

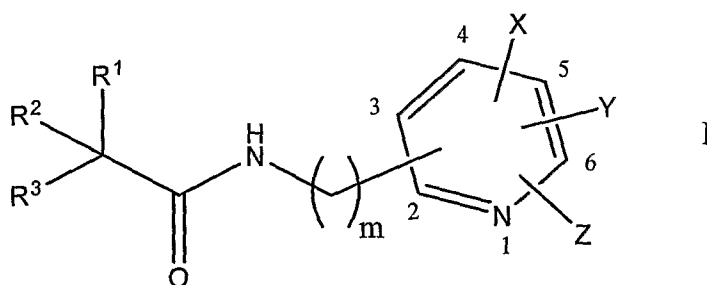
AMIDE ADDITION REACTION

This disclosure relates to the addition of carboxamides to vinyl pyridines.

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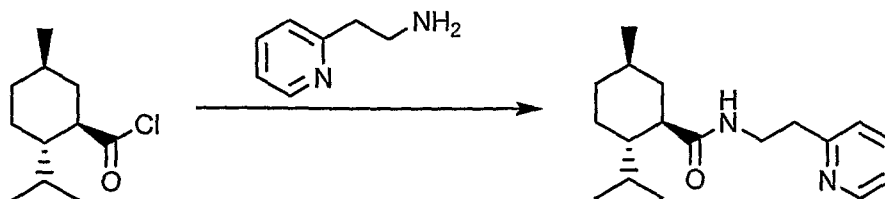
N-substituted p-menthane carboxamides are well known in the art as compounds that impart a cooling sensation to the skin or the mucous membranes of the body. Typical examples of such compounds are described in, for example, British Patent GB 1,421,744

10 In International Application PCT/CH2006/000427 there are disclosed compounds of the general formula I



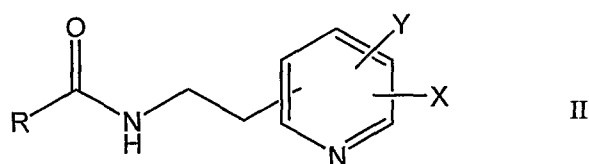
in which X, Y, Z, R¹, R², R³ and m are as defined in that document. In particular examples, at least two of R¹, R², R³ together form a cyclic radical.

15 These compounds have usually been prepared by the reaction of a menthane carboxylic acid chloride with a suitable monoamine. One example of this is the following reaction:

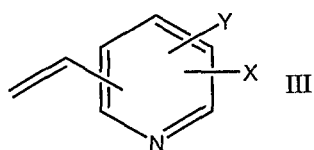


20 Although efficient, this reaction involves the use of expensive materials.

It has now been found that it is possible to prepare such compounds by a simple, inexpensive process. There is therefore provided a method of making a compound of formula II



comprising the reaction of a compound of the formula RCONH₂ with a compound of formula III



R being a moiety having between 1 and 15 carbon atoms and optionally from 1 to 5 heteroatoms independently selected from oxygen, nitrogen and sulfur, and X and Y being independently selected from the group consisting of H, methyl (Me), ethyl (Et), OMe, OEt and mixtures thereof;

the reaction being performed in a solvent in the presence of a base.

There is also provided a compound of the formula II as hereinabove defined, preparable by a process as hereinabove defined.

The compounds of Formula III are vinyl pyridines, optionally substituted. Either the 2- or the 4-vinyl pyridine or derivatives thereof may be used.

The solvent may be any suitable solvent. It may be capable of dissolving all the reactants and the reaction product. Useful solvents include oxygen- and nitrogen-containing non-reactive solvents and aromatic hydrocarbons. Non-limiting examples of solvents include xylene, toluene, dimethyl formamide and tetrahydrofuran (THF).

The quantity of solvent present is any suitable quantity.

The base for use in the process may be any suitable base. Typical examples of suitable bases include sodium methoxide, potassium *tert*-butoxide, lithium diisopropyl amine,

sodium hydride, sodium hydroxide and potassium hydroxide. A acceptable concentration range is from about 0.01 to about 0.5 equivalents.

Particular examples of bases include sodium hydroxide, potassium hydroxide and potassium *tert*-butoxide. These may be used at concentration ranges of from about 0.05 to about 0.25 equivalents.

