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New esters derived from substituted phenyl-cyclohexyl compounds

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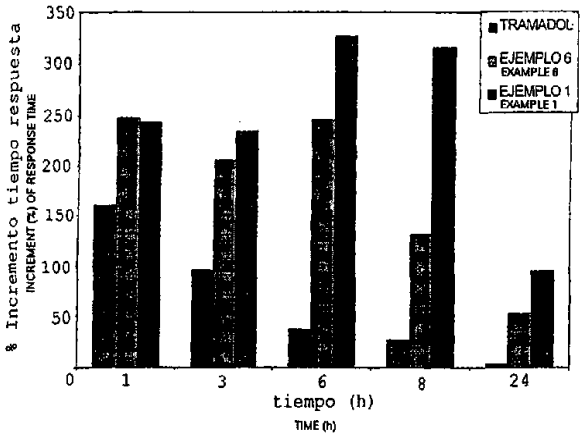
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(54) Title: NEW ESTERS DERIVED FROM SUBSTITUTED PHENYL-CYCLOHEXYL COMPOUNDS

(54) Título: NUEVOS ESTERES DERIVADOS DE COMPUESTOS FENIL-CICLOHEXIL SUSTITUIDOS



(57) Abstract

New esters derived from substituted phenyl-cyclohexyl compounds, derived from tramadol, process for obtaining such esters and use of said compounds for the fabrication of a medicament having analgesic properties. These new products having the general formula (I) have an analgesic activity which is higher than that of tramadol, a lesser toxicity and longer duration of activity.

ABSTRACT

New esters derived from substituted phenyl-cyclohexyl compounds, which are derived from Tramadol, process for obtaining them and their use for preparing a drug with analgesic properties. These new compounds of general formula (I) have a higher analgesic activity, a lower toxicity and a longer effective time period than Tramadol.

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NEW ESTERS DERIVED FROM SUBSTITUTED PHENYL-CYCLOHEXYL COMPOUNDS

DESCRIPTION

Field of the invention

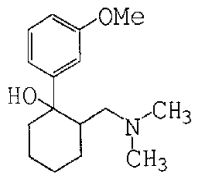
The present invention relates to new esters derived from substituted phenyl-cyclohexyl compounds, which are derived from Tramadol. The obtained compounds have a higher analgesic activity, a lower toxicity and a longer effective time period than Tramadol.

Background of the invention

The treatment of pain is of great importance in the field of medicine. The pharmacological agents presently used for the treatment of pain can be primarily classified into two large groups: opioid compounds and non-steroidal anti-inflammatories (NSAIs). The NSAIs are only useful in the case of light or moderate pain; severe pain has traditionally been treated with opiod compounds. However, these opioid compounds have several undesirable side effects, such as constipation, respiratory depression, tolerance and possibility of addiction.

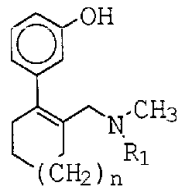
US patent 3652589 describes a type of analgesic compounds with a structure of substituted cycloalkanol phenol ethers having a basic amino group in the cycloalkyl ring. Among them the (1R, 2R or 1S, 2S)-2-[(dimethylamino)methyl]-1-(3-methoxyphenyl) cyclohexanol compound, generally known as Tramadol, is specially noted and specifically claimed in said patent.

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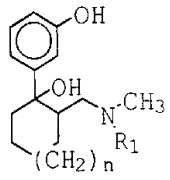
Tramadol

A series of products derived from the above, in which the dehydration in the cycloalkanol ring has occurred together with the demethylation of the methoxyl in the 3 position of the phenyl ring, of structure:



have been described in the Dutch patent NL 6610022.

This patent also describes products derived from those of said US patent, in which the methoxyl group in the 3 position of the phenyl ring has been demethylated. That is, products of structure:



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O-Demethyltramadol is included among those products described in patent NL 6610022, said product having been described as one of the metabolisation products of Tramadol (Von W. Lintz et al. *Arzneim-Forsch (Drug Res)* 31 (II); 1932-43 (1981). The analgesic activity of Tramadol is attributed to its (+) isomer (Lars Poulsen et al. *Clin. Pharmacol. Ther* (St. Louis) 1996, 60 (6), 636-644). However, there is no data as to the clinical use of the O-demethyltramadol metabolite.

More recently, in patent EP 753506, new derivatives of Tramadol have been described, which are O-demethylsubstituted, halogenated at position 1 and/or 3-cyclohexyl substituted.

Tramadol has an opioid agonist effect. However, the clinical experience with Tramadol shows that in spite of this, it does not present some of the side effects typical of the opioid agonists, such as respiratory depression (W. Vogel et al. *Arzneim. Forsch (Drug Res)* 28 (I), 183 (1978), constipation (I. Arend et al. *Arzneim. Forsch (Drug Res)* 28 (I), 199 (1978), tolerance (L. Flohe et al., Arzneim. Forsch (Drug Res) 28 (I), 213 (1978) and possibility of abuse (T. Yenagita et al., Arzneim. Forsch (Drug Res) 28 (I), 158 (1978). Some side effects specific for Tramadol have been found, which are caused when it is injected intravenously (i.v.) and quickly, such as hot flushes and sweating.

