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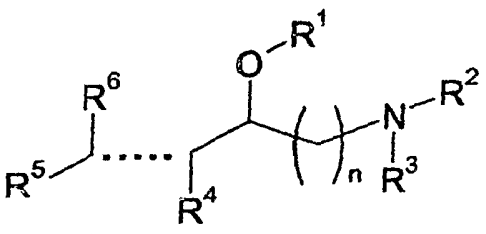
(54) Title: NOVEL SUBSTITUTED HETEROARYLOXY ALKYLAMINES AND THEIR USE AS MONOAMINE NEUROTRANSMITTER RE-UPTAKE INHIBITORS



(I)

(57) Abstract: This invention relates to novel substituted heteroaryloxy alkylamines of structure (I) useful as monoamine neurotransmitter re-uptake inhibitors. In other aspects the invention relates to the use of these compounds in a method for therapy and to pharmaceutical compositions comprising the compounds of the invention.

NOVEL SUBSTITUTED HETEROARYLOXY ALKYLAMINES AND THEIR USE AS MONOAMINE NEUROTRANSMITTER RE-UPTAKE INHIBITORS

TECHNICAL FIELD

This invention relates to novel substituted heteroaryloxy alkylamines useful as monoamine neurotransmitter re-uptake inhibitors.

In other aspects the invention relates to the use of these compounds in a method for therapy and to pharmaceutical compositions comprising the compounds of the invention.

BACKGROUND ART

US 4,500,541 (Merck) describes pharmacologically active cyclopropane derivatives.

EP 273 658 (Eli Lilly and Co) describes 3-aryloxy-3-substituted propanamines capable of inhibiting the uptake of serotonin and norepinephrine.

WO 01/62714 (AstraZeneca AB) describes phenylheteroalkylamine derivatives active as NOS inhibitors.

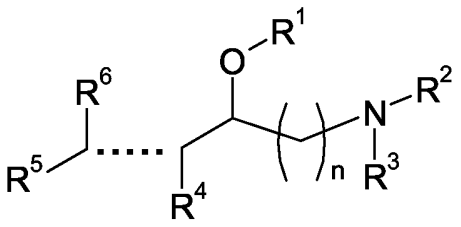
WO 02/094262 (Eli Lilly and Co) describes heteroaryloxy 3-substituted propanamines as serotonin and norepinephrine reuptake inhibitors.

WO 2004/043904 (Eli Lilly and Co) describes 3-aryloxy/thio-3-substituted propanamines and their use in inhibiting serotonin and norepinephrine reuptake.

However, there is still a strong need for compounds with an optimised pharmacological profile as regards the activity on reuptake of the monoamine neurotransmitters serotonin, dopamine and noradrenaline, such as the ratio of the serotonin reuptake versus the noradrenaline and dopamine reuptake activity.

SUMMARY OF THE INVENTION

In its first aspect, the invention provides a compound of the Formula I:



(I),

any of its isomers or any mixture of its isomers, or a pharmaceutically acceptable salt thereof,

wherein R^1, R^2, R^3, R^4, R^5, R^6 and n are as defined below.

In its second aspect, the invention provides a pharmaceutical composition, comprising a therapeutically effective amount of a compound of the invention, any of its isomers or any mixture of its isomers, or a pharmaceutically acceptable salt thereof, together with at least one pharmaceutically acceptable carrier, excipient or diluent.

In a further aspect, the invention provides the use of a compound of the invention, any of its isomers or any mixture of its isomers, or a pharmaceutically acceptable salt thereof, for the manufacture of a pharmaceutical composition for the treatment, prevention or alleviation of a disease or a disorder or a condition of a mammal, including a human, which disease, disorder or condition is responsive to inhibition of monoamine neurotransmitter re-uptake in the central nervous system.

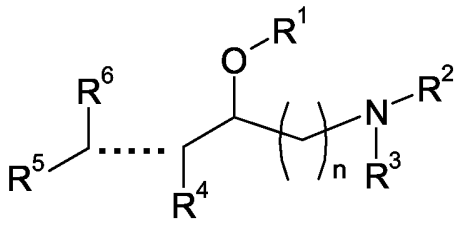
In a still further aspect, the invention relates to a method for treatment, prevention or alleviation of a disease or a disorder or a condition of a living animal body, including a human, which disorder, disease or condition is responsive to responsive to inhibition of monoamine neurotransmitter re-uptake in the central nervous system, which method comprises the step of administering to such a living animal body in need thereof a therapeutically effective amount of a compound of the invention, any of its isomers or any mixture of its isomers, or a pharmaceutically acceptable salt thereof.

Other objects of the invention will be apparent to the person skilled in the art from the following detailed description and examples.

DETAILED DISCLOSURE OF THE INVENTION

Substituted aryloxy alkylamines

In its first aspect the present invention provides compounds of formula I:



(I),

any of its isomers or any mixture of its isomers,
or a pharmaceutically acceptable salt thereof, wherein
R^1 represents a quinolyl, isoquinolyl or pyridyl group;
which group is optionally substituted with one or more substituents independently selected from the group consisting of:
halo, trifluoromethyl, trifluoromethoxy, cyano, hydroxy, amino, nitro, alkoxy, cycloalkoxy, alkyl, cycloalkyl, cycloalkylalkyl, alkenyl and alkynyl;

n is 1 or 2;
R^2 and R^3 independent of each other represent hydrogen or alkyl;
the bond · · · · · represents a single or a double bond;
R^4 and R^5 independent of each other represent hydrogen or alkyl; or R^4 and R^5 together with the carbon atoms to which they are attached form a three-membered carbocyclic ring; and
R^6 represents hydrogen or alkyl.