In particular embodiments involving the use of sodium or potassium bases, the mixture may comprise a chelating agent. This permits higher yields and faster reaction times. Examples of suitable chelating agents include crown ethers, such as 18-crown-6, particularly in combination with bases such as potassium hydroxide and potassium *tert*-butoxide.

Alternatively, the solvent itself may be selected such that it has chelating properties. If such solvents are used, a separate chelating agent may be used in a reduced quantity or even omitted altogether. Solvents that are useful in this regard include dimethyl formamide (DMF), N-methylpyrrolidone (NMP). Combinations of all or any these solvents may be used in any desired proportions.

In a particular embodiment, the reaction is heated or performed under pressure, for example, in a bomb or in a sealed microwave vessel. While it is generally not essential to do this, the use of such measures can lead to higher yields and faster reaction times. A particular temperature range for heating is at least about 50°C, more particularly from about 100° to about 200°C. Naturally, the use of higher temperatures will have an effect on the selection of solvent, but the skilled person will be able to select suitable solvents for each case.

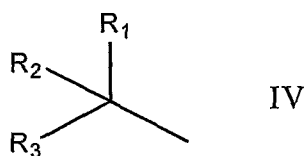
Particular embodiments of the compound are those in which R is selected according to the description hereinafter provided.

In particular embodiments, R is selected from arylalkenyl, heteroarylalkenyl, arylalkyl, heteroarylalkyl, alkyl, alkoxy-alkyl, alkenyl, cycloalkyl, cycloalkenyl, aryl and heteroaryl moieties, and mixtures thereof.

Particular examples of R include (but are not limited to) 2,4-dimethylpent-3-yl, 2,3,4-dimethylpent-3-yl, adamantyl and 2-isopropyl-5-methyl-cyclohexyl-1-yl (in particular embodiments, the (1R, 2S, 5R) form).

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In a certain embodiment, the process is particularly useful for producing the compounds of International Application PCT/CH2006/000427 hereinabove described. In such a case, R is a moiety of formula IV



in which R₁, R₂ and R₃ together comprise at least 6 carbons, and are selected such that

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- (a) (i) R₁ is selected from the group consisting of H, Me, Et, isopropyl and C₄-C₅ branched alkyl; and
- (ii) R₂ and R₃ are independently selected from the group consisting of Me, Et, isopropyl and C₄-branched alkyl; or
- (b) any two or all of R₁, R₂ and R₃ together form a monocyclic, bicyclic or tricyclic radical having up to 10 carbons.

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Examples of cyclic radicals as described under (b) above include 3-para-menthyl, bornyl and adamantyl.

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A particular example of Formula IV is 2-isopropyl-5-methyl-cyclohexyl-1-yl (in a particular embodiment, the (1R, 2S, 5R) variant).

The method is now described with reference to the following non-limiting examples.

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Example 1**Preparation of N-(2-pyridin-2-ylethyl) p-menthanecarboxamide [(1R,2S,5R)-2-isopropyl-5-methyl-N-(2-(pyridin-2-yl)ethyl)cyclohexanecarboxamide]:**

- 5 In a 15mL round bottom flask, fitted with magnetic stirrer and reflux condensor, 0.368g of p-menthanecarboxamide, 4mL of toluene, 0.32mL of 2-vinyl pyridine, 0.027g of 18-crown-6 and 0.12mL of potassium *tert*-butoxide (20% in THF) were added. The mixture was heated at 110°C for 3 hours, yielding 97% conversion by GC.

10 **Example 2**

Preparation of N-(2-pyridin-2-ylethyl) p-menthanecarboxamide [(1R,2S,5R)-2-isopropyl-5-methyl-N-(2-(pyridin-2-yl)ethyl)cyclohexanecarboxamide]:

- 15 In a 5mL Biotage microwave vial, fitted with magnetic stirrer, 0.1g of p-menthanecarboxamide, 0.55mL of toluene, 0.45mL of NMP, 0.086g of 2-vinyl pyridine and 3.1mg of KOH were added. The vial was sealed and heated in the Biotage microwave instrument at 150°C for 10min, yielding 90.9% conversion by GC.

