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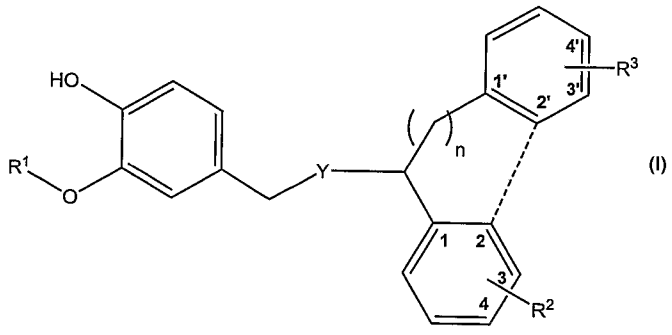

(I)

(57) Abstract: Para-substituted 2-alkoxyphenols having cooling properties of formula (I) wherein R^1 is methyl or ethyl; Y is, NH, O or S; R^2 and R^3 are independently of each other hydrogen or C_{1-3} alkoxy; n is 0 or 1; and the dotted line between C-2 and C-2' represents at least one of no bond, a single bond, or a $(CH_2)_m$- group, wherein m is 1 or 2. A process for their production and consumer products that have or use them are also disclosed.

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ORGANIC COMPOUNDS

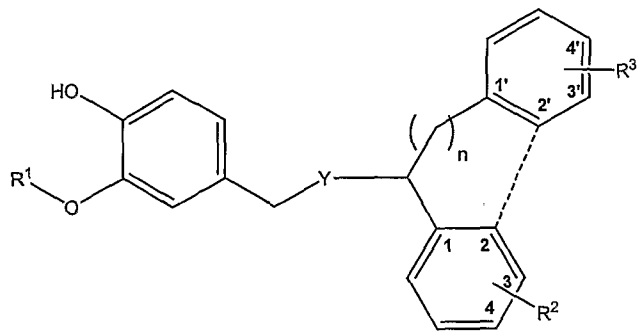
The present invention relates to para-substituted 2-alkoxyphenols having cooling properties. The present invention refers furthermore to a process for their production and to consumer products comprising them.

In the flavor and fragrance industry there is an ongoing demand for compounds having unique cooling properties that provide the user with a pleasing cooling effect and which are suitable for use in a variety of products, particularly in ingestible and topical products.

Cooling compounds, that is, chemical compounds that impart a cooling sensation to the skin or the mucous membranes of the body, are well known to the art and are widely used in a variety of products such as foodstuffs, tobacco products, beverages, chewing gum, dentifrices, mouthwashes and toiletries.

A most well-known compound is l-menthol, which is found naturally in oil of mint. Since menthol has a strong minty odor and a bitter taste, and provides a burning sensation when used in high concentrations, a variety of other menthyl ester-based and menthyl carboxamide-based cooling compounds have been developed. One that has enjoyed substantial success is N-ethyl p-menthane-carboxamide (WS-3) and is thus also often used as benchmark.

Surprisingly it has been found that certain 2-alkoxyphenols derivatives exhibit cooling intensities that are stronger than those of l-menthol and even stronger than those of WS-3. Thus an embodiment uses at least one of the subject compounds as cooling agent, wherein the compounds are represented by formula (I)



(I)

wherein

R^1 is methyl or ethyl;

Y is, NH, O, or S;

R^2 and R^3 are independently selected from at least one of hydrogen or C_{1-3} alkoxy, such as methoxy, ethoxy or iso-propoxy;

n is 0 or 1; and

the dotted line between C–2 and C–2' represents at least one of no bond, a single bond, or a $-(CH_2)_m-$ group, wherein m is 1 or 2.

Non-limiting examples are compounds of formula (I) wherein R^2 is bonded at C-4, R^3 is bonded at C-4', or R^2 and R^3 are bonded at C-4 and C-4' respectively. Non-limiting examples also include compounds of formula (I) wherein $R^2$and R^3 have the same chemical formula.

In particular, embodiments are compounds of formula (I) comprising at least one of 4-((benzhydrylamino)methyl)-2-methoxyphenol, 4-((bis(4-methoxyphenyl)-methylamino)-methyl)-2-methoxyphenol, 4-((1,2-diphenylethylamino)methyl)-2-methoxyphenol, 4-((benzhydryloxy)methyl)-2-methoxyphenol, 4-((9H-fluoren-9-ylamino)methyl)-2-methoxyphenol or 4-((benzhydrylamino)methyl)-2-ethoxyphenol.

The compounds of formula (I) may be used in products that are applied to mucous membranes such as oral mucosa, or the skin, to give a cooling sensation. By "applying" is meant any form of bringing into contact, for example, oral ingestion, topical application or, in the case of tobacco products, inhalation. In the case of application to the skin, it may be, for example, by including the compound in a cream or salve, or in a sprayable composition. There is therefore also provided a method of providing a cooling effect to the mucous membrane or skin by applying thereto a product comprising an effective amount of a compound as hereinabove described.

Products that are applied to the oral mucosa may include foodstuffs and beverages taken into the mouth and swallowed, and products taken for reasons other than their nutritional value, e.g. tablets, mouthwash, throat sprays, dentifrices and chewing gums. Products that are applied to the skin may be selected from perfumes, toiletries, lotions, oils and ointments, applicable to the skin of the human body, whether for medical or other reasons. Accordingly, in a further aspect there is provided a composition

comprising an amount of at least one compound of formula (I) sufficient to stimulate the cold receptors in the areas of the skin or mucous membrane with which the composition comes into contact and thereby promote the desired cooling effect. A cooling effect may be achieved upon application of a product, for example, mouthwash or chewing gums, to the mucous membrane, e.g. oral mucosa, comprising less than 5000 ppm, in certain embodiments between 50 and 3000 ppm, such as about 500 ppm, of a compound of formula (I). If used for beverages the addition of about 15ppm may be sufficient to achieve a cooling effect.