Another of the disadvantages associated with Tramadol is its short effective time period (T. Matthiesen, T. Wohrmann, T.P. Coogan, H. Uragg, "*The experimental toxicology of tramadol: an overview*", Toxicology Letters 95, 63-71, (1998).

The patent US-A-5733936 discloses some esters of 6-dimethylaminomethyl-1-phenyl-cyclohexane in the general formula of the description section with analgesic activity and low toxicity.

The object of the patent US-A-5733936 is to obtain esters, phosphonates, ethers, phenols, carbonates, carbamates, etc of derivatives of 6-dimethylaminomethyl-1-phenyl-cyclohexane, said derivatives can be substituted in the 5-position of cyclohexyl (according to the meaning of R^2 and R^3 of claims, as well as of their dehydroxylated, chlorinated, fluorinated analog compounds.

Moreover, although the patent US-A-5733936 discloses some esters of 6-dimethylaminomethyl-1-phenyl-cyclohexane, none of the examples of the patent US-A-5733936 refers to an ester of O-demethyltramadol. None of these examples includes compounds which have the tertiary OH characteristic of O-demethyltramadol. In particular, Example 13 which is the closest to the application discloses an ester of an analog of O-demethyltramadol with acetyl salicylic acid and not an ester of O-demethyltramadol. Therefore, the patent US-A-5733936 does not disclose an ester of O-demethyltramadol with the characteristic hydroxyl group in the 1-position. The patent US-A-5733936 discloses no working examples of an ester of O-demethyltramadol. The three other esters exemplified (Examples 14, 15, 16) also lack the tertiary hydroxyl group.

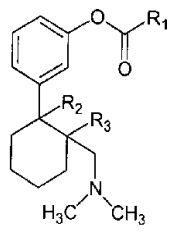
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Therefore, stability, activity and side effects data could have not been foreseen nor suggested. According to the present application a surprising effect is achieved with the compounds of formula 1.

Based on the above background of the invention, the compounds with an analgesic activity similar to or higher than that of Tramadol and with a lower toxicity and with a higher effective time period are still of interest.

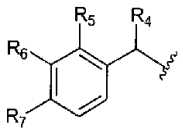
Summary of the Invention

According to a first embodiment of the invention there is provided a compound of general formula (I):

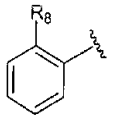


(I)

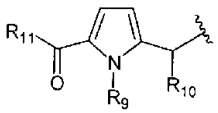
wherein R_1 is:



A



B or



C

R_2 is OH;

R_3 is H;

or R_2 and R_3 together form a double bond;

R_4 is H or C_1-C_3 alkyl;

R_5 is H, NH_2, NH-R_{11}, or O-R_{11};

R_6 is H, CO-R_{11}, O-R_{11} or halogen;

R_7 is H, C_1-C_5 alkyl, C_2-C_5 O-alkenyl, phenyl;

or R_6 and R_7 are -CH=CR_{12}-CR_{13}=CH-, forming an optionally substituted condensed aromatic ring;

R_8 is OH, -O-CO-N(CH_3)$_2$, or NH-R_{11};

R_9 and R_{10} are H or C_1-C_4 alkyl, whether equal or different, or form a -CH_2-CH_2- group;

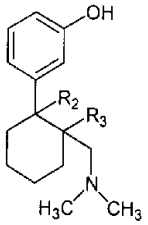
R_{11} is phenyl, phenyl optionally substituted by one or more of the following substituents: halogen (Cl, Br, I), NO_2, C_1-C_6 alkyl, C_2-C_6 alkenyl, OH, or NH_2;

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R_{12} and R_{13} are H, or C_1-C_3 O-alkyl, whether equal or different;

its salts and optical isomers.

According to a second embodiment of the invention there is provided a process for obtaining a compound according to the first embodiment of the invention, wherein a compound of formula (II) is reacted with a compound of formula (III):



(II)



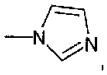
(III)

where:

R_2 = OH;

R_3 = H;

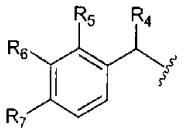
or R_2 and R_3 together form a double bond;

X = OH, halogen, , O-R_{14} or –CO-R_{15};

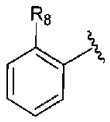
R_{14} = $C_{1\text{-}6}$ alkyl, phenyl, optionally substituted phenyl, and

R_{15} = alkyl, a phenyl ring optionally substituted by one or more substituents or a heterocyclic ring optionally substituted by one or more substituents;

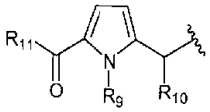
R_1 =



A



B



C

R_4 is: H or C_1-C_3 alkyl;

R_5 is: H, NH_2, NH-R_{11} or O-R_{11};

R_6 is: H, CO-R_{11}, O-R_{11} or halogen;

R_7 is: H, C_1-C_5 alkyl, C_2-C_5 O-alkenyl, phenyl, or R_6 and R_7 are –CH=CR_{12}-CR_{13}=CH-, forming an optionally substituted condensed aromatic ring;

R_8 is: OH, -O-CO-N$(CH_3)_2$ or NH-R_{11};

R_9 and R_{10} are: H or C_1-C_4 alkyl, whether equal or different, or form a -CH_2- CH_2- group,

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R_{11} is: phenyl; phenyl optionally substituted by one or more of the following substituents: halogen (Cl, Br, I), NO_2, C_1-C_6 alkyl, C_2-C_6 alkenyl, OH, or NH_2;

R_{12} and R_{13} are H, or C_1-C_3 O-alkyl, whether equal or different;

in an inert solvent, in a temperature range of -20° to 120°C, in the presence or absence of a condensation promoting agent.