In one embodiment, R^1 represents an optionally substituted quinolyl group. In a special embodiment, R^1 represents quinolyl, such as quinolin-2-yl or quinolin-4-yl.

In a further embodiment, R^1 represents an optionally substituted isoquinolyl group. In a special embodiment, R^1 represents isoquinolyl, such as isoquinolin-5-yl.

In a still further embodiment, R^1 represents an optionally substituted pyridyl group, such as an optionally substituted pyridin-2-yl group. In a special embodiment, R^1 represents a mono-substituted pyridyl, such as halo-pyridyl. In a further embodiment, R^1 represents 6-halo-pyridin-2-yl, such as 6-chloro-pyridin-2-yl.

In a still further embodiment, R^2 represent hydrogen. In a further embodiment, R^2 represent alkyl, such as methyl.

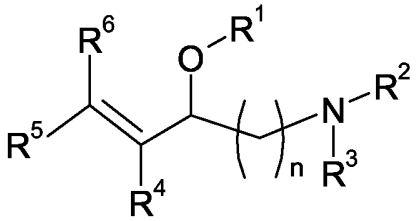
In a still further embodiment, R^3 represent hydrogen. In a further embodiment, R^3 represent alkyl, such as methyl.

In a still further embodiment, R^4 represent hydrogen. In a further embodiment, R^4 and R^5 together with the carbon atoms to which they are attached form a three-membered carbocyclic ring.

In a still further embodiment, R^5 represents hydrogen. In a further embodiment, R^5 represents alkyl, such as methyl.

In a further embodiment, R^6 represents hydrogen. In a still further embodiment, R^6 represents alkyl, such as methyl.

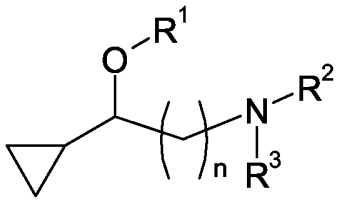
In a still further embodiment, the invention provides compounds of general formula (II)



(II),

any of its isomers or any mixture of its isomers, or a pharmaceutically acceptable salt thereof, wherein R^1, R^2, R^3, R^6 and n are as defined above; and
R^4 and R^5 independent of each other represent hydrogen or alkyl;

In an even further embodiment, the invention provides compounds of general formula (III)



(III),

any of its isomers or any mixture of its isomers, or a pharmaceutically acceptable salt thereof, wherein R^1, R^2, R^3 and n are as defined above.

In a special embodiment the chemical compound of the invention is
(±)-[(*E*)-3-(Isoquinolin-5-yloxy)-hex-4-enyl]-methylamine;
(±)-[(*E*)-3-(Quinolin-2-yloxy)-hex-4-enyl]-methylamine;
(±)-[(*E*)-3-(Quinolin-4-yloxy)-hex-4-enyl]-methylamine;
(±)-[(*E*)-3-(6-Chloro-pyridin-2-yloxy)-hex-4-enyl]-methylamine;
(±)-[3-(Isoquinolin-5-yloxy)-5-methyl-hex-4-enyl]-methylamine;
or a pharmaceutically acceptable salt thereof.

Any combination of two or more of the embodiments as described above is considered within the scope of the present invention.

Definition of Substituents

In the context of this invention halo represents fluoro, chloro, bromo or iodo.

In the context of this invention an alkyl group designates a univalent saturated, straight or branched hydrocarbon chain. The hydrocarbon chain preferably contains of from one to six carbon atoms (C_{1-6}-alkyl), including pentyl, isopentyl, neopentyl, tertiary pentyl, hexyl and isohexyl. In a preferred embodiment alkyl represents a C_{1-4}-alkyl group, including butyl, isobutyl, secondary butyl, and tertiary butyl. In another preferred embodiment of this invention alkyl represents a C_{1-3}-alkyl group, which may in particular be methyl, ethyl, propyl or isopropyl.

In the context of this invention an alkenyl group designates a carbon chain containing one or more double bonds, including di-enes, tri-enes and poly-enes. In a preferred embodiment the alkenyl group of the invention comprises of from two to six carbon atoms (C_{2-6}-alkenyl), including at least one double bond. In a most preferred embodiment the alkenyl group of the invention is ethenyl; 1- or 2-propenyl; 1-, 2- or 3-butenyl, or 1,3-butadienyl; 1-, 2-, 3-, 4- or 5-hexenyl, or 1,3-hexadienyl, or 1,3,5-hexatrienyl.

In the context of this invention an alkynyl group designates a carbon chain containing one or more triple bonds, including di-ynes, tri-ynes and poly-ynes. In a preferred embodiment the alkynyl group of the invention comprises of from two to six carbon atoms (C_{2-6}-alkynyl), including at least one triple bond. In its most preferred

embodiment the alkynyl group of the invention is ethynyl; 1-, or 2-propynyl; 1-, 2-, or 3-butynyl, or 1,3-butadiynyl; 1-, 2-, 3-, 4-pentynyl, or 1,3-pentadiynyl; 1-, 2-, 3-, 4-, or 5-hexynyl, or 1,3-hexadiynyl or 1,3,5-hexatriynyl.

In the context of this invention a cycloalkyl group designates a cyclic alkyl group, preferably containing of from three to seven carbon atoms (C_{3-7}-cycloalkyl), including cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl and cycloheptyl.

Alkoxy is O-alkyl, wherein alkyl is as defined above.

Cycloalkoxy means O-cycloalkyl, wherein cycloalkyl is as defined above.

Cycloalkylalkyl means cycloalkyl as above and alkyl as above, meaning for example, cyclopropylmethyl.

Amino is NH_2 or NH-alkyl or N-$(alkyl)_2$, wherein alkyl is as defined above.

