)-, -NHCH<sub>2</sub>-, -CH<sub>2</sub>CONH-, -NHCH<sub>2</sub>CO-, -CH<sub>2</sub>CO-, -COCH<sub>2</sub>-, -CH<sub>2</sub>COCH<sub>2</sub>-, -CH(CH<sub>3</sub>)-, -CH= et HC=CH-, dans lesquelles les atomes de carbone et/ou d'azote sont non substitués ou substitués avec un alkyle inférieur, un halogène, un groupe hydroxy ou un groupe alkoxy ;

R et Q sont identiques ou différents et R est sélectionné dans le groupe constitué d'un halogène, d'un alkyle C<sub>1-10</sub>, d'un alkényle C<sub>1-10</sub>, d'un alkylidène C<sub>1-10</sub>, d'un cycloalkyle C<sub>3-12</sub>, d'un alkoxy C<sub>1-10</sub> et d'un groupe oxo et Q est sélectionné dans le groupe constitué d'un hydrogène, d'un halogène, d'un alkyle C<sub>1-10</sub>, d'un alkényle C<sub>1-10</sub>, d'un alkylidène C<sub>1-10</sub>, d'un cycloalkyle C<sub>3-12</sub>, d'un alkoxy C<sub>1-10</sub> et d'un groupe oxo ;

n est un entier de 0 à 3 ;

R<sub>1</sub> est sélectionné dans le groupe constitué d'un hydrogène, d'un alkyle C<sub>1-10</sub>, d'un cycloalkyle C<sub>3-12</sub>, d'un alkényle C<sub>2-10</sub>, d'un amino, d'un alkylamino C<sub>1-10</sub>, d'un cycloalkylamino C<sub>3-12</sub>, d'un benzyle, d'un cycloalkényle C<sub>3-12</sub>, d'un anneau aryle ou hétéroaryle monocyclique, bicyclique ou tricyclique, d'un anneau hétéromonocyclique, d'un système annulaire bicyclique et d'un système annulaire spiro de formule (V) :



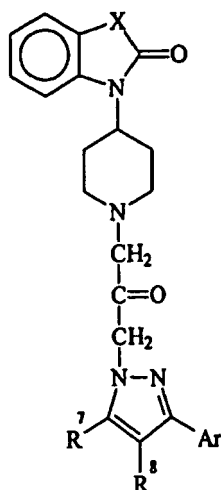
(V)

dans laquelle X<sub>1</sub> et X<sub>2</sub> sont sélectionnés indépendamment dans le groupe constitué de NH, O, S et CH<sub>2</sub> ;

dans laquelle ledit alkyle, cycloalkyle, alkényle, alkylamino C<sub>1-10</sub>, cycloalkylamino C<sub>3-12</sub> ou benzyle est optionnellement substitué avec 1 à 3 substituants sélectionnés dans le groupe constitué d'un halogène, d'un alkyle C<sub>1-10</sub>, d'un alkoxy C<sub>1-10</sub>, d'un nitro, d'un trifluorométhyle, d'un cyano, d'un phényle, d'un benzyle, d'un benzyloxy, lesdits phényle, benzyle et benzyloxy étant optionnellement substitués avec 1 à 3 substituants sélectionnés



dans le groupe constitué d'un halogène, d'un alkyle  $C_{1-10}$ , d'un alkoxy  $C_{1-10}$  et d'un cyano ;  
 dans laquelle lesdits cycloalkyle  $C_{3-12}$ , cycloalkényle  $C_{3-12}$ , anneau hétéroaryle ou aryle monocyclique, bicy-  
 clique ou tricyclique, anneau hétéromonocyclique, système annulaire hétérobicyclique et système annulaire  
 spiro de formule (V) sont optionnellement substitués avec 1 à 3 substituants sélectionnés dans le groupe  
 constitué d'un halogène, d'un alkyle  $C_{1-10}$ , d'un alkoxy  $C_{1-10}$ , d'un nitro, d'un trifluorométhyle, d'un phényle,  
 d'un benzyle, d'un phényloxy et d'un benzyloxy, lesdits phényle, benzyle, phényloxy et benzyloxy étant option-  
 nellement substitués avec 1 à 3 substituants sélectionnés dans le groupe constitué d'un halogène, d'un alkyle  
 $C_{1-10}$ , d'un alkoxy  $C_{1-10}$  et d'un cyano ;  
 $R_2$  est sélectionné dans le groupe constitué d'un hydrogène, d'un alkyle  $C_{1-10}$ , d'un cycloalkyle  $C_{3-12}$  et d'un  
 halogène, ledit alkyle étant optionnellement substitué avec un groupe oxo ;  
 mais pas un composé de la formule suivante :