According to a third embodiment of the invention there is provided the use of a compound of general formula (I) according to the first embodiment of the invention for preparing a medicament for the treatment of pain.

According to a fourth embodiment of the invention there is provided an effective amount of a compound of formula I according to the first embodiment of the invention when used for the treatment of pain.

According to a fifth embodiment of the invention there is provided a method of treating pain in a subject comprising administering to said subject an effective amount of a compound according to the first embodiment of the invention.

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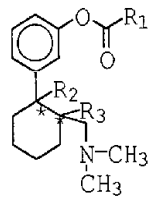
Description of the invention

The present invention relates to new esters of O-demethyltramadol or its 1,2-dehydrated derivative.

The analgesic activity of these compounds has been found to be higher than that of Tramadol with a lower toxicity and a longer effective time period when administered orally (see Figure 1).

In particular, the present invention describes and claims those products of general formula (I), its salts and optical isomers, as well as the process for obtaining them.

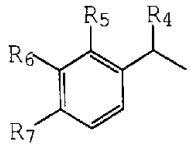
The products of the present invention are represented by the following general formula (I):



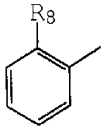
(I)

* Shows possibility of asymmetric carbons

where R_1 is:

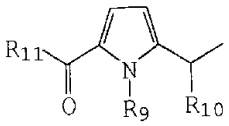


A



B

or



C

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R_2 is: OH;

R_3 is: H;

or R_2 and R_3 together form a double bond;

R_4 is: H or C_1-C_3 alkyl;

R_5 is: H, NH_2, NH-R_{11} or O-R_{11};

R_6 is: H, CO-R_{11}, O-R_{11} or halogen;

R_7 is: H, C_1-C_5 alkyl, C_2-C_5 O-alkenyl, phenyl,

or R_6 and R_7 are -CH=CR_{12}-CR_{13}=CH-, forming an optionally substituted condensed aromatic ring;

R_8 is: OH, -O-CO-$N(CH_3)_2$ or NH-R_{11};

R_9 and R_{10} are: H or C_1-C_4 alkyl, whether equal or different,

or form a -CH_2-CH_2- group;

R_{11} is: phenyl; phenyl optionally substituted by one or more of the following substituents: halogen (Cl, Br, I), NO_2, C_1-C_6 alkyl, C_2-C_6 alkenyl, OH, or NH_2;

R_{12} and R_{13} are: H, or C_1-C_3 O-alkyl, whether equal or different.

When R_1 is A, preferably, R_4 is methyl or H, R_5 is NH_2, 2,5-dichlorophenylamino or H, R_6 is substituted CO-phenyl or H, R_7 is isobutyl or H, or R_6 and R_7 form a substituted condensed aromatic ring.

More preferably, when R_1 is A, the products are:

3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenyl 2-(4-isobutyl-phenyl)-propionate

3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenyl 2-(6-methoxy-naphthalen-2-yl)-propionate

3-(2-dimethylaminomethyl-cyclohex-1-enyl)-phenyl 2-(4-isobutyl-phenyl)-propionate

3-(2-dimethylaminomethyl-cyclohex-1-enyl)-phenyl 2-(6-methoxy-naphthalen-2-yl)-propionate.

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When R_1 is B, preferably, R_8 is OH or $-O-CO-N(CH_3)_2$.

More preferably, when R_1 is B, the products are:

3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenyl 2-hydroxybenzoate

3-(2-dimethylaminomethyl-cyclohex-1-enyl)-phenyl 2-hydroxybenzoate

3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenyl 2-dimethylcarbamoyloxy-benzoate

3-(2-dimethylaminomethyl-cyclohex-1-enyl)-phenyl 2-dimethylcarbamoyloxy-benzoate.

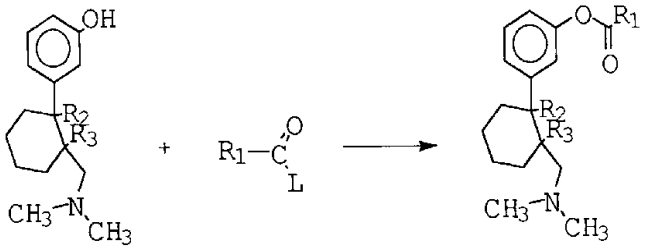
When R_1 is C, preferably, R_9 is methyl or H or forms a $-CH_2-CH_2-$ group with R_{10}. More preferably, when R_1 is C, the products are:

3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)phenyl 5-benzoyl-2,3-dihydro-1H-pyrrolizine-1-carboxylate

Description of the Methods

The compounds of general formula (I) of the present invention can be obtained by a general process which is characterised by reacting a compound of general formula (II) with the corresponding acid or acid derivative of general formula (III).