Pharmaceutically Acceptable Salts

The chemical compound of the invention may be provided in any form suitable for the intended administration. Suitable forms include pharmaceutically (i.e. physiologically) acceptable salts, and pre- or prodrug forms of the chemical compound of the invention.

Examples of pharmaceutically acceptable addition salts include, without limitation, the non-toxic inorganic and organic acid addition salts such as the hydrochloride, the hydrobromide, the nitrate, the perchlorate, the phosphate, the sulphate, the formate, the acetate, the aconate, the ascorbate, the benzenesulphonate, the benzoate, the cinnamate, the citrate, the embonate, the enantate, the fumarate, the glutamate, the glycolate, the lactate, the maleate, the malonate, the mandelate, the methanesulphonate, the naphthalene-2-sulphonate, the phthalate, the salicylate, the sorbate, the stearate, the succinate, the tartrate, the toluene-p-sulphonate, and the like. Such salts may be formed by procedures well known and described in the art.

Other acids such as oxalic acid, which may not be considered pharmaceutically acceptable, may be useful in the preparation of salts useful as intermediates in obtaining a chemical compound of the invention and its pharmaceutically acceptable acid addition salt.

Examples of pharmaceutically acceptable cationic salts of a chemical compound of the invention include, without limitation, the sodium, the potassium, the calcium, the magnesium, the zinc, the aluminium, the lithium, the choline, the lysinium, and the ammonium salt, and the like, of a chemical compound of the invention containing an anionic group. Such cationic salts may be formed by procedures well known and described in the art.

In the context of this invention the “onium salts” of N-containing compounds are also contemplated as pharmaceutically acceptable salts. Preferred “onium salts”

include the alkyl-onium salts, the cycloalkyl-onium salts, and the cycloalkylalkyl-onium salts.

Examples of pre- or prodrug forms of the chemical compound of the invention include examples of suitable prodrugs of the substances according to the invention include compounds modified at one or more reactive or derivatizable groups of the parent compound. Of particular interest are compounds modified at a carboxyl group, a hydroxyl group, or an amino group. Examples of suitable derivatives are esters or amides.

The chemical compound of the invention may be provided in dissoluble or indissoluble forms together with a pharmaceutically acceptable solvent such as water, ethanol, and the like. Dissoluble forms may also include hydrated forms such as the monohydrate, the dihydrate, the hemihydrate, the trihydrate, the tetrahydrate, and the like. In general, the dissoluble forms are considered equivalent to indissoluble forms for the purposes of this invention.

Steric Isomers

It will be appreciated by those skilled in the art that the compounds of the present invention may contain one or more chiral centers, and that such compounds exist in the form of isomers.

Also, some of the chemical compounds of the invention having a -C=C- double bond may exist in two forms, syn- and anti-form (Z- and E-form), depending on the arrangement of the substituents around the double bond. A chemical compound of the present invention may thus be the syn- or the anti-form, or it may be a mixture hereof.

Moreover, the chemical compounds of the present invention may exist as enantiomers in (+) and (-) forms as well as in racemic forms (±).

The invention includes all such isomers and any mixtures thereof including racemic mixtures.

Racemic forms can be resolved into the optical antipodes by known methods and techniques. One way of separating the isomeric salts is by use of an optically active acid, and liberating the optically active amine compound by treatment with a base. Another method for resolving racemates into the optical antipodes is based upon chromatography on an optical active matrix. Racemic compounds of the present invention can thus be resolved into their optical antipodes, e.g., by fractional crystallisation of d- or l- (tartrates, mandelates, or camphorsulphonate) salts for example.

The chemical compounds of the present invention may also be resolved by the formation of diastereomeric amides by reaction of the chemical compounds of the present invention with an optically active activated carboxylic acid such as that derived from (+) or (-) phenylalanine, (+) or (-) phenylglycine, (+) or (-) camphanic acid

or by the formation of diastereomeric carbamates by reaction of the chemical compound of the present invention with an optically active chloroformate or the like.

Additional methods for the resolving the optical isomers are known in the art. Such methods include those described by *Jaques J, Collet A, & Wilen S* in "Enantiomers, Racemates, and Resolutions", John Wiley and Sons, New York (1981).

Optical active compounds can also be prepared from optical active starting materials.

Labelled Compounds

The compounds of the invention may be used in their labelled or unlabelled form. In the context of this invention the labelled compound has one or more atoms replaced by an atom having an atomic mass or mass number different from the atomic mass or mass number usually found in nature. The labelling will allow easy quantitative detection of said compound.

The labelled compounds of the invention may be useful as diagnostic tools, radio tracers, or monitoring agents in various diagnostic methods, and for *in vivo* receptor imaging.

The labelled isomer of the invention preferably contains at least one radionuclide as a label. Positron emitting radionuclides are all candidates for usage. In the context of this invention the radionuclide is preferably selected from ^{2}H (deuterium), ^{3}H (tritium), ^{13}C, ^{14}C, ^{131}I, ^{125}I, ^{123}I, and ^{18}F.

The physical method for detecting the labelled isomer of the present invention may be selected from Position Emission Tomography (PET), Single Photon Imaging Computed Tomography (SPECT), Magnetic Resonance Spectroscopy (MRS), Magnetic Resonance Imaging (MRI), and Computed Axial X-ray Tomography (CAT), or combinations thereof.

Methods of Preparation

The chemical compounds of the invention may be prepared by conventional methods for chemical synthesis, e.g. those described in the working examples. The starting materials for the processes described in the present application are known or may readily be prepared by conventional methods from commercially available chemicals.

Also one compound of the invention can be converted to another compound of the invention using conventional methods.

The end products of the reactions described herein may be isolated by conventional techniques, e.g. by extraction, crystallisation, distillation, chromatography, etc.

