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**NEW ESTERS DERIVED FROM (RR,SS)-3-(2-DIMETHYLAMINOMETHYL-
1-HYDROXYCYCLOHEXYL) PHENYL 2-HYDROXYBENZOATE**

Field of the invention

5 The present invention refers to new esters derived from (RR,SS)-3-(2-dimethylaminomethyl-1-hydroxycyclohexyl)phenyl 2-hydroxybenzoate, analog to Tramadol. The obtained compounds exhibit an analgesic activity higher than that of tramadol.

10 Background of the invention

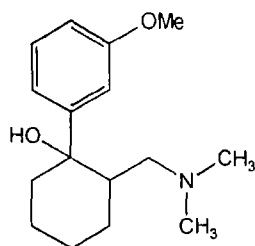
Treatment of pain is of foremost importance in the field of medicine. The pharmacological agents currently used for the treatment of pain may be included, for the most part, in two large groups: opioid compounds and
15 nonsteroidal anti-inflammatory drugs (NSAIDs). The NSAIDs are only useful in the case of light to moderate pain; severe pain has been traditionally treated with opioid compounds. However, said opioid compounds present a series of undesired side effects, such as constipation,
20 respiratory depression, and tolerance and addiction liability.

US Patent No. 3,652,589 describes a class of analgesic compounds with a structure of substituted cycloalkanol phenol ethers having an amino group of
25 alkaline character in the cycloalkyl ring. Among them, the compound (1R,2R or 1S,2S)-2-[(dimethylamino)methyl]-1-(3-methoxyphenyl)cyclohexanol, commonly known as Tramadol, may be thrown into relief, and it is specifically claimed in said patent.



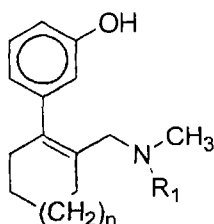
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Tramadol

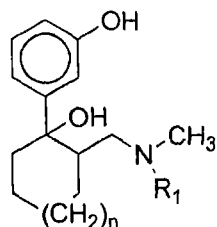
A series of products derived from the previous ones, in which dehydration in the cycloalkanol ring together with demethylation of the 3-methoxyl on the phenyl ring has taken place, having the structure:



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are disclosed in the Dutch Patent NL 6,610,022.

This patent also describes products derived from those of the aforementioned US Patent, in which the methoxyl group at the 3-position on the phenyl ring has been demethylated. Namely, products having the structure:



Among the products described in this patent O-demethyltramadol is included, which compound has been described as one of the metabolization products of Tramadol (Von W. Lintz and col. *Arzneim-Forsch (Drug Res)*)

31 (II); 1932-43 (1981). To its (+) isomer has been attributed the analgesic activity of Tramadol (Lars Poulsen and col. *Clin. Pharmacol. Ther* (St. Louis) 1996, 60 (6), 636-644). Even so, data do not exist on the 5 clinical use of the metabolite O-demethyltramadol.

More recently, in EP 753506, new O-demethylsubstituted, 1-halogenated and/or 3-cyclohexyl substituted derivatives of tramadol, have been described.

Tramadol possesses an opioid agonistic effect. 10 However, the clinical practice with Tramadol indicates that in spite of this fact, it does not possess some of the typical side effects of the opioid agonists, such as respiratory depression (W. Vogel and col. *Arzneim. Forsch (Drug Res)* 28 (I), 183 (1978)), constipation (I. Arend and 15 col., *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 specific side effects of Tramadol, caused when it is 20 rapidly injected by the intravenous route (i.v.), such as suffocations and sweating, have been detected.

Another of the drawbacks shown by Tramadol is its short duration of action (T. Matthiesen, T. Wohrmann, T.P. Coogan, H. Uragg. "The experimental toxicology of 25 tramadol: an overview", *Toxicology Letters*, 95, 63-71, (1998)).

US-5733936 discloses some esters of 6-dimethylaminomethyl-1-phenyl-cyclohexane in the general formula of the description section with analgesic activity 30 and low toxicity.