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II III I

Where R_1, R_2, R_3 have the above defined meaning, and

L = OH, halogen,  , $O-R_{14}$ or $-CO-R_{15}$,

being

R_{14} = C_{1-6} alkyl, phenyl, optionally substituted phenyl, and

R_{15} = alkyl, a phenyl ring optionally substituted by one or more substituents or a heterocyclic ring optionally substituted by one or more substituents.

Preferably L is OH or halogen.

The reaction is carried out in an inert solvent, preferably dichloromethane, tetrahydrofuran, etc., in a temperature range of -20° to 120°C, preferably a range of 0° to 35°C, and preferably in the presence of a condensation promoting agent, such as carbonyldiimidazol, dicyclohexylcarbo-diimida, etc.

The compounds of formula (II) are obtained according to the methods disclosed in the literature (NL 6610022 or Flick *et al. Arzneim. Forsch/Drug Res.* (1978), **28** (I), 107-113).

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Description of the pharmacological processes

Analgesic Activity Tests

The pharmacological activity of the products of the present invention was tested *in vivo* in several experimental models, which are known to evaluate the pain in animals.

a) Hot plate method

The method that was used is described by Eddy N.B. and Leimbach D. (J. Pharm. Exp. Ther. 107: 385-393, 1953). The analgesic effect of the products was evaluated analysing the behaviour of the animals on a hot surface at 55°C±1°C.

Male Swiss mice weighing 20-25 g were used. The compounds being tested were administered orally or intraperitoneally 1 hour o 30 minutes before starting the test, respectively.

The process consisted of placing the animals on the plate and keeping them in a Plexiglas cylinder 25 cm high and 21 cm high. The time the animals took to jump off the hot surface was determined. The animals were selected before starting the test so that those that took longer than 10 seconds to jump off were not included in the group that would receive treatment.

30 minutes after administering the product being tested, the test was repeated and the maximum time it took the animals to jump off was again recorded. Those animals that did not jump off after 60 seconds were removed from the plate to avoid any injuries and were recorded as 100% protection.

The results are expressed as the % of jump time

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increase calculated as follows:

$$\%\,jump\ time\ increase = \frac{(treated\ \ jump\ time - base\ \ jump\ time)}{base\ \ jump\ tieme} \times 100$$

In order to determine the duration of the analgesic effect of the orally administered products, the analgesic activity was evaluated on the hot plate 1, 3, 6, 8, and 24 hours after the administration of the product, as well as the control group which received treatment only with the vehicle. The base responses were evaluated at 30 and 5 minutes prior to administering the products.

b) Determination of the DL50 in the products.

(EUDRA/S/87/011, *Single Dose Toxicity,* European Directive 75/318/EEC) (ICH S4, Toxicity Studies, single dose and repeated dose, CPMP vol **III** Feb. 87, *Single dose toxicity*)

Male Swiss mice of the same batch weighing 20-25 g are used in order to estimate the acute toxicity of the products.

Prior to administering the products, the animals were forced to fast for 12 hours with no intake of food but free access to water. Several subgroups of 10 animals were randomly selected and orally given increasing doses of the products in single administration, after which they remained under observation for a period of 14 days with free access to water and food. Finally, the number of dead animals of each subgroup was quantified and the value of the DL50 was calculated (1-2).

Description of the figure

Figure 1 shows the analgesic effect on the hot plate test with mice in terms of time, expressed as percentage of increased response time with relation to the

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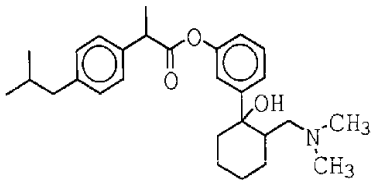
time (in hours) elapsed since the administration of the product. It is represented in grey for Tramadol, striped for compound (I) of example 6 and in black for example 1.

EXPERIMENTAL PART

1.1. Synthesis examples

EXAMPLE 1

Synthesis of 3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenyl 2-(4-isobutyl-phenyl)-propionate



0.76 g (4.8 mmol) of carbonyldiimidazol were added to 1 g (4.8 mmol) of (±)-Ibuprofen in 60 ml of dry THF. The reaction was kept at room temperature for 2 h, after which a 60% solution of 0.59 g (2.4 mmol) of (RR,SS)-3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenol previously treated with 0.1 g (2.5 mmol) of sodium hydride in mineral oil was added.

The reaction was left at room temperature for 16 h. It was concentrated to dryness and the residue was treated with 100 ml of dichloromethane and washed with 2 x 50 ml of NaOH 1N and then with 100 ml of H_2O.

The organic phase was dried and concentrated and the residue was chromatographed on silica gel. By eluting with CH_2Cl_2/EtOH 98/2 to 96/4, 0.65 g (62%) of pure product was obtained as a colourless oil.