dans laquelle X représente  $CHR^{41}$  et  $R^{41}$  représente un alkyle  $C_{1-5}$ , dans laquelle Ar représente un anneau aryle  
 monocyclique optionnellement substitué avec un halogène, un alkoxy  $C_{1-5}$ , un alkyle  $C_{1-5}$  et un cyano et dans  
 laquelle  $R_7$  et  $R_8$  représentent indépendamment un hydrogène, un alkyle  $C_{1-5}$  et un alkoxy  $C_{1-5}$  ou un halogène ;  
 en variante,  $R_7$  et  $R_8$  peuvent être pris ensemble pour former un anneau carbocyclique ou hétérocyclique de 5 à 7  
 membres optionnellement substitué, cet anneau pouvant être saturé, insaturé ou aromatique ;  
 ou un sel pharmaceutiquement acceptable de celui-ci.

2. Composé de la revendication 1, dans lequel Q représente un hydrogène ou un méthyle.
3. Composé de la revendication 1, dans lequel R représente un méthyle, un éthyle ou un éthylidène.
4. Composé de la revendication 1, dans lequel  $R_1$  représente un alkyle sélectionné dans le groupe constitué d'un  
 méthyle, d'un éthyle, d'un propyle, d'un butyle d'un pentyle et d'un hexyle.
5. Composé de la revendication 1, dans lequel  $R_1$  représente un cycloalkyle sélectionné dans le groupe constitué du  
 cyclohexyle, du cycloheptyle, du cyclooctyle, du cyclononyle, du cyclodécyle et du norbornyle.
6. Composé de la revendication 1, dans lequel  $R_1$  représente le tétrahydronaphthyle, le décahydronaphthyle ou le  
 dibenzocycloheptyle.
7. Composé de la revendication 1, dans lequel  $R_1$  représente un phényle ou un benzyle.
8. Composé de la revendication 1, dans lequel  $R_1$  représente un anneau aromatique bicyclique.
9. Composé de la revendication 8, dans lequel ledit anneau aromatique bicyclique est l'indényle, la quinoline ou le  
 naphthyle.

10. Composé de la revendication 1, dans lequel Z représente une liaison, un méthyle ou un éthyle.

11. Composé de la revendication 1, dans lequel n est égal à 0.

5 12. Composé de la revendication 1, dans lequel  $X_1$  et  $X_2$  représentent tous les deux O.