Biological Activity

Compounds of the invention may be tested for their ability to inhibit reuptake of the monoamines dopamine, noradrenaline and serotonin in synaptosomes e.g. such as described in WO 97/30997 (NeuroSearch A/S). Based on the balanced activity observed in these tests the compound of the invention is considered useful for the treatment, prevention or alleviation of a disease or a disorder or a condition of a mammal, including a human, which disease, disorder or condition is responsive to inhibition of monoamine neurotransmitter re-uptake in the central nervous system.

In a special embodiment, the compounds of the invention are considered useful for the treatment, prevention or alleviation of: mood disorder, depression, atypical depression, depression secondary to pain, major depressive disorder, dysthymic disorder, bipolar disorder, bipolar I disorder, bipolar II disorder, cyclothymic disorder, mood disorder due to a general medical condition, substance-induced mood disorder, pseudodementia, Ganser's syndrome, obsessive compulsive disorder, panic disorder, panic disorder without agoraphobia, panic disorder with agoraphobia, agoraphobia without history of panic disorder, panic attack, memory deficits, memory loss, attention deficit hyperactivity disorder, obesity, anxiety, generalized anxiety disorder, eating disorder, Parkinson's disease, parkinsonism, dementia, dementia of ageing, senile dementia, Alzheimer's disease, acquired immunodeficiency syndrome dementia complex, memory dysfunction in ageing, specific phobia, social phobia, post-traumatic stress disorder, acute stress disorder, drug addiction, drug abuse, cocaine abuse, nicotine abuse, tobacco abuse, alcohol addiction, alcoholism, pain, chronic pain, inflammatory pain, neuropathic pain, migraine pain, tension-type headache, chronic tension-type headache, pain associated with depression, fibromyalgia, arthritis, osteoarthritis, rheumatoid arthritis, back pain, cancer pain, irritable bowel pain, irritable bowel syndrome, post-operative pain, post-mastectomy pain syndrome (PMPS), post-stroke pain, drug-induced neuropathy, diabetic neuropathy, sympathetically-maintained pain, trigeminal neuralgia, dental pain, myofacial pain, phantom-limb pain, bulimia, premenstrual syndrome, late luteal phase syndrome, post-traumatic syndrome, chronic fatigue syndrome, urinary incontinence, stress incontinence, urge incontinence, nocturnal incontinence, sexual dysfunction, premature ejaculation, erectile difficulty, erectile dysfunction, premature female orgasm, restless leg syndrome, eating disorders, anorexia nervosa, sleep disorders, autism, mutism, trichotillomania, narcolepsy, post-stroke depression, stroke-induced brain damage, stroke-induced neuronal damage or Gilles de la Tourettes disease. In a preferred embodiment, the compounds are considered useful for the treatment, prevention or alleviation of depression.

It is at present contemplated that a suitable dosage of the active pharmaceutical ingredient (API) is within the range of from about 0.1 to about 1000 mg

API per day, more preferred of from about 10 to about 500 mg API per day, most preferred of from about 30 to about 100 mg API per day, dependent, however, upon the exact mode of administration, the form in which it is administered, the indication considered, the subject and in particular the body weight of the subject involved, and further the preference and experience of the physician or veterinarian in charge.

Preferred compounds of the invention show a biological activity in the sub-micromolar and micromolar range, i.e. of from below 1 to about 100 μM.

Pharmaceutical Compositions

In another aspect the invention provides novel pharmaceutical compositions comprising a therapeutically effective amount of the chemical compound of the invention.

While a chemical compound of the invention for use in therapy may be administered in the form of the raw chemical compound, it is preferred to introduce the active ingredient, optionally in the form of a physiologically acceptable salt, in a pharmaceutical composition together with one or more adjuvants, excipients, carriers, buffers, diluents, and/or other customary pharmaceutical auxiliaries.

In a preferred embodiment, the invention provides pharmaceutical compositions comprising the chemical compound of the invention, or a pharmaceutically acceptable salt or derivative thereof, together with one or more pharmaceutically acceptable carriers, and, optionally, other therapeutic and/or prophylactic ingredients, known and used in the art. The carrier(s) must be "acceptable" in the sense of being compatible with the other ingredients of the formulation and not harmful to the recipient thereof.

Pharmaceutical compositions of the invention may be those suitable for oral, rectal, bronchial, nasal, pulmonal, topical (including buccal and sub-lingual), transdermal, vaginal or parenteral (including cutaneous, subcutaneous, intramuscular, intraperitoneal, intravenous, intraarterial, intracerebral, intraocular injection or infusion) administration, or those in a form suitable for administration by inhalation or insufflation, including powders and liquid aerosol administration, or by sustained release systems. Suitable examples of sustained release systems include semipermeable matrices of solid hydrophobic polymers containing the compound of the invention, which matrices may be in form of shaped articles, e.g. films or microcapsules.

The chemical compound of the invention, together with a conventional adjuvant, carrier, or diluent, may thus be placed into the form of pharmaceutical compositions and unit dosages thereof. Such forms include solids, and in particular tablets, filled capsules, powder and pellet forms, and liquids, in particular aqueous or non-aqueous solutions, suspensions, emulsions, elixirs, and capsules filled with the same, all for oral use, suppositories for rectal administration, and sterile injectable solutions for parenteral use. Such pharmaceutical compositions and unit dosage forms thereof may comprise

conventional ingredients in conventional proportions, with or without additional active compounds or principles, and such unit dosage forms may contain any suitable effective amount of the active ingredient commensurate with the intended daily dosage range to be employed.

The chemical compound of the present invention can be administered in a wide variety of oral and parenteral dosage forms. It will be obvious to those skilled in the art that the following dosage forms may comprise, as the active component, either a chemical compound of the invention or a pharmaceutically acceptable salt of a chemical compound of the invention.