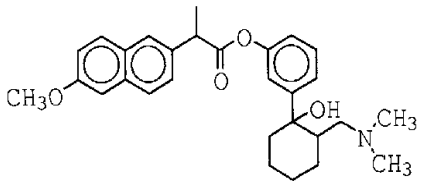
^{1}H-NMR ($CDCl_3$): 0.90 (d, 6H); 1.20-2.20 [m, 21H including

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1.6 (d, 3H) and 2.05 (s, 6H)]; 2.32-2.44 (d.d, 1H); 2.47 (d, 2H); 3.92 (c, 1H); 6.78-6.86 (m, 1H); 7.12 (d, 2H); 7.18 (s.a., 1H); 7.22-7.34 (m, 4H).

EXAMPLE 2

Synthesis of 3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenyl 2-(6-methoxy-naphthalen-2-yl)-propionate



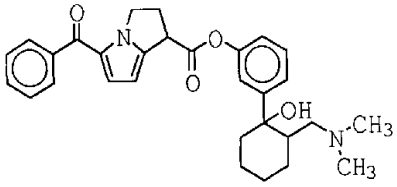
Following the process described in example 1 and substituting the (±)-Ibuprofen with (+)-6-methoxy-α-methyl-2-naphthylacetic acid (Naproxen) the title product is obtained as an oil with a 40% yield.

^{1}H-NMR ($CDCl_3$): 1.20-2.20 [m, 20 H including 1.67 (d, 3H,) and 2.06 (s, 6H]; 2.35 (dd, 1H); 3.91 (s, 3H); 4.09 (c, 1H); 6.75-6.85 (m, 1H); 7.00 (s.a., 1H); 7.15-7.35 (m, 4H); 7.50 (d.d, 1H); 7.70-7.80 (m, 3H).

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EXAMPLE 3

Synthesis of 3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenyl 5-benzoyl-2,3-dihydro-1H-pyrrolizine-1-carboxylate

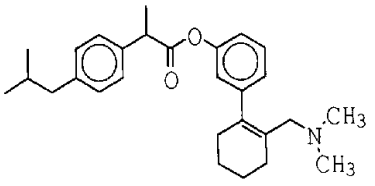


Following the process described in example 1 and substituting the (±)-Ibuprofen with (±) ketorolac (5-benzoyl-1,2-dihydro-1H-pyrrolizine-1-carboxylic acid) the title product is obtained as an oil.

^{1}H-NMR ($CDCl_3$): 1.20-2.20 (m, 17H); 2.40 (d.d, 1H); 2.80-3.10 (m, 2H); 4.28-4.72 (m, 3H); 6.26 (d, 1H); 6.87 (d, 1H); 6.90-6.98 (m, 1H); 7.30-7.60 (m, 6H); 7.78-7.88 (m, 2H)

EXAMPLE 4

Synthesis of 3-(2-dimethylaminomethyl-cyclohex-1-enyl)-phenyl 2-(4-isobutyl-phenyl)-propionate



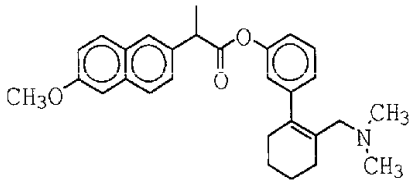
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Following the process described in example 1 and substituting the (RR,SS)-3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenol with 3-(2-dimethyl-aminomethyl-1-cyclohex-1-enyl)-phenol the title product is obtained as an oil.

^{1}H-NMR ($CDCl_3$): 0.90 (d, 6H); 1.60 (d, 3H); 1.62-1.98 (m, 4H); 2.02 (s, 6H); 2.10-2.25 (m, 4H); 2.45 (d, 2H); 2.70 (s.a., 2H); 3.92 (c, 1H); 6.70 (d, 1H); 6.82-6.90 (m, 2H); 7.12 (d, 2H); 7.20-7.32 (m, 3H).

EXAMPLE 5

Synthesis of 3-(2-dimethylaminomethyl-cyclohex-1-enyl)-phenyl 2-(6-methoxy-naphthalen-2-yl)-propionate



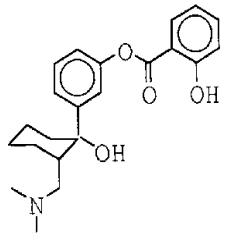
Following the process described in example 1 and substituting the (±)-Ibuprofen with (+)-6-methoxy-α-methyl-2-naphthalenacetic acid (Naproxen) and the (RR,SS)-3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenol with 3-(2-dimethylaminomethyl-cyclohex-1-enyl)-phenol the title product is obtained as an oil.

^{1}H-NMR ($CDCl_3$): 1.60-1.76 (m, 4H); 1.68 (d, 3H); 2.02 (s, 6H); 2.10-2.24 (m, 4H); 2.66 (s, 2H); 3.92 (s, 3H); 4.09 (c, 1H); 6.70 (d, 1H); 2.82-2.92 (m, 2H); 7.12-7.28 (m, 3H); 7.50 (dd, 1H); 7.70-7.78 (m, 3H).