13. Composé de la revendication 1, dans lequel la ligne pointillée est une double liaison.

14. Composé de la revendication 1, sélectionné dans le groupe constitué de :

10

3-éthylidène-1-[1-(5-méthylhex-2-yl)-4-pipéridinyl]-1,3-dihydro-2H-indole-2-one ;  
 3-éthylidène-1-[1-(4-propylcyclohexyl)-4-pipéridinyl]-1,3-dihydro-2H-indole-2-one ;  
 3-éthylidène-1-[1-(1,2,3,4-tétrahydro-2-naphthyl)-4-pipéridinyl]-1,3-dihydro-2H-indole-2-one ;  
 3-éthylidène-1-[1-(1,3-dihydroindène-2-yl)-4-pipéridinyl]-1,3-dihydro-2H-indole-2-one ;  
 15 3-éthylidène-1-[1-(naphth-2-yl-méthyl)-4-pipéridinyl]-1,3-dihydro-2H-indole-2-one ;  
 3-éthylidène-1-[1-(p-benzyloxybenzyl)-4-pipéridinyl]-1,3-dihydro-2H-indole-2-one ;  
 3-éthylidène-1-[1-(benzyl)-4-pipéridinyl]-1,3-dihydro-2H-indole-2-one ;  
 3-éthylidène-1-[1-(cyclooctylméthyl)-4-pipéridinyl]-1,3-dihydro-2H-indole-2-one ;  
 3-éthylidène-1-[1-(norbornan-2-yl)-4-pipéridinyl]-1,3-dihydro-2H-indole-2-one ;  
 20 3-éthylidène-1-[1-(3,3-diphénylpropyl)-4-pipéridinyl]-1,3-dihydro-2H-indole-2-one ;  
 3-éthylidène-1-[1-(p-cyanobenzyl)-4-pipéridinyl]-1,3-dihydro-2H-indole-2-one ;  
 3-éthyl-1-[1-(5-méthylhex-2-yl)-4-pipéridinyl]-1,3-dihydro-2H-indole-2-one ;  
 3-éthyl-1-[1-[4-(1-méthyléthyl)-cyclohexyl]-4-pipéridinyl]-1,3-dihydro-2H-indole-2-one ;  
 3-éthyl-1-[1-(4-propylcyclohexyl)-4-pipéridinyl]-1,3-dihydro-2H-indole-2-one ;  
 25 3-éthyl-1-[1-(1,2,3,4-tétrahydro-2-naphthyl)-4-pipéridinyl]-1,3-dihydro-2H-indole-2-one ;  
 3-éthyl-1-[1-(décahydro-2-naphthyl)-4-pipéridinyl]-1,3-dihydro-2H-indole-2-one ;  
 3-éthyl-1-[1-(1,3-dihydroindène-2-yl)-4-pipéridinyl]-1,3-dihydro-2H-indole-2-one ;  
 3-éthyl-1-[1-(cyclooctylméthyl)-4-pipéridinyl]-1,3-dihydro-2H-indole-2-one ;  
 3-éthyl-1-[1-(norbornan-2-yl)-4-pipéridinyl]-1,3-dihydro-2H-indole-2-one ;  
 30 3-éthyl-1-[1-(3,3-Bis(phényl)propyl)-3-(méthyl)-4-pipéridinyl]-1,3-dihydro-2H-indole-2-one ;  
 3-éthyl-1-[1-(4-propylcyclohexyl)-3-(méthyl)-4-pipéridinyl]-1,3-dihydro-2H-indole-2-one ;  
 3-éthyl-1-[1-(5-méthylhex-2-yl)-3-(méthyl)-4-pipéridinyl]-1,3-dihydro-2H-indole-2-one ;  
 3-éthyl-1-[1-[4-(1-méthyléthyl)cyclohexyl]-3-méthyl-4-pipéridinyl]-1,3-dihydro-2H-indole-2-one ;  
 3-éthyl-1-[1-[4-(décahydro-2-naphthyl)-3-(méthyl)-4-pipéridinyl]-1,3-dihydro-2H-indole-2-one ;

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et des sels pharmaceutiquement acceptables de ceux-ci.

15. Composition pharmaceutique contenant un composé de la revendication 1 et au moins un excipient pharmaceutiquement acceptable.

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16. Utilisation d'un composé analgésique selon la revendication 1 pour la fabrication d'un médicament permettant de traiter la douleur.

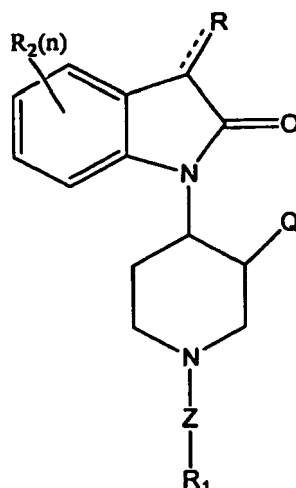
17. Utilisation d'un composé selon la revendication 1 pour la fabrication d'un médicament permettant de moduler une réponse pharmacologique du récepteur ORL1.