For preparing pharmaceutical compositions from a chemical compound of the present invention, pharmaceutically acceptable carriers can be either solid or liquid. Solid form preparations include powders, tablets, pills, capsules, cachets, suppositories, and dispersible granules. A solid carrier can be one or more substances which may also act as diluents, flavouring agents, solubilizers, lubricants, suspending agents, binders, preservatives, tablet disintegrating agents, or an encapsulating material.

In powders, the carrier is a finely divided solid, which is in a mixture with the finely divided active component.

In tablets, the active component is mixed with the carrier having the necessary binding capacity in suitable proportions and compacted in the shape and size desired.

The powders and tablets preferably contain from five or ten to about seventy percent of the active compound. Suitable carriers are magnesium carbonate, magnesium stearate, talc, sugar, lactose, pectin, dextrin, starch, gelatin, tragacanth, methylcellulose, sodium carboxymethylcellulose, a low melting wax, cocoa butter, and the like. The term "preparation" is intended to include the formulation of the active compound with encapsulating material as carrier providing a capsule in which the active component, with or without carriers, is surrounded by a carrier, which is thus in association with it. Similarly, cachets and lozenges are included. Tablets, powders, capsules, pills, cachets, and lozenges can be used as solid forms suitable for oral administration.

For preparing suppositories, a low melting wax, such as a mixture of fatty acid glyceride or cocoa butter, is first melted and the active component is dispersed homogeneously therein, as by stirring. The molten homogenous mixture is then poured into convenient sized moulds, allowed to cool, and thereby to solidify.

Compositions suitable for vaginal administration may be presented as pessaries, tampons, creams, gels, pastes, foams or sprays containing in addition to the active ingredient such carriers as are known in the art to be appropriate.

Liquid preparations include solutions, suspensions, and emulsions, for example, water or water-propylene glycol solutions. For example, parenteral injection liquid preparations can be formulated as solutions in aqueous polyethylene glycol solution.

The chemical compound according to the present invention may thus be formulated for parenteral administration (e.g. by injection, for example bolus injection or continuous infusion) and may be presented in unit dose form in ampoules, pre-filled syringes, small volume infusion or in multi-dose containers with an added preservative. The compositions may take such forms as suspensions, solutions, or emulsions in oily or aqueous vehicles, and may contain formulation agents such as suspending, stabilising and/or dispersing agents. Alternatively, the active ingredient may be in powder form, obtained by aseptic isolation of sterile solid or by lyophilization from solution, for constitution with a suitable vehicle, e.g. sterile, pyrogen-free water, before use.

Aqueous solutions suitable for oral use can be prepared by dissolving the active component in water and adding suitable colorants, flavours, stabilising and thickening agents, as desired.

Aqueous suspensions suitable for oral use can be made by dispersing the finely divided active component in water with viscous material, such as natural or synthetic gums, resins, methylcellulose, sodium carboxymethylcellulose, or other well known suspending agents.

Also included are solid form preparations, intended for conversion shortly before use to liquid form preparations for oral administration. Such liquid forms include solutions, suspensions, and emulsions. In addition to the active component such preparations may comprise colorants, flavours, stabilisers, buffers, artificial and natural sweeteners, dispersants, thickeners, solubilizing agents, and the like.

For topical administration to the epidermis the chemical compound of the invention may be formulated as ointments, creams or lotions, or as a transdermal patch. Ointments and creams may, for example, be formulated with an aqueous or oily base with the addition of suitable thickening and/or gelling agents. Lotions may be formulated with an aqueous or oily base and will in general also contain one or more emulsifying agents, stabilising agents, dispersing agents, suspending agents, thickening agents, or colouring agents.

Compositions suitable for topical administration in the mouth include lozenges comprising the active agent in a flavoured base, usually sucrose and acacia or tragacanth; pastilles comprising the active ingredient in an inert base such as gelatin and glycerine or sucrose and acacia; and mouthwashes comprising the active ingredient in a suitable liquid carrier.

Solutions or suspensions are applied directly to the nasal cavity by conventional means, for example with a dropper, pipette or spray. The compositions may be provided in single or multi-dose form.

Administration to the respiratory tract may also be achieved by means of an aerosol formulation in which the active ingredient is provided in a pressurised pack with a suitable propellant such as a chlorofluorocarbon (CFC) for example dichlorodifluoromethane,

trichlorofluoromethane, or dichlorotetrafluoroethane, carbon dioxide, or other suitable gas. The aerosol may conveniently also contain a surfactant such as lecithin. The dose of drug may be controlled by provision of a metered valve.

Alternatively the active ingredients may be provided in the form of a dry powder, for example a powder mix of the compound in a suitable powder base such as lactose, starch, starch derivatives such as hydroxypropylmethyl cellulose and polyvinylpyrrolidone (PVP). Conveniently the powder carrier will form a gel in the nasal cavity. The powder composition may be presented in unit dose form for example in capsules or cartridges of, e.g., gelatin, or blister packs from which the powder may be administered by means of an inhaler.

In compositions intended for administration to the respiratory tract, including intranasal compositions, the compound will generally have a small particle size for example of the order of 5 microns or less. Such a particle size may be obtained by means known in the art, for example by micronization.

When desired, compositions adapted to give sustained release of the active ingredient may be employed.

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

Tablets or capsules for oral administration and liquids for intravenous administration and continuous infusion are preferred compositions.

Further details on techniques for formulation and administration may be found in the latest edition of Remington's Pharmaceutical Sciences (Maack Publishing Co., Easton, PA).