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EXAMPLE 6

3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenyl (RR-SS)-2-hydroxybenzoate



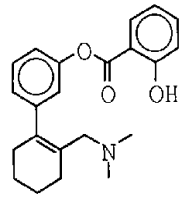
To a solution of 7.3 g (29.3 mmol) of (RR-SS)-3-(2-dimethylaminomethyl-1-hydroxycyclohexyl)-phenol and 2.6 g (32.5 mmol) of pyridine in 50 ml of CH_2Cl_2 a 5.8 g (29.3 mmol) solution of acetylsalicyloyl chloride in 50 ml of CH_2Cl_2 was added dropwise at 0°C. The mixture was kept at 0°C for 10 h, 100 ml of methanol and 100 ml of HCl 1N were added and it was kept at 25°C for 4 days. After evaporating the methanol and basifying to pH 8.5 with Na_2CO_3, it was extracted with EtOAc (3 x 50 ml). The combined organic extracts were dried ($MgSO_4$) and evaporated, and the residue was purified by silica gel chromatography, by eluting with CH_2Cl_2/MeOH/NH_4OH 1000:30:3, to obtain 1.7 g (16%) of the title compound as a yellow oil.

^{1}H-NMR ($CDCl_3$): 1.20-2.25 (m, 16H) including 2.11 (s, 6H); 2.45 (dd, 1H); 6.90-7.15 (m, 3H); 7.30-7.48 (m, 3H); 7.48-7.62 (m, 1H); 8.08 (dd, 1H); 10.55 (s, 1H, exchange with D_2O)

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EXAMPLE 7

3-(2-dimethylaminomethyl-cyclohex-1-enyl)-phenyl 2-hydroxybenzoate

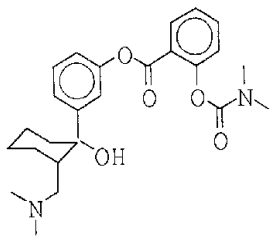


Starting from 3-(2-dimethylaminomethyl-cyclohex-1-enyl)-phenol and following the process described in example 6, the title compound was obtained as a yellow oil.

^{1}H-NMR ($CDCl_3$): 1.60-1.80 (m, 4H); 2.10 (s, 6H); 2.15-2.35 (m, 4H); 2.75 (s, 2H); 6.90-7.10 (m, 5H); 7.40 (t, 1H); 7.55 (t, 1H); 8.10 (d, 1H); 10.50 (sa, 1H, exchange with D_2O).

EXAMPLE 8

3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenyl (RR-SS)-2-dimethylcarbamoyloxy-benzoate



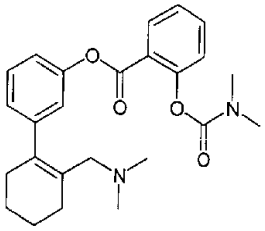
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A solution of 1.82 g (8.0 nmol) of 2-dimethylcarbamoyloxybenzoyl chloride in 25 ml of CH_2Cl_2 was added dropwise at 0°C to a solution of 1.9 g (7.7 nmol) of (RR,SS)-3-(2-dimethylaminomethyl-1-hydroxycyclohexyl)-phenol and 0.73 g (9.2 nmol) of pyridine in 50 ml of CH_2Cl_2. The mixture was maintained at 0°C for 10 h, and poured over frozen water, the phases were separated and the aqueous phase was extracted with 100 ml of CH_2Cl_2. The organic phase was dried ($MgSO_4$) and evaporated. The residue was chromatographed on silica gel by eluting with CH_2Cl_2/acetone 80:20. 570 mg (48%) of the title compound was obtained as an orange oil.

^{1}H-NMR ($CDCl_3$): 1.30-1.90 (m, 9H); 2.05 (m, 1H); 2.10 (s, 6H); 2.45 (dd, 1H); 2.95 (s, 3H); 3.05 (s, 3H); 7.00-7.10 (m, 1H); 7.20 (d, 1H); 7.30-7.40 (m, 4H); 7.60 (t, 1H); 8.15 (d, 1H).

Example 9

3-(2-Dimethylaminomethyl-cyclohex-1-enyl)-phenyl 2-dimethylcarbamoyloxy-benzoate



Starting from 925 mg (4.0 mmol) of 3-(2-dimethylaminomethyl-cyclohex-1-enyl)-phenol and following the process described in Example 8, 190 mg (32%) of the title compound was obtained as a yellow oil.

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^{1}H-NMR ($CDCl_3$): 1.70 (m, 4H); 2.07 (s, 6H); 2.10-2.30 (m, 4H); 2.75 (s, 2H); 2.95 (s, 3H); 3.10 (s, 2H); 6.90 (s, 1H); 6.95 (d, 1H); 7.05 (d, 1H); 7.20 (d, 1H); 7.30-7.45 (m, 2H); 7.65 (t, 1H); 8.20 (d, 1H).

Examples of pharmacological results

Table 1 below shows the results of the pharmacological activity of several examples of the invention product, as well as Tramadol. The results are expressed as percentage of increased response time on the hot plate test.

Table 2 shows the acute toxicity figures of Tramadol and of examples of the invention product, where the lower toxicity of the latter can be observed.