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18. Composé de formule (IIA) :

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(IIA)

dans laquelle

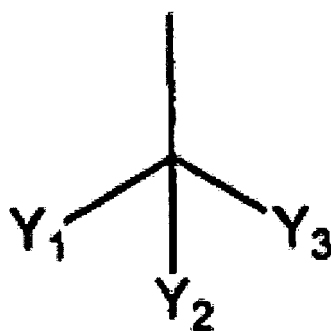
la ligne pointillée représente une double liaison optionnelle ;

R et Q sont identiques ou différents et R est sélectionné dans le groupe constitué d'un halogène, d'un alkyle C<sub>1-10</sub>, d'un alkenyle C<sub>1-10</sub>, d'un alkylidène C<sub>1-10</sub>, d'un cycloalkyle C<sub>3-12</sub>, d'un alkoxy C<sub>1-10</sub> et d'un groupe oxo et Q est sélectionné dans le groupe constitué d'un hydrogène, d'un halogène, d'un alkyle C<sub>1-10</sub>, d'un alkenyle C<sub>1-10</sub>, d'un alkylidène C<sub>1-10</sub>, d'un cycloalkyle C<sub>3-12</sub>, d'un alkoxy C<sub>1-10</sub> et d'un groupe oxo ;

n est un entier de 0 à 3 ;

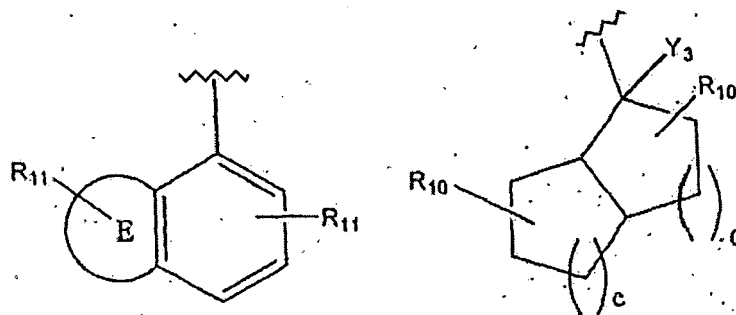
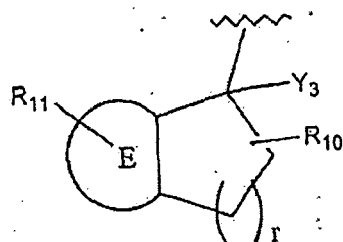
R<sub>2</sub> est sélectionné dans le groupe constitué d'un hydrogène, d'un alkyle C<sub>1-10</sub>, d'un cycloalkyle C<sub>3-12</sub>, et d'un halogène, ledit alkyle étant optionnellement substitué avec un groupe oxo ;

ZR<sub>1</sub> représente la formule suivante :

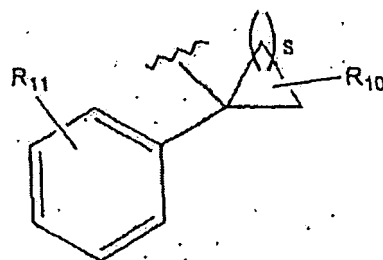


dans laquelle

Y<sub>1</sub> représente R<sub>3</sub>-alkyle (C<sub>1</sub>-C<sub>12</sub>), R<sub>4</sub>-aryle, R<sub>5</sub>-hétéroaryle, R<sub>6</sub>-cycloalkyle (C<sub>3</sub>-C<sub>12</sub>), R<sub>7</sub>-hétérocycloalkyle (C<sub>3</sub>-C<sub>7</sub>), -CO<sub>2</sub>-alkyle (C<sub>1</sub>-C<sub>6</sub>), CN ou -C(O)NR<sub>8</sub>R<sub>9</sub> ; Y<sub>2</sub> représente un hydrogène ou Y<sub>1</sub> ; Y<sub>3</sub> représente un hydrogène ou un alkyle (C<sub>1</sub>-C<sub>6</sub>) ou Y<sub>1</sub>, Y<sub>2</sub> et Y<sub>3</sub> forment, avec le carbone avec lequel ils sont liés, une des structures suivantes :