Example 3

- 20 **Preparation of N-(2-pyridin-2-ylethyl) p-menthanecarboxamide [(1R,2S,5R)-2-isopropyl-5-methyl-N-(2-(pyridin-2-yl)ethyl)cyclohexanecarboxamide]:**

- 25 In a 5mL Biotage microwave vial, fitted with magnetic stirrer, 0.1g of p-menthanecarboxamide, 1.0mL of THF, 0.086g of 2-vinyl pyridine and 0.1 eq. of potassium *tert*-butoxide (KOtBu) (20% in THF) were added. The vial was sealed and heated in the Biotage microwave instrument at 160°C for 20min, yielding 88% conversion by GC.

Example 4**Preparation of N-(2-pyridin-2-ylethyl) p-menthanecarboxamide [(1R,2S,5R)-2-isopropyl-5-methyl-N-(2-(pyridin-2-yl)ethyl)cyclohexanecarboxamide]:**

- 5 In a 5mL Biotage microwave vial, fitted with magnetic stirrer, 0.1g of p-menthanecarboxamide, 1.0mL of NMP, 0.086g of 2-vinyl pyridine and 0.1 eq. of KOtBu (20% in THF) were added. The vial was sealed and heated in the Biotage microwave instrument at 150°C for 10min, yielding 95.3% conversion by GC.

10 **Example 5**

Preparation of N-(2-pyridin-2-ylethyl) p-menthanecarboxamide [(1R,2S,5R)-2-isopropyl-5-methyl-N-(2-(pyridin-2-yl)ethyl)cyclohexanecarboxamide]:

- 15 In a 5mL Biotage microwave vial, fitted with magnetic stirrer, 0.1g of p-menthanecarboxamide, 1.0mL of NMP, 0.086g of 2-vinyl pyridine and 2.2mg of NaOH were added. The vial was sealed and heated in the Biotage microwave instrument at 150°C for 10min, yielding 85.7% conversion by GC.

Example 6

- 20 **Preparation of N-(2-pyridin-2-ylethyl) p-menthanecarboxamide [(1R,2S,5R)-2-isopropyl-5-methyl-N-(2-(pyridin-2-yl)ethyl)cyclohexanecarboxamide]:**

- 25 In a 5mL Biotage microwave vial, fitted with magnetic stirrer, 0.1g of p-menthanecarboxamide, 0.05mL of NMP, 0.95mL of toluene, 0.082mL of 2-vinyl pyridine and 3.1mg of KOH were added. The vial was sealed and heated in the Biotage microwave instrument at 150°C for 10min, yielding 74.6% conversion by GC.

Example 7**Preparation of N-(2-pyridin-2-ylethyl) p-menthanecarboxamide [(1R,2S,5R)-2-isopropyl-5-methyl-N-(2-(pyridin-2-yl)ethyl)cyclohexanecarboxamide]:**

5 In a 100mL round bottom flask, fitted with magnetic stirrer and reflux stirrer, 5.0g of p-menthanecarboxamide, 10mL of NMP, and 150mg of KOH were added. The mixture was heated for 1hour at 120°C.

The mixture was cooled to room temperature and 60mL of water were added slowly under stirring, while crystals separated from the mixture. The mixture was cooled to
10 0°C, filtered and the crystals were washed times with ice cold water. The crude product was re-crystallized from ethyl acetate and hexane, yielding 3.96g of white crystals (50% yield).

MS: 288 ($[M^{+}]$), 273, 245, 149, 121, 95

¹H NMR (300 MHz; DMSO) δ : 8.53 (d, 1H), 7.62 (td, 1H), 7.16 (m, 2H), 6.43 (s, 1H),
15 3.67 (nontuplet, 2H), 3.00 (t, 2H), 1.95 (td, 1H), 1.84-1.53 (m, 4H), 1.47 (broad t, 1H), 1.4-1.1 (m, 2H), 0.87 (d, 3H), 0.84 (d,3H), 0.66 (d, 3H)

¹³C NMR (75 MHz; DMSO) δ : 175.8, 159.7, 148.9, 136.7, 123.6, 121.55, 49.8, 44.3, 39.4, 38.35, 36.9, 34.6, 32.3, 28.55, 23.9, 22.3, 21.3, 15.95

20 **Example 8**

Preparation of N-(4-pyridin-2-ylethyl) p-menthanecarboxamide [(1R,2S,5R)-2-isopropyl-5-methyl-N-(2-(pyridin-4-yl)ethyl)cyclohexanecarboxamide]:

In a 5mL Biotage microwave vial, fitted with magnetic stirrer, 0.1g of p-
25 menthanecarboxamide, 1mL of NMP, 0.082mL of 4-vinyl pyridine and 3.1mg of KOH were added. The vial was sealed and heated in the Biotage microwave instrument at 150°C for 10min, yielding 54% conversion by GC.