A therapeutically effective dose refers to that amount of active ingredient, which ameliorates the symptoms or condition. Therapeutic efficacy and toxicity, e.g. ED_{50} and LD_{50}, may be determined by standard pharmacological procedures in cell cultures or experimental animals. The dose ratio between therapeutic and toxic effects is the therapeutic index and may be expressed by the ratio LD_{50}/ED_{50}. Pharmaceutical compositions exhibiting large therapeutic indexes are preferred.

The dose administered must of course be carefully adjusted to the age, weight and condition of the individual being treated, as well as the route of administration, dosage form and regimen, and the result desired, and the exact dosage should of course be determined by the practitioner.

The actual dosage depends on the nature and severity of the disease being treated, and is within the discretion of the physician, and may be varied by titration of

the dosage to the particular circumstances of this invention to produce the desired therapeutic effect. However, it is presently contemplated that pharmaceutical compositions containing of from about 0.1 to about 500 mg of active ingredient per individual dose, preferably of from about 1 to about 100 mg, most preferred of from about 1 to about 10 mg, are suitable for therapeutic treatments.

The active ingredient may be administered in one or several doses per day. A satisfactory result can, in certain instances, be obtained at a dosage as low as 0.1 μg/kg i.v. and 1 μg/kg p.o. The upper limit of the dosage range is presently considered to be about 10 mg/kg i.v. and 100 mg/kg p.o. Preferred ranges are from about 0.1 μg/kg to about 10 mg/kg/day i.v., and from about 1 μg/kg to about 100 mg/kg/day p.o.

Methods of Therapy

In another aspect the invention provides a method for the treatment, prevention or alleviation of a disease or a disorder or a condition of a living animal body, including a human, which disease, disorder or condition is responsive to inhibition of monoamine neurotransmitter re-uptake in the central nervous system, and which method comprises administering to such a living animal body, including a human, in need thereof an effective amount of a chemical compound of the invention.

It is at present contemplated that suitable dosage ranges are 0.1 to 1000 milligrams daily, 10-500 milligrams daily, and especially 30-100 milligrams daily, dependent as usual upon the exact mode of administration, form in which administered, the indication toward which the administration is directed, the subject involved and the body weight of the subject involved, and further the preference and experience of the physician or veterinarian in charge.

EXAMPLES

The invention is further illustrated with reference to the following examples, which are not intended to be in any way limiting to the scope of the invention as claimed.

Method A

(±)-[(*E*)-3-(Quinolin-2-yloxy)-hex-4-enyl]-methylamine fumaric acid salt

(±)-(*E*)-1-Methylamino-hex-4-en-3-ol (641 mg, 3.32 mmol) was dissolved in DMSO (15 mL) and cooled on an ice bath. NaH (60% in mineral oil, 266 mg, 6.65 mmol) was added and the mixture stirred for 30 min. followed by addition of 2-chloroquinoline (1.14 g, 6.98 mmol) in DMSO (2 ml). The mixture was stirred for 18 h. at room temperature followed by addition of water and extraction with ethyl acetate (4 x 50 mL). The combined organic phases were dried (sodium sulfate), filtered and

evaporated to give the crude product. Flash chromatography with dichloromethane and a gradient of 5-10% methanol containing ammonia (1%) gave the product as a pale yellow oil. The corresponding salt was obtained by addition of a diethylether and methanol mixture (9:1) saturated with fumaric acid. Yield 249 mg (20%). Mp. 89.9-91.6°C.

(±)-[(*E*)-3-(Isoquinolin-5-yloxy)-hex-4-enyl]-methylamine fumaric acid salt
Was prepared according to method A from (*E*)-1-methylamino-hex-4-en-3-ol and 5-fluoroisoquinoline (Roe, A and Teague C. E. in J. Chem. Am. Soc. 73, 1951, 687) as a gum.

(±)-[(*E*)-3-(Quinolin-4-yloxy)-hex-4-enyl]-methylamine fumaric acid salt
Was prepared according to method A from (*E*)-1-methylamino-hex-4-en-3-ol and 4-chloroquinoline as a sticky yellow solid.

(±)-[(*E*)-3-(6-Chloro-pyridin-2-yloxy)-hex-4-enyl]-methylamine fumaric acid salt
Was prepared according to method A from (*E*)-1-methylamino-hex-4-en-3-ol and 2,6-dichloropyridine. Mp. 95.2-96.2°C.

(±)-[3-(Isoquinolin-5-yloxy)-5-methyl-hex-4-enyl]-methylamine fumaric acid salt
Was prepared according to method A from 5-methyl-1-methylamino-hex-4-en-3-ol and 5-fluoroisoquinoline (Roe, A and Teague C. E. in J. Chem. Am. Soc. 73, 1951, 687) Mp. 120.7-122.6°C.

Method B

(±)-5-Methyl-1-methylamino-hex-4-en-3-ol
Acetonitrile (11.5 mL, 219 mmol) in THF (300 mL) was cooled to -78°C and *n*-BuLi (2,5 M in hexanes, 96 mL) was added slowly. The mixture was stirred at -78°C for 2 h. 3-Methyl-2-butenal (25 mL, 262 mmol) dissolved in dry THF (50 mL) was added slowly and after 15 min the reaction was quenched with HCl (3N, 175 mL). After evaporation of the majority of solvents, the residue was extracted twice with diethylether. The combined ether extracts were dried (sodium sulfate), filtered and concentrated to give crude (±)-3-hydroxy-5-methyl-hex-4-enenitrile (29.6 g, 100%) as a yellow oil.