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Analgesic activity in mice of the products on the hot plate

TABLE 1

PRODUCT (15 mg/kg, intraperitoneal adm.)	% response time increase (n = 20)
Tramadol	218±98
EXAMPLE 1	568±100
EXAMPLE 2	539±50
EXAMPLE 3	416±146
EXAMPLE 4	333±134
EXAMPLE 5	356±151
EXAMPLE 6	546±63
EXAMPLE 7	634±42
EXAMPLE 8	327±65
EXAMPLE 9	465±13

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TABLE 2

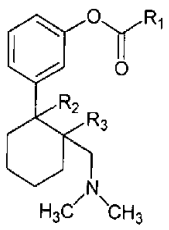
PRODUCT (20 µmol/kg, oral adm.)	**% response time increase on hot plate** (n= 20-40)	**DL50 approx. (mg/kg) Oral adm.**
TRAMADOL	87±23	350
EXAMPLE 6	248±72	550
EXAMPLE 1	210±88	900

5

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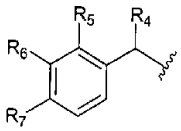
The claims defining the invention are as follows:

1. A compound of general formula (I):

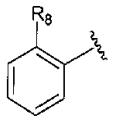


(I)

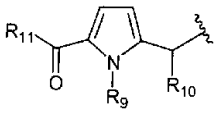
wherein R_1 is:



A



B or



C

R_2 is OH;

R_3 is H;

or R_2 and R_3 together form a double bond;

R_4 is H or C_1-C_3 alkyl;

R_5 is H, NH_2, NH-R_{11}, or O-R_{11};

R_6 is H, CO-R_{11}, O-R_{11} or halogen;

R_7 is H, C_1-C_5 alkyl, C_2-C_5 O-alkenyl, phenyl

or R_6 and R_7 are -CH=CR_{12}-CR_{13}=CH-, forming an optionally substituted condensed aromatic ring;

R_8 is OH, -O-CO-N$(CH_3)_2$, or NH-R_{11};

R_9 and R_{10} are H or C_1-C_4 alkyl, whether equal or different, or form a -CH_2-CH_2- group;

R_{11} is phenyl, phenyl optionally substituted by one or more of the following substituents: halogen (Cl, Br, I), NO_2, C_1-C_6 alkyl, C_2-C_6 alkenyl, OH, or NH_2;

R_{12} and R_{13} are H, or C_1-C_3 O-alkyl, whether equal or different;

its salts and optical isomers.

2. The compound as claimed in claim 1, wherein R_1 is A, and R_4 is methyl or H, R_5 is NH_2, 2,5-dichlorophenylamino, or H, R_6 is substituted CO-phenyl or H, R_7 is isobutyl or H, or R_6 and R_7 form a substituted condensed aromatic ring.

3. The compound as claimed in claim 1, wherein R_1 is B, and R_8 is OH or -O-CO-N$(CH_3)_2$.

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4. The compound as claimed in claim 1, wherein R_1 is C, and R_9 is methyl or H, or forms a $-CH_2-CH_2-$ group with R_{10}, and R_{11} is phenyl or tolyl.

5. The compound as claimed in claim 2, wherein said compound is selected from one of the following:

3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenyl 2-(4-isobutyl-phenyl)-propionate;

3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenyl 2-(6-methoxy-naphthalen-2-yl)-propionate;

3-(2-dimethylaminomethyl-cyclohex-1-enyl)-phenyl 2-(4-isobutyl-phenyl)-propionate;

3-(2-dimethylaminomethyl-cyclohex-1-enyl)-phenyl 2-(6-methoxy-naphthalen-2-yl)-propionate;

6. The compound as claimed in claim 3, wherein said compound is selected from one of the following:

3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenyl 2-hydroxybenzoate;

3-(2-dimethylaminomethyl-cyclohex-1-enyl)-phenyl 2-hydroxybenzoate;

3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenyl 2-dimethylcarbamoyloxy-benzoate;

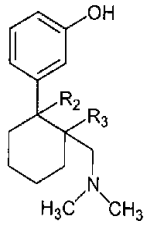
3-(2-dimethylaminomethyl-cyclohex-1-enyl)-phenyl 2-dimethylcarbamoyloxy-benzoate.

7. The compound as claimed in claim 4, wherein said compound is:

3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)phenyl 5-benzoyl-2,3-dihydro-1H-pyrrolizine-1-carboxylate.

8. Esters derived from substituted phenyl-cyclohexyl compounds substantially as hereinbefore described with reference to any one of the examples.

9. A process for obtaining a compound as claimed in claim 1, wherein a compound of formula (II) is reacted with a compound of formula (III):



(II)



(III)

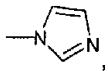
where:

R_2 = OH

R_3 = H

or R_2 and R_3 together form a double bond;

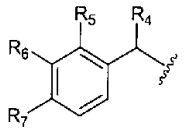
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X = OH, halogen, , O-R_{14} or –CO-R_{15}

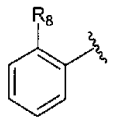
R_{14} = C_{1-6} alkyl, phenyl, optionally substituted phenyl, and

R_{15} = alkyl, a phenyl ring optionally substituted by one or more substituents or a heterocyclic ring optionally substituted by one or more substituents;

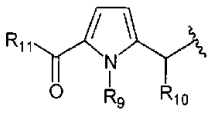
R_1 =



A



B



C

R_4 is: H or C_1-C_3 alkyl;

R_5 is: H, NH_2, NH-R_{11} or O-R_{11};

R_6 is: H, CO-R_{11}, O-R_{11} or halogen;