The object of US-5733936 is to obtain esters, phosphonates, ethers, phenols, carbonates, carbamates, etc. of derivatives being substituted in the 5-position of

ciclohexyl as well as of their dehydroxilated, chlorinated, fluorated analog compounds.

Moreover, although US-5733936 discloses some esters of 6-dimethylaminomethyl-1-phenyl-cyclohexane, none of the 5 examples of US-5733936 refers to an ester of O-demethyltramadol. All of the esters exemplified (Examples 13, 14, 15, 16) lack the tertiary hydroxyl group of O-demethyltramadol.

Therefore, stability, activity and side effects data 10 could have not been foreseen nor suggested. According to the present application a surprisingly effect is achieved with the compounds of formula I of the present invention.

Because of the previous backgrounds, new compounds with an improved analgesic activity still are of interest.

15 **Description of the invention**

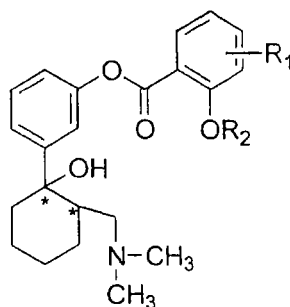
The present invention refers to new derivates of (RR,SS)-3-(2-dimethylaminomethyl-1-hydroxycyclohexyl)phenyl 2-hydroxybenzoate, analog to Tramadol.

20 The analgesic activity of these compounds has turned out to be higher than that of Tramadol.

In particular, the present invention describes and claims the products of the general formula (I), their salts and optical isomers, as well as a process for the 25 preparation thereof. The present invention also refers to the use of these compounds for the production of a medicament intended for treatment of pain.

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

5



(I)

* Indicates possibility of asymmetrical carbons

wherein:

- R₁ is halogen, unsubstituted or substituted partially or totally by halogen C₁-C₆ alkyl, OR₃, NO₂ or unsubstituted or substituted partially or totally by halogen aryl, where R₃ is C₁-C₆ alkyl.
- R₂ is H or CH₃CO-.

Preferably, R₁ is halogen, such as F, Cl, Br, halosubstituted phenyl, or hydro(C₁-C₆ fluoroalkyl).

Particularly, the preferred compounds of the present invention are:

- (RR-SS)-2-Acetoxy-4-trifluoromethyl-benzoic acid 3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenyl ester
- 15 - (RR-SS)-2-Hydroxy-4-trifluoromethyl-benzoic acid 3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenyl ester
- (RR-SS)-4-Chloro-2-hydroxy-benzoic acid 3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenyl ester
- (RR-SS)-2-Hydroxy-4-methyl-benzoic acid 3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenyl ester
- 20 - (RR-SS)-2-Hydroxy-4-methoxy-benzoic acid 3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenyl ester
- (RR-SS)-2-Hydroxy-5-nitro-benzoic acid 3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenyl ester
- 25 - (RR-SS)-2',4'-Difluoro-3-hydroxy-biphenyl-4-carboxylic

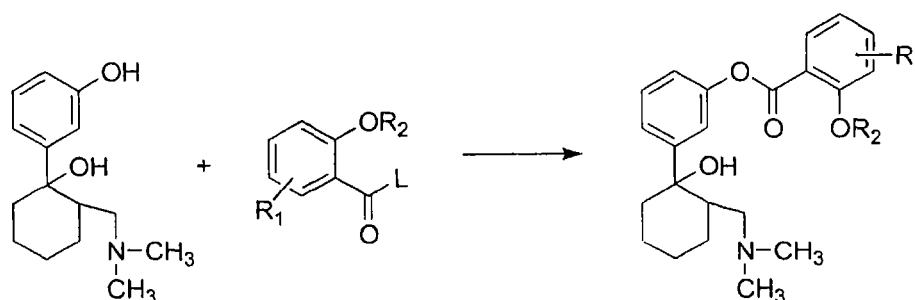
acid 3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-
phenyl ester

The compounds of general formula (I) may be obtained
5 by means of the following procedures, also within the
scope of the present invention.