This oil (29.6 g, 219 mmol) was dissolved in tetrahydrofuran (250 mL) and added to $LiAlH_4$ (1M in diethylether, 234 mL) maintaining reflux. Reflux was maintained for 2 h. The mixture was cooled on an ice bath and 15% aq. sodium hydroxide was added drop-wise until a white precipitate separated out. The precipitate was filtered and washed with tetrahydrofuran (3x) and diethylether (3x). The combined

washes were evaporated. The resulting oil was redissolved in diethylether, dried (sodium sulfate), filtered and evaporated to give the crude product (±)-1-amino-5-methyl-hex-4-en-3-ol (28.5 g, 100%) as a yellow oil.

(±)-1-Amino-5-methyl-hex-4-en-3-ol (28.5 g, 219 mmol) and diisopropyl ethylamine (45.9 mL, 263 mmol) were dissolved in dichloromethane (400 mL) and cooled on an ice bath. Methyl chloroformate (17 mL, 219 mmol) in dichloromethane (20 mL) was added slowly. The mixture was stirred for 2 h. at 0°C. A saturated aqueous solution of sodium hydrogencarbonate was added and the phases separated. The aqueous phase was extracted twice with dichloromethane. The organic phases were dried, filtered and evaporated to give (±)-(3-hydroxy-5-methyl-hex-4-enyl) carbamic acid methyl ester (38.9 g, 100%) as a yellow oil.

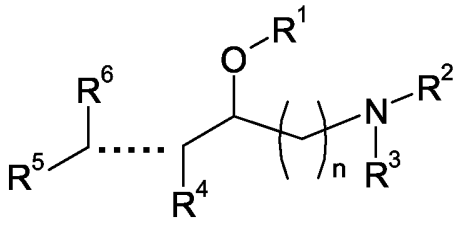
(±)-(3-Hydroxy-5-methyl-hex-4-enyl) carbamic acid methyl ester (38.9 g, 219 mmol) dissolved in tetrahydrofuran (150 mL) was added drop-wise to a refluxing solution of $LiAlH_4$ (1M in tetrahydrofuran, 232 mL) maintaining reflux. After refluxing for 2 h the mixture was cooled on an ice bath and 15% aq. sodium hydroxide (50 mL) was added drop-wise until a white precipitate separated out. The precipitate was filtrated and washed with tetrahydrofuran (2 x 200 mL), dichloromethane (2 x 200 mL) and diethylether (2 x 200 mL). The combined washes were evaporated. The resulting oil was redissolved in diethylether, dried (sodium sulfate), filtered and evaporated to give the crude product (29.5 g, 100%) as a yellow oil. The crude product was used without further purification.

(±)-(*E*)-1-Methylamino-hex-4-en-3-ol

Was prepared according to method B from crotonaldehyde and acetonitrile (Tamaru, Y. et al. in J. Org. Chem. 53, 23, 1988, 5491-5502).

CLAIMS

1. A compound of the Formula I:



(I),

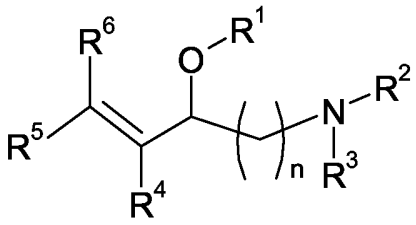
any of its isomers or any mixture of its isomers,
or a pharmaceutically acceptable salt thereof,
wherein
R^1 represents a quinolyl, isoquinolyl or pyridyl group;
which group is optionally substituted with one or more substituents independently selected from the group consisting of:
halo, trifluoromethyl, trifluoromethoxy, cyano, hydroxy, amino, nitro, alkoxy, cycloalkoxy, alkyl, cycloalkyl, cycloalkylalkyl, alkenyl and alkynyl;
n is 1 or 2;
R^2 and R^3 independent of each other represent hydrogen or alkyl;
the bond · · · · · represents a single or a double bond;
R^4 and R^5 independent of each other represent hydrogen or alkyl; or R^4 and R^5 together with the carbon atoms to which they are attached form a three-membered carbocyclic ring; and
R^6 represents hydrogen or alkyl.

2. The chemical compound of claim 1, wherein
R^1 represents an optionally substituted quinolyl group.

3. The chemical compound of claim 1, wherein
R^1 represents an optionally substituted isoquinolyl group.

4. The chemical compound of claim 1, wherein
R^1 represents an optionally substituted pyridyl group.

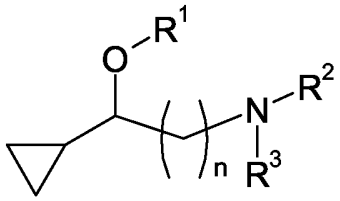
5. The chemical compound of any one of claims 1-4 being a compound of general formula (II)



(II),

any of its isomers or any mixture of its isomers,
or a pharmaceutically acceptable salt thereof,
wherein
R^1, R^2, R^3, R^6 and n are as defined in claim 1; and
R^4 and R^5 independent of each other represent hydrogen or alkyl;

6. The chemical compound of any one of claims 1-4 being a compound of general formula (III)



(III),

any of its isomers or any mixture of its isomers,
or a pharmaceutically acceptable salt thereof,
wherein
R^1, R^2, R^3 and n are as defined in claim 1.

7. The chemical compound of claim 1, which is
(±)-[(*E*)-3-(Isoquinolin-5-yloxy)-hex-4-enyl]-methylamine;
(±)-[(*E*)-3-(Quinolin-2-yloxy)-hex-4-enyl]-methylamine;
(±)-[(*E*)-3-(Quinolin-4-yloxy)-hex-4-enyl]-methylamine;
(±)-[(*E*)-3-(6-Chloro-pyridin-2-yloxy)-hex-4-enyl]-methylamine;
(±)-[3-(Isoquinolin-5-yloxy)-5-methyl-hex-4-enyl]-methylamine;
or a pharmaceutically acceptable salt thereof.