Particular examples of foodstuffs and beverages may include, but are not limited to, beverages, alcoholic or non-alcoholic, such as fruit juice beverages, fruit liquors, milk drinks, carbonated beverages, refreshing beverages, and health and nutrient drinks; frozen confectionery such as ice creams and sorbets; desserts such as jelly and pudding; confectionery such as cakes, cookies, chocolates, and chewing gum; jams; candies; breads; tea beverages such as green tee, black tea, chamomile tea, mulberry leaf tea, Roobos tea, peppermint tea; soaps; seasonings; instant beverages; snack foods and the like.

Further examples of topical products may include, but are not limited to, skin-care cosmetics, such as cleansing tissues, talcum powders, face creams, lotions, tonics and gels, hand creams, hand- and body lotions, anticellulite/slimming creams and –lotions, lotions, balms, gels, sprays and creams; sunburn cosmetics including sunscreen lotions, balms, gels, sprays and creams; after sun lotions, sprays and creams; soaps, toothpicks, lip sticks, agents for bathing, deodorants and antiperspirants, face washing creams, massage creams, and the like.

Thus there is further provided an end-product selected from at least one of products that are applied to the oral mucosa or products that are applied to the skin, such as topical products, oral care products, nasal care products, toilet articles, ingestible products and chewing gum, and the like, the end-product comprises a product base and an effective amount of at least one cooling compound of formula (I) as defined herein above.

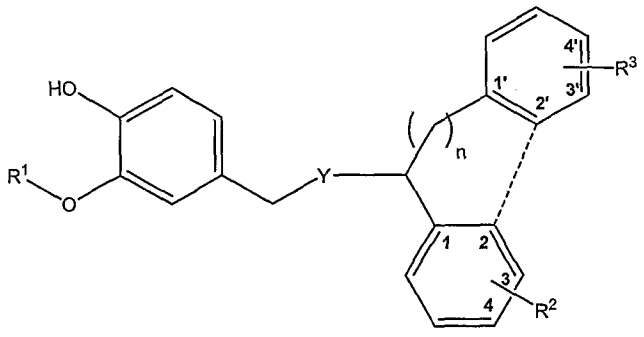
The compounds as hereinabove described may be used alone or in combination with other cooling compounds known in the art, *e.g.* menthol, menthone, isopulegol, N-ethyl

p-menthanecarboxamide (WS-3), N,2,3-trimethyl-2-isopropylbutanamide (WS-23), menthyl lactate, menthone glycerine acetal (Frescolat® MGA), mono-menthyl succinate (Physcool®), mono-menthyl glutarate, O-menthyl glycerine (CoolAct® 10) and 2-sec-butylcyclohexanone (Freskomenthe®), menthane, camphor, pulegol, cineol, mint oil, peppermint oil, spearmint oil, eucalyptus oil, 3-l-menthoxypropane-1,2-diol, 3-l-menthoxy-2-methylpropane-1,2-diol, p-menthane-3,8-diol, 2-l-menthoxyethane-1-ol, 3-l-menthoxypropane-1-ol, and 4-l-menthoxybutane-1-ol. Further examples of cooling compounds can be found e.g. in WO 2005/049553, which is incorporated by reference.

The cooling compounds may be employed into the products simply by directly mixing the compound with the product, or they may, in an earlier step, be entrapped with an entrapment material such as polymers, capsules, microcapsules and nanocapsules, liposomes, film formers, absorbents such as cyclic oligosaccharides, or they may be chemically bonded to a substrate, which are adapted to release the cooling compound upon application of an external stimulus such as temperature, enzyme or the like, and then mixed with the product. Or they may be added while being solubilized, dispersed, or diluted using alcohols or polyhydric alcohols, such as, glycerine, propylene glycole, triazethine and mygliol, natural gums such as gum Arabic, or surfactants, such as glycerine fatty acid esters and saccharide fatty acid esters.

The class of compounds as hereinabove described has never been described in literature and are thus novel in its own right.

Thus an embodiment further refers to a compound of formula (I)



(I)

wherein

R^1 is methyl or ethyl;

Y is, NH, O, or S;

R^2 and R^3 are independently selected from at least one of hydrogen or C_{1-3} alkoxy, such as methoxy, ethoxy or iso-propoxy;
n is 0 or 1; and
the dotted line between C–2 and C–2' represents at least one of no bond, a single bond, or a $-(CH_2)_m-$ group, wherein m is 1 or 2.

The compounds of formula (I) wherein Y is NH can be prepared by the reaction of the appropriate diphenylmethanamine with the appropriated 3-alkoxy-4-hydroxy-benzaldehyde resulting in the corresponding imine, which is then further reduced resulting in a secondary amine.

The compounds of formula (I) wherein Y is O can be prepared by reaction of the appropriated diphenylmethanol with the appropriated 4-(hydroxymethyl)-2-alkoxyphenol.

The compounds of formula (I) wherein Y is S can be prepared by alkylation of the appropriated protected 4-(mercaptomethyl)-2-methoxyphenol with the appropriated diphenylmethyl halide.

The compositions and methods are now further described with reference to the following non-limiting examples. 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. It should be understood that the embodiments described are not only in the alternative, but can be combined.

Example 1: 4-((benzhydrylamino)methyl)-2