DESCRIPTION OF THE METHODS

METHOD A

The compounds of general formula (I) of the present
10 invention may be obtained by means of a general procedure
characterized in reacting a compound of the formula (II)
with the corresponding acid or acid derivate of the
general formula (III):



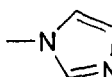
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(II)

(III)

(I)

wherein R₁ and R₂ have the above defined meaning, and

L = OH, halogen, , O-R₄ or -CO-R₅,

where

R₄ = C₁-C₆ alkyl, phenyl, optionally substituted phenyl,
20 and

R₅ = Alkyl, a phenyl ring optionally substituted with one
or more substituents, or a heterocyclic ring optionally
substituted with one or more substituents.

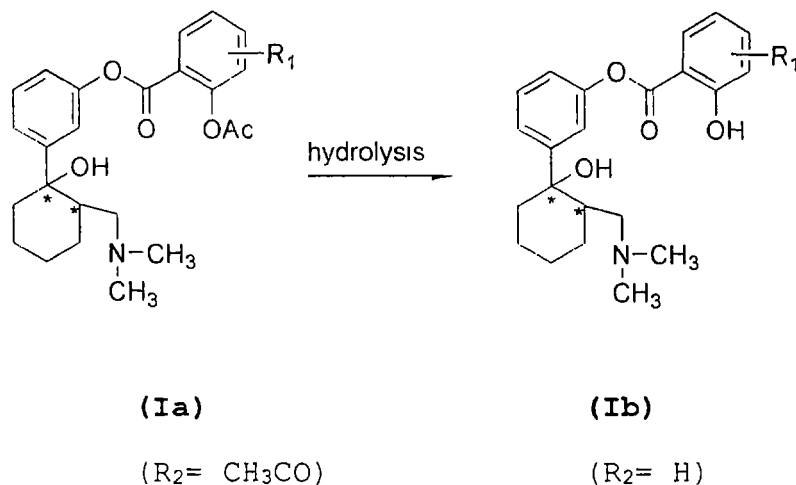
Preferably, L is OH or halogen.

The reaction is carried out in an inert solvent, such as dichloromethane, tetrahydrofuran, acetonitrile, 1,2-dichloroethane, ethyl acetate, dimethoxyethane or dioxane, preferably dichloromethane or tetrahydrofuran, at 5 temperatures ranging from -20°C to 120°C, preferably from 0°C to 35°C, to obtain compounds of higher purity, and preferably in the presence of a condensation promoting agent to accelerate the reaction, such as carbonyldiimidazole, dicyclohexylcarbodiimide, 10 triethylamine ethylchloroformate, triethylamine benzotriazoletosylate or diethylchlorophosphate, preferably carbonyldiimidazole or dicyclohexylcarbodiimide.

The compounds of formula (II) are obtained according 15 to the methods described in the literature (NL 6610022 or Flick et al., *Arzneim. Forsch/Drug Res.* (1978), **28** (I), 107-113).

METHOD B

This method consists in subjecting a compound of 20 general formula (Ia) wherein $R_2 = CH_3CO$ to a hydrolysis reaction in an acidic medium to obtain a compound of general formula (Ib) in which $R_2 = H$:



5 wherein R_1 has the above defined meaning.

Next, the methods used for ascertaining the pharmacological activity of the compounds are described.

Analgesic activity assays

Hot-plate method

10 The method used is the one described by Eddy N.B. and Leimbach D. (J. Pharm. Exp. Ther. **107**: 385-393, 1953). The analgesic effect of the products was assessed by analyzing the behavior of animals on a hot surface maintained at $55^\circ\text{C} \pm 1^\circ\text{C}$.

15 Male Swiss mice weighing 20-25 g were used. The test compounds were administered, by the oral route, 1 hour before beginning the test.

The method consisted in placing the animals on a hot plate, while maintaining them in a 25 cm diameter and 21 cm height Plexiglas cylinder, and determining the time that they take in jumping off the hot surface. The animals were selected before the beginning of the test so that those animals that remained more than 10 seconds without jumping were not included in the group that would receive 25 treatment.