R_7 is: H, C_1-C_5 alkyl, C_2-C_5 O-alkenyl, phenyl, or R_6 and R_7 are –CH=CR_{12}-CR_{13}=CH-, forming an optionally substituted condensed aromatic ring;

R_8 is: OH, -O-CO-$N(CH_3)_2$ or NH-R_{11};

R_9 and R_{10} are: H or C_1-C_4 alkyl, whether equal or different,

or form a -CH_2- CH_2- group,

R_{11} is: phenyl; phenyl optionally substituted by one or more of the following substituents: halogen (Cl, Br, I), NO_2, C_1-C_6 alkyl, C_2-C_6 alkenyl, OH, or NH_2;

R_{12} and R_{13} are: H, or C_1-C_3 O-alkyl, whether equal or different;

in an inert solvent, in a temperature range of -20° to 120°C, in the presence or absence of a condensation promoting agent.

10. The process as claimed in claim 9, wherein said inert solvent is dichloromethane or tetrahydrofuran.

11. The process as claimed in claim 8, 9 or 10 wherein said condensation promoting agent is carbonyldiimidazol or dicyclohexylcarbodiimide.

12. The process as claimed in any one of claims 9 to 11 wherein said temperature range is from 0° to 35°C.

13. A process for preparing compounds of claim 1, substantially as hereinbefore described with reference to any one of the examples.

14. Esters derived from substituted phenyl-cyclohexyl compounds prepared by the process of any one of claims 9 to 13.

15. Use of a compound of general formula (I) as claimed in any one of claims 1 to 8 for preparing a medicament for the treatment of pain.

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16. An effective amount of a compound of formula I as claimed in any one of claims 1 to 8 when used for the treatment of pain in a subject.

17. A method of treating pain in a subject comprising administering to said subject an effective amount of a compound of any one of claims 1 to 8.

18. The method of claim 17 wherein the compound is administered orally.

19. The method of claim 17 or 18 wherein the subject is a human.

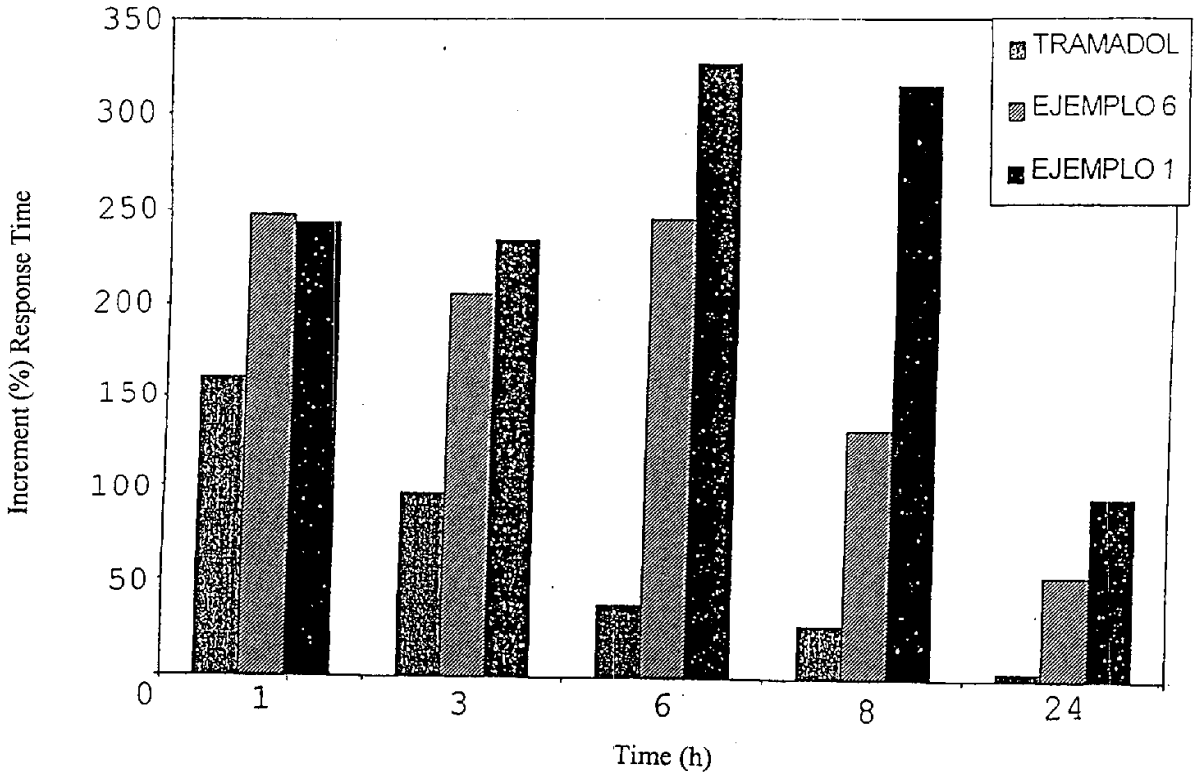
Dated 1 June, 2001

Vita-Invest, S.A.

Patent Attorneys for the Applicant/Nominated Person

SPRUSON & FERGUSON

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350
300
250
200
150
100
50
0
1
3
6
8
24
Increment (%) Response Time
Time (h)
TRAMADOL
EJEMPLO 6
EJEMPLO 1