8. A pharmaceutical composition, comprising a therapeutically effective amount of a compound of any one of claims 1-7, any of its isomers or any mixture of its isomers, or a pharmaceutically acceptable salt thereof, together with at least one pharmaceutically acceptable carrier, excipient or diluent.

9. Use of the chemical compound of any of claims 1-7, any of its isomers or any mixture of its isomers, or a pharmaceutically acceptable salt thereof, for the manufacture of a medicament.

10. The use according to claim 9, for the manufacture of a pharmaceutical pharmaceutical composition for the treatment, prevention or alleviation of a disease or a disorder or a condition of a mammal, including a human, which disease, disorder or condition is responsive to inhibition of monoamine neurotransmitter re-uptake in the central nervous system.

11. The use according to claim 10, wherein the disease, disorder or condition is mood disorder, depression, atypical depression, depression secondary to pain, major depressive disorder, dysthymic disorder, bipolar disorder, bipolar I disorder, bipolar II disorder, cyclothymic disorder, mood disorder due to a general medical condition, substance-induced mood disorder, pseudodementia, Ganser's syndrome, obsessive compulsive disorder, panic disorder, panic disorder without agoraphobia, panic disorder with agoraphobia, agoraphobia without history of panic disorder, panic attack, memory deficits, memory loss, attention deficit hyperactivity disorder, obesity, anxiety, generalized anxiety disorder, eating disorder, Parkinson's disease, parkinsonism, dementia, dementia of ageing, senile dementia, Alzheimer's disease, acquired immunodeficiency syndrome dementia complex, memory dysfunction in ageing, specific phobia, social phobia, post-traumatic stress disorder, acute stress disorder, drug addiction, drug abuse, cocaine abuse, nicotine abuse, tobacco abuse, alcohol addiction, alcoholism, pain, chronic pain, inflammatory pain, neuropathic pain, migraine pain, tension-type headache, chronic tension-type headache, pain associated with depression, fibromyalgia, arthritis, osteoarthritis, rheumatoid arthritis, back pain, cancer pain, irritable bowel pain, irritable bowel syndrome, post-operative pain, post-mastectomy pain syndrome (PMPS), post-stroke pain, drug-induced neuropathy, diabetic neuropathy, sympathetically-maintained pain, trigeminal neuralgia, dental pain, myofacial pain, phantom-limb pain, bulimia, premenstrual syndrome, late luteal phase syndrome, post-traumatic syndrome, chronic fatigue syndrome, urinary incontinence, stress incontinence, urge incontinence, nocturnal incontinence, sexual dysfunction, premature ejaculation, erectile difficulty, erectile dysfunction, premature female orgasm, restless leg syndrome, eating disorders, anorexia nervosa, sleep disorders, autism, mutism, trichotillomania, narcolepsy, post-stroke depression, stroke-induced brain damage, stroke-induced neuronal damage or Gilles de la Tourettes disease.

12. A method for treatment, prevention or alleviation of a disease or a disorder or a condition of a living animal body, including a human, which disorder, disease or

condition is responsive to inhibition of monoamine neurotransmitter re-uptake in the central nervous system, which method comprises the step of administering to such a living animal body in need thereof a therapeutically effective amount of a compound according to any one of the claims 1-7, any of its isomers or any mixture of its isomers, or a pharmaceutically acceptable salt thereof.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP2005/054152

A. CLASSIFICATION OF SUBJECT MATTER
C07D215/22 C07D217/02 C07D213/64 A61K31/44 A61K31/47
A61P25/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C07D A61K A61P

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, CHEM ABS Data, BEILSTEIN Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 03/011831 A (ASTRAZENECA AB; CHEN, DEBORAH; CHESHIRE, DAVID; CONNOLLY, STEPHEN; MET) 13 February 2003 (2003-02-13) claims example 3 page 16, line 7 - page 17, line 7	1-12
X	WO 2004/043931 A (ELI LILLY AND COMPANY; BOULET, SERGE, LOUIS; FILLA, SANDRA, ANN; GALLA) 27 May 2004 (2004-05-27) claims 1,24,25	1-12
X	WO 2004/043904 A (ELI LILLY AND COMPANY; BOULET, SERGE, LOUIS; FILLA, SANDRA, ANN; GALLA) 27 May 2004 (2004-05-27) cited in the application claims 1,41,42	1-12

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 December 2005	23/12/2005

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Kollmannsberger, M

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP2005/054152

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DATABASE CAPLUS 'Online! CHEMICAL ABSTRACTS SERVICE, COLUMBUS, OHIO, US; HOFFERTH, BURT FREDERICK: "Some organometallic compounds containing reactive functional groups" XP002358683 retrieved from STN Database accession no. 1953:51365 abstract; compounds 855649-52-4, 856851-46-2, 858471-46-2 & IOWA STATE COLLEGE JOURNAL OF SCIENCE , 26, 219-21 CODEN: ISCJAF; ISSN: 0096-2783, 1952,	1-4
Y	GB 2 060 622 A (WYETH & BRO LTD JOHN) 7 May 1981 (1981-05-07) examples 3,4,8,11 claim 1 page 2, lines 7-16	1-12
Y	US 4 500 541 A (HAUSBERG ET AL) 19 February 1985 (1985-02-19) cited in the application claim 1 column 9, line 42 - column 10, line 21	1-12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2005/054152

Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. [X] Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

Although claim 12 is directed to a method of treatment of the human/animal body, the search has been carried out and based on the alleged effects of the compounds/compositions.

2. [ ] Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. [ ] Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. [ ] As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. [ ] As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. [ ] As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. [ ] No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

[ ] The additional search fees were accompanied by the applicant's protest.

[ ] No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/EP2005/054152

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 03011831 A	13-02-2003	EP 1421067 A1	26-05-2004
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