After the administration of the product under study, the test was repeated, the maximal permanence time on the hot plate being measured yet again. Those animals that did not jump lapsed 60 seconds were removed from the plate in order to avoid damage to the animal, and they were taken as being 100% protected.

The results were expressed as percent increment in the time (t) of jump, which was calculated as follows:

$$10 \% \text{ increm. } t \text{ jump} = \frac{(t \text{ jump treated} - t \text{ jump basal})}{t \text{ jump basal}} \times 100$$

It is an object of the present invention the use of the compound of the general formula (I) for the production of a medicament intended for the treatment of pain. Likewise, it is also an object of the present invention a pharmaceutical composition, which comprises said compound of the general formula (I) together with a pharmaceutically acceptable excipient, for the treatment of pain.

20 **EXPERIMENTAL. -**

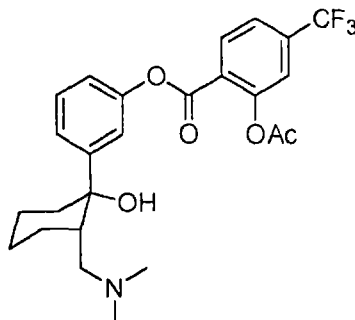
Next, the following illustrative examples are set forth, but they are not to be construed as limitative of the scope of the invention:

SYNTHESIS EXAMPLES.

Example N° 1

(RR-SS)-2-Acetoxy-4-trifluoromethyl-benzoic acid 3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenyl ester

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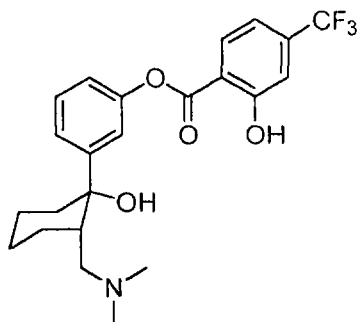
To a solution of 15.0 g (60.5 mmol) 4-trifluoromethylacetylsalicylic acid in 150 ml anhydrous tetrahydrofuran 9.3 g (57.4 mmol) carbonyldiimidazole was added, at room temperature, under an inert atmosphere. After thirty minutes, 13.1 g (52.6 mmol) 3-(2-dimethylaminomethyl-1-hydroxycyclohexyl)phenol was added. The resulting solution was maintained at room temperature for 3 days. The mixture was added onto a NaHCO₃ aqueous solution at pH 8 and it was extracted with dichloromethane (3 x 50 ml). The pooled organic extracts were dried over Na₂SO₄, filtered and concentrated at reduced pressure to give a residue which was purified by column chromatography on silica gel (eluent: 9:1 dichloromethane / acetone and increasing amounts of acetone), whereby yielding 20 g of the title compound as an oil.

¹H-NMR (CDCl₃): 1.20-2.25 (m, 16H) including a 2.15 (s, 6H); 2.30 (s, 3H), 2.45 (dd, 1H); 7.08 (m, 1H); 7.15-7.50 (m, 5H); 8.35 (m, 1H).

Example N° 2

(RR-SS)-2-Hydroxy-4-trifluoromethyl-benzoic acid 3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenyl ester

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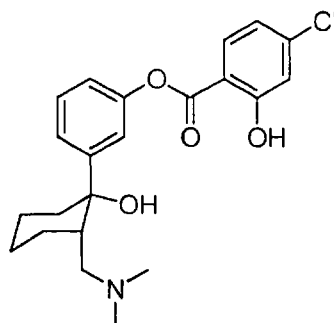
The compound of Example 1 was dissolved in 600 ml isopropanol and 25 ml 35% hydrochloric acid. The resulting solution was stirred for 16 hours at 40°C. The isopropanol was evaporated, the residue was dissolved in 100 ml dichloromethane, and it was added onto 100 ml of a NaHCO₃ aqueous solution at pH 8. Extraction of the product was carried out, and the aqueous phase was washed with fresh dichloromethane portions (2 x 50 ml). The pooled organic extracts were dried over Na₂SO₄, then filtered and concentrated at reduced pressure. The resultant crude product was purified by column chromatography on silica gel (eluent: dichloromethane / acetone 9:1 and increasing amounts of acetone), whereby 12.4 g (57%) of the title compound were obtained as a white foam.

25 ¹H-NMR(CDCl₃): 1.20-2.30 (m, 16H) including a 2.15 (s, 6H); 2.45 (dd, 1H); 7.08 (m, 1H); 7.15-7.35 (m, 2H); 7.45 (m, 3H); 8.20 (m, 1H); 10.50 (br. s, 1H).

Example N° 3

(RR-SS)-4-Chloro-2-hydroxy-benzoic acid 3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenyl ester

5



10 To a solution of 10.0 g (58.0 mmol) 4-chlorosalicylic acid in 150 ml anhydrous tetrahydrofuran 8.9 g (54.9 mmol) carbonyldiimidazole was added at room temperature and under an inert atmosphere. After thirty minutes, 12.6 g (50.6 mmol) 3-(2-dimethylaminomethyl-1-hydroxycyclohexyl)phenol was added. The resulting solution was maintained at room temperature for 3 days. The mixture was added onto a NaHCO₃ aqueous solution at pH 8, and it was extracted with dichloromethane (3 x 50 ml). The pooled organic extracts were dried over Na₂SO₄, then filtered and 20 concentrated at reduced pressure. The resulting residue was purified by column chromatography on silica gel (eluent: dichloromethane / acetone 9:1 and increasing amounts of acetone), whereby 12.2 g (66%) of the title compound as a white foam were obtained.

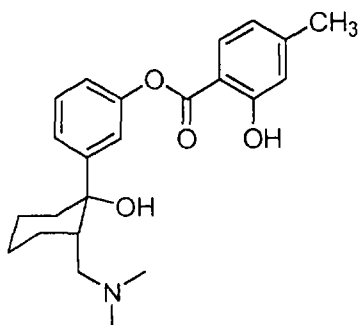
25 ¹H-NMR(CDCl₃): 1.20-2.20 (m, 16H) including a 2.12 (s, 6H); 2.45 (dd, 1H); 6.95 (dd, 1H); 7.05 (m, 2H); 7.43 (m, 3H); 8.05 (d, 1H); 10.60 (br. s, 1H).

Example N° 4

(RR-SS)-2-Hydroxy-4-methyl-benzoic acid 3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenyl ester

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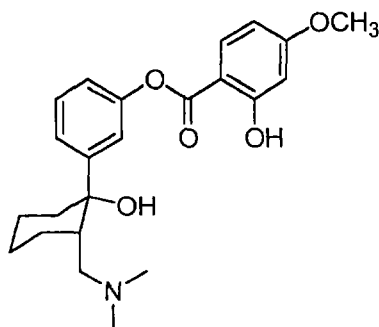
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Operating in a similar way to that described to prepare the compound of Example 3 and starting from 10.0 g (65.7 mmol) 4-methylsalicylic acid, 10.0 g (61.7 mmol) carbonyldiimidazole, 14.3 g (57.4 mmol) 3-(2-dimethylaminomethyl-1-hydroxycyclohexyl)phenol and 165 ml anhydrous tetrahydrofuran, and after column chromatography on silica gel (eluent: 9:1 dichloromethane / acetone and increasing amounts of acetone), 14.6 g (66%) of the title compound was obtained as a white foam.

$^1\text{H-NMR}$ (CDCl_3): 1.20-2.60 (m, 20H) including a 2.15 (s, 6H) and a 2.20 (s, 3H); 6.80 (m, 2H); 7.05 (m, 1H); 7.45 (m, 3H); 7.95 (d, 1H); 10.55 (s, 1H).

Example N° 5

20 **(RR-SS)-2-Hydroxy-4-methoxy-benzoic acid 3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenyl ester**



25

Operating in a similar way to that described to prepare the compound of Example 3 and starting from 10.0 g (59.5 mmol) 4-methoxysalicylic acid, 9.1 g (56.2 mmol)

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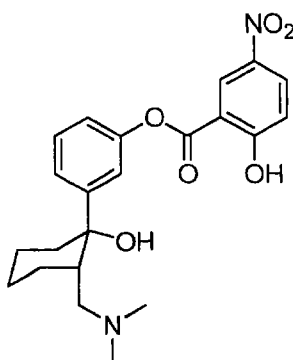
carbonyldiimidazole, 12.9 g (51.8 mmol) 3-(2-dimethylaminomethyl-1-hydroxycyclohexyl)phenol and 150 ml anhydrous tetrahydrofuran, and after column chromatography on silica gel (eluent: 9:1 dichloromethane / acetone and increasing amounts of acetone), 13.7 g (66%) of the title compound was obtained as a white foam.

$^1\text{H-NMR}(\text{CDCl}_3)$: 1.20-2.30 (m, 16H) including a 2.15 (s, 6H); 2.45 (dd, 1H); 3.85 (s, 3H); 6.55 (m, 2H); 7.07 (m, 1H); 7.40 (m, 3H); 7.95 (d, 1H); 10.75 (s, 1H).

10 **Example N° 6**

(RR-SS)-2-Hydroxy-5-nitro-benzoic acid 3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenyl ester

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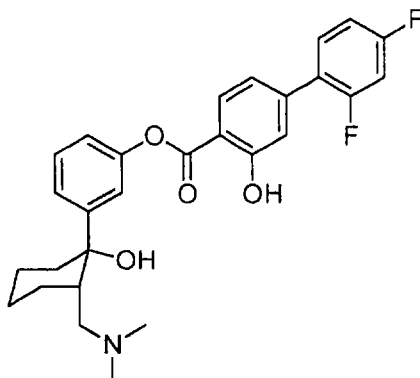


Operating in a similar way to that described to prepare the compound of Example 3 and starting from 10.0 g (54.6 mmol) 5-nitrosalicylic acid, 8.3 g (51.2 mmol) carbonyldiimidazole, 11.9 g (47.8 mmol) 3-(2-dimethylaminomethyl-1-hydroxycyclohexyl)phenol and 135 ml anhydrous tetrahydrofuran, and after column chromatography on silica gel (eluent: 1:1 dichloromethane / acetone and increasing amounts of acetone), 326 mg (2%) of the title compound was obtained as a yellow solid.

$^1\text{H-NMR}(\text{CDCl}_3)$: 1.20-2,30 (m, 16H) including at 2,15 (s, 6H); 2.45 (dd, 1H); 7.00-7.25 (m, 2H); 7.45 (m, 3H); 8.40 (dd, 1H); 9.05 (d, 1H).

Example N° 7

(RR-SS)-2',4'-Difluoro-3-hydroxy-biphenyl-4-carboxylic acid 3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenyl ester



Operating in a similar way to that described in Example 3 and starting from 5.0 g 2',4'-difluoro-3-hydroxy-biphenyl-4-carboxylic acid, 3.5 g carbonyldiimidazole, 5.0 g 3-(2-dimethylaminomethyl-1-hydroxycyclohexyl)phenol and 50 ml anhydrous tetrahydrofuran, and after column chromatography on silica gel, 4,1 g of the title compound was obtained as a white foam.

$^1\text{H-NMR}$ (CDCl_3): 1.20-2.30 (m, 16H) including at 2.15 (s, 20 6H); 2.45 (dd, 1H); 6.85-7.55 (m, 9H); 7.70 (m, 1H); 8.22 (d, 1H); 10.60 (br. s, 1H).

Pharmacological results

In the following Table 1, the pharmacological activity results for several examples of the product of 25 the invention are shown, as well as for Tramadol. The results are expressed as percent increment in the response time in the hot plate test.

As it can be seen, the compounds of the invention present activities up to three times higher than that of 30 tramadol.

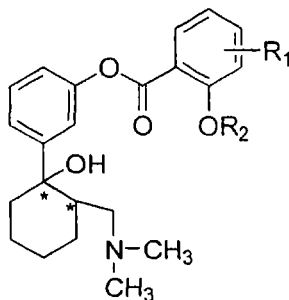
Analgesic activity of the products
in the hot plate test in mice

TABLE 1

PRODUCT 80 μ mol/kg p.o.	Percent increment response time
<i>Tramadol</i>	218
EXAMPLE 1	710
EXAMPLE 2	724
EXAMPLE 3	400
EXAMPLE 4	525
EXAMPLE 5	688
EXAMPLE 6	661
EXAMPLE 7	686

CLAIMS

1. A compound of general formula (I):



(I)

wherein:

- R₁ is halogen, unsubstituted or substituted partially or totally by halogen C₁-C₆ alkyl, OR₃, NO₂ or unsubstituted or substituted partially or totally by halogen aryl, where R₃ is C₁-C₆ alkyl,

- R₂ is H or CH₃CO-;

and the salts and optical isomers thereof.

2. A compound according to claim 1, characterized in that R₁ is halogen, such as F, Cl, Br, halosubstituted phenyl or hydro(C₁-C₆ fluoroalkyl).

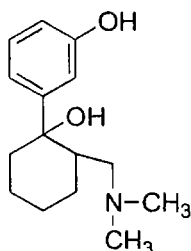
3. A compound according to claim 1, characterized in that it is selected from one of the following:

- (RR-SS)-2-Acetoxy-4-trifluoromethyl-benzoic acid 3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenyl ester
- 20 - (RR-SS)-2-Hydroxy-4-trifluoromethyl-benzoic acid 3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenyl ester
- (RR-SS)-4-Chloro-2-hydroxy-benzoic acid 3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenyl ester

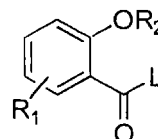
- (RR-SS)-2-Hydroxy-4-methyl-benzoic acid 3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenyl ester
- (RR-SS)-2-Hydroxy-4-methoxy-benzoic acid 3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenyl ester
- 5 - (RR-SS)-2-Hydroxy-5-nitro-benzoic acid 3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenyl ester
- (RR-SS)-2',4'-Difluoro-3-hydroxy-biphenyl-4-carboxylic acid 3-(2-dimethylaminomethyl-1-hydroxy-cyclohexyl)-phenyl ester.

10

4. A process for obtaining a compound of general formula (I) as claimed in claim 1, characterized in that a compound of formula (II) is reacted with a compound of general formula (III):



II

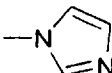


III

15

wherein:

R₁ y R₂ have the same meaning as above, and

L = OH, halogen, , O-R₄ or -CO-R₅,

20

where

R₄ = C₁-C₆ alkyl, phenyl, optionally substituted phenyl, and

R₅ = Alkyl, a phenyl ring optionally substituted with one or more substituents, or a heterocyclic ring optionally substituted with one or more substituents, in an inert solvent, at temperatures ranging from -20°C to 120°C.

25

5. A process according to claim 4, characterized in that a condensation promoting agent is added.
6. A process according to claim 4, characterized in that said inert solvent is selected from dichloromethane, tetrahydrofuran, acetonitrile, 1,2-dichloroethane, ethyl acetate, dimethoxyethane or dioxane, preferably dichloromethane or tetrahydrofuran.
7. A process according to claim 5, characterized in that said condensation promoting agent is selected from carbonyldiimidazole, dicyclohexylcarbodiimide, triethylamine ethylchloroformate, triethylamine benzotriazoletosylate or diethylchlorophosphate, preferably carbonyldiimidazole or dicyclohexylcarbodiimide.
8. A process according to claim 4, characterized in that said temperature range is from 0° and 35°C.
9. The use of a compound of general formula (I) according to any of claims 1 to 3, for the production of a medicament for the treatment of pain.
10. A pharmaceutical composition, which comprises a compound of general formula (I) according to any of claims 1 to 3 and a pharmaceutically acceptable excipient, for the treatment of pain.