ou



dans lesquelles  $r$  est un entier de 0 à 3 ;  $c$  et  $d$  sont indépendamment égaux à 1 ou 2 ;  $s$  est un entier de 1 à 5 ; et l'anneau E est un anneau  $R_4$ -phényle ou  $R_5$ -hétéroaryle fusionné ;

$R_{10}$  représente 1 à 3 substituants sélectionnés indépendamment dans le groupe constitué de H, alkyle ( $C_1$ - $C_6$ ),  $-OR_8$ , alkyle ( $C_1$ - $C_6$ )- $OR_8$ ,  $NR_8R_9$  et alkyle ( $C_1$ - $C_6$ )- $NR_8R_9$  ;

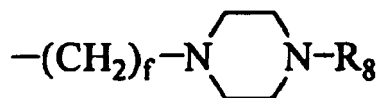
$R_{11}$  représente 1 à 3 substituants sélectionnés indépendamment dans le groupe constitué de  $R_{10}$ ,  $-CF_3$ ,  $-OCF_3$ ,  $NO_2$  et halo ou les substituants  $R_{11}$  sur des atomes de carbone adjacents de l'anneau peuvent former ensemble un anneau méthylènedioxy ou éthylènedioxy ;

$R_8$  et  $R_9$  sont indépendamment sélectionnés dans le groupe constitué d'un hydrogène, d'un alkyle ( $C_1$ - $C_6$ ), d'un cycloalkyle ( $C_3$ - $C_{12}$ ) d'un aryle et d'un aryl-alkyle ( $C_1$ - $C_6$ ) ;

$R_3$  représente 1 à 3 substituants indépendamment sélectionnés dans le groupe constitué de H,  $R_4$ -aryle,  $R_6$ -cycloalkyle ( $C_3$ - $C_{12}$ ),  $R_5$ -hétéroaryle,  $R_7$ -hétérocycloalkyle ( $C_3$ - $C_7$ ),  $-NR_8R_9$ ,  $-OR_{12}$  et  $-S(O)_{0-2}R_{12}$  ;

$R_6$  représente 1 à 3 substituants indépendamment sélectionnés dans le groupe constitué de H, alkyle ( $C_1$ - $C_6$ ),  $R_4$ -aryle,  $-NR_8R_9$ ,  $-OR_{12}$  et  $-SR_{12}$  ;

$R_4$  représente 1 à 3 substituants indépendamment sélectionnés dans le groupe constitué d'un hydrogène, d'un halo, d'un alkyle ( $C_1$ - $C_6$ ), d'un  $R_{13}$ -aryle, d'un cycloalkyle ( $C_3$ - $C_{12}$ ),  $-CN$ ,  $-CF_3$ ,  $OR_8$ ,  $-alkyle (C_1-C_6)-OR_8$ ,  $-OCF_3$ ,  $-NR_8R_9$ ,  $alkyle (C_1-C_6)-NR_8R_9$ ,  $-NHCO_2R_8$ ,  $-SO_2N(R_{14})_2$ ,  $-SO_2R_8$ ,  $-SOR_8$ ,  $-SR_8$ ,  $-NO_2$ ,  $-CONR_8R_9$ ,  $-NR_9COR_8$ ,  $-COR_8$ ,  $-COCF_3$ ,  $-OCOR_8$ ,  $-OCO_2R_8$ ,  $-COOR_8$ ,  $alkyle (C_1-C_6)-NHCOOC(CH_3)_3$ ,  $alkyle (C_1-C_6)-NHCOCF_3$ ,  $alkyle (C_1-C_6)-NHSO_2-alkyle (C_1-C_6)$ ,  $alkyle (C_1-C_6)-NHCONH(alkyle (C_1-C_6))$  et