MS: 260 ($[M^{+}]$), 217, 149, 121, 95

Example 9**Preparation of 2-isopropyl-2,3-dimethyl-N-(2-(pyridin-2-yl)ethyl)butanamide:**

In a 20mL Biotage microwave vial, fitted with magnetic stirrer, 1.0g of 2-isopropyl-2,3-dimethylbutanamide, 10mL of toluene, 1.0g of 2-vinyl pyridine, 0.027g of 18-crown-6 and 0.18g of potassium *tert*-butoxide (20% in THF) were added. The vial was sealed and heated in the Biotage microwave instrument at 200°C for 30min.

The mixture was acidified with 100mL of HCl (1N in water) and 2 times extracted with MTBE. The aqueous layer was treated with 150mL of NaOH (1N in water) and extracted 2 times with MTBE. The organic layer was dried over magnesium sulfate, concentrated and purified by column chromatography. 1.17g of white crystals were obtained (70% yield).

Mp: 60-61°C

MS: 262 ([M+]), 220, 205, 149, 121, 106, 93

¹H NMR (300 MHz; CDCl₃) 8.53 (d, 1H), 7.63 (t, 1H), 7.16 (m, 2H), 6.69 (s, 1H), 3.67 (dd, 2H), 2.99 (t, 2H), 1.96 (m, 2H), 0.96 (s, 3H), 0.85 (d, 6H), 0.79 (d, 6H)
¹³C (75MHz; CDCl₃) 175.6, 160.0, 149.1, 136.6, 123.4, 121.5, 51.4, 38.4, 36.9, 32.6, 18.1, 17.4, 14.1

Example 10**Preparation of 2-phenyl-N-(2-(pyridin-2-yl)ethyl)butanamide:**

In a 10mL Biotage microwave vial, fitted with magnetic stirrer, 2.5g of 2-phenylbutyramide, 3mL of NMP, 1.6g of 2-vinyl pyridine, 0.1g of KOH were added. The vial was sealed and heated in the Biotage microwave instrument at 150°C for 10min.

The mixture poured on ice, the pH was adjusted with NaOH (1N in water) to pH 12 and extracted with MTBE. The organic layer was washed with brine, dried over magnesium sulfate, concentrated and purified by column chromatography. 2.3g of beige oil were obtained (56% yield).

MS: 266 ([M+]), 253, 240, 149, 121, 106, 91, 78, 65

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¹H NMR (300 MHz; CDCl₃) 8.40 (m, 1H), 7.50 (dt, 1H), 7.3-7.2 (m, 5H), 7.1 (dt, 1H), 7.0 (d, 1H), 6.35 (s, 1H), 3.60 (dd, 2H), 3.20 (t, 1H), 2.90 (t, 2H), 2.2-2.1 (m, 1H), 1.8-1.7 (m, 1H), 0.84 (t, 3H)

¹³C (75MHz; CDCL₃) 173.5, 159.6, 149.1, 140.0, 136.5, 128.6, 128.1, 127.0, 123.4,

5 121.4, 55.4, 38.8, 36.8, 26.1, 12.3

Example 11

Preparation of 2-(2-methoxybenzylamino)-N-(2-(pyridin-2-yl)ethyl)acetamide:

10 In a 10mL Biotage microwave vial, fitted with magnetic stirrer, 2.5g of 2-(2-methoxybenzylamino)acetamide, 3mL of NMP, 1.6g of 2-vinyl pyridine, 0.1g of KOH were added. The vial was sealed and heated in the Biotage microwave instrument at 150°C for 10min.

The mixture poured on ice, the pH was adjusted with NaOH (1N in water) to pH 12 and
15 extracted with MTBE. The organic layer was washed with brine, dried over magnesium sulfate, concentrated and purified by column chromatography. 1.05g of beige oil were obtained (27% yield).