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dans lequel f est un entier de 0 à 6; ou les substituants R<sub>4</sub> sur des atomes de carbone adjacents de l'anneau peuvent former ensemble un anneau méthylènedioxy ou éthylènedioxy ;

10 R<sub>5</sub> représente 1 à 3 substituants indépendamment sélectionnés dans le groupe constitué d'un hydrogène, d'un halo, d'un alkyle (C<sub>1</sub>-C<sub>6</sub>), d'un R<sub>13</sub>-aryle, d'un cycloalkyle (C<sub>3</sub>-C<sub>12</sub>), -CN, -CF<sub>3</sub>, OR<sub>8</sub>, -alkyle (C<sub>1</sub>-C<sub>6</sub>)-OR<sub>8</sub>, -OCF<sub>3</sub>, -NR<sub>8</sub>R<sub>9</sub>, alkyle (C<sub>1</sub>-C<sub>6</sub>)-NR<sub>8</sub>R<sub>9</sub>, -NHSO<sub>2</sub>R<sub>8</sub>, -SO<sub>2</sub>N(R<sub>14</sub>)<sub>2</sub>, - NO<sub>2</sub>, -CONR<sub>8</sub>R<sub>9</sub>, -NR<sub>9</sub>COR<sub>8</sub>, -COR<sub>8</sub>, -OCOR<sub>8</sub>, -OCO<sub>2</sub>R<sub>8</sub> et -COOR<sub>8</sub> ;

R<sub>7</sub> représente H, alkyle (C<sub>1</sub>-C<sub>6</sub>), OR<sub>8</sub>, -alkyle (C<sub>1</sub>-C<sub>6</sub>)-OR<sub>8</sub> ou - NR<sub>8</sub>R<sub>9</sub>, ou alkyle (C<sub>1</sub>-C<sub>6</sub>)-NR<sub>8</sub>R<sub>9</sub> ;

15 R<sub>12</sub> représente H, alkyle (C<sub>1</sub>-C<sub>6</sub>), R<sub>4</sub>-aryle, -alkyle (C<sub>1</sub>-C<sub>6</sub>)-OR<sub>8</sub>, alkyle (C<sub>1</sub>-C<sub>6</sub>)-NR<sub>8</sub>R<sub>9</sub>, alkyle (C<sub>1</sub>-C<sub>6</sub>)-SR<sub>8</sub> ou aryl-alkyle (C<sub>1</sub>-C<sub>6</sub>) ;

R<sub>13</sub> représente 1 à 3 substituants indépendamment sélectionnés dans le groupe constitué de H, alkyle (C<sub>1</sub>-C<sub>6</sub>), alkoxy (C<sub>1</sub>-C<sub>6</sub>) et halo ;

R<sub>14</sub> est indépendamment sélectionné dans le groupe constitué de H, alkyle (C<sub>1</sub>-C<sub>6</sub>) et R<sub>13</sub>-C<sub>6</sub>H<sub>4</sub>-CH<sub>2</sub>- ;

20 ou un sel pharmaceutiquement acceptable de celui-ci.

19. Composition pharmaceutique contenant un composé de la revendication 18 et au moins un excipient pharmaceutiquement acceptable.

25 20. Utilisation d'un composé analgésique selon la revendication 18 pour la fabrication d'un médicament permettant le traitement de la douleur.

21. Utilisation d'un composé selon la revendication 18 pour la fabrication d'un médicament permettant de moduler une réponse pharmacologique du récepteur ORL1.

30 22. Utilisation d'un composé selon la revendication 1 pour la fabrication d'un médicament permettant de moduler une réponse pharmacologique d'un récepteur d'opioïde.

35 23. Utilisation d'un composé selon la revendication 18 pour la fabrication d'un médicament permettant de moduler une réponse pharmacologique d'un récepteur d'opioïde.

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## REFERENCES CITED IN THE DESCRIPTION

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