MS: 299 ([M+]), 178, 164, 150, 136, 121, 106, 91, 78, 65, 51

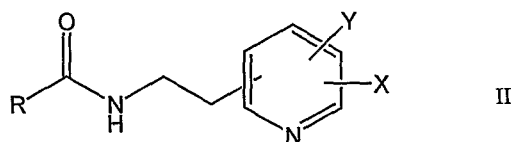
¹H NMR (300 MHz; CDCl₃) 8.50 (m, 1H), 7.80 (s, 1H), 7.6 (dt, 1H), 7.3-7.1 (m, 4H),
20 7.0-6.8 (m, 2H), 3.82 (s, 3H), 3.75-3.65 (m, 2H), 3.65 (s, 2H), 3.23 (s, 2H), 3.05 (t, 2H), 1.95 (s, 1H)

¹³C (75MHz; CDCL₃) 171.8, 159.4, 157.6, 149.4, 136.4, 129.9, 128.6, 123.4, 121.5,
120.5, 110.3, 55.2, 51.8, 49.4, 38.3, 37.6

25 These examples are for the purpose of illustration only and it is understood that variations and modifications can be made by one skilled in the art without departing from the spirit and the scope of the invention. It should be understood that the embodiments described are not only in the alternative, but can be combined.

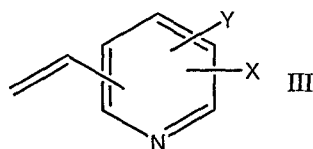
Claims:

1. A method of making a compound of formula II



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comprising reacting a compound of the formula $RCONH_2$ with a compound of formula III



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R being a moiety having between 1 and 15 carbon atoms and optionally from 1 to 5 heteroatoms independently selected from oxygen, nitrogen and sulfur, and X and Y being independently selected from the group consisting of H, methyl, ethyl, OMe, OEt, and mixtures thereof;

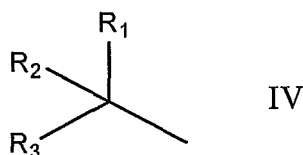
the reaction being performed in a solvent in the presence of a base.

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2. The method according to claim 1, in which R is a moiety selected from the group consisting of arylalkenyl, heteroarylalkenyl, arylalkyl, heteroarylalkyl, alkyl, alkoxy-alkyl, alkenyl, cycloalkyl, cycloalkenyl, aryl and heteroaryl moieties, and mixtures thereof, preferably a moiety selected from the group consisting of 2,4-dimethylpent-3-yl, 2,3,4-dimethylpent-3-yl, adamantyl, 2-isopropyl-5-methyl-cyclohexyl-1-yl, and mixtures thereof.
3. The method according to claim 2, in which R is 2-isopropyl-5-methyl-cyclohexyl-1-yl in the (1R, 2S, 5R) form.
4. The method according to claim 1, in which the base is selected from the group consisting of sodium hydroxide, potassium hydroxide, potassium *tert*-butoxide, and mixtures thereof.

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5. The method according to claim 1, in which the base is selected from the group of sodium- and potassium-containing bases and the solvent comprises at least one chelating agent.
- 5 6. The method according to claim 5, in which the chelating agent is selected from the group consisting of solvents having chelating properties and separately-added chelating agents, and which is preferably a crown ether.
- 10 7. The method according to claim 1, in which the reaction is performed under conditions selected from at least one of elevated temperature and elevated pressure, the temperature being preferably at least 50°C, and more preferably lying within the range of 100° to 200°C.
- 15 8. The method according to claim 1, in which R is a moiety of formula IV



in which R¹, R² and R³ together comprise at least 6 carbons, and in which R¹, R² and R³ are selected such that

- (a) (i) R₁ is selected from the group consisting of H, Me, Et, isopropyl, C₄-C₅ branched alkyl, and mixtures thereof; and
- 20 (ii) R₂ and R₃ are independently selected from the group consisting of Me, Et, isopropyl, C₄-branched alkyl, and mixtures thereof; or
- (b) any two or all of R₁, R₂ and R₃ together form a monocyclic, bicyclic or tricyclic radical having up to 10 carbons.
- 25 9. The method according to claim 8, in which the monocyclic, bicyclic or tricyclic radical is selected from 3-para-menthyl, bornyl, adamantyl, and mixtures thereof.

10. The method according to claim 9, in which R is 2-isopropyl-5-methyl-cyclohexyl-1-yl, optionally in the (1R, 2S, 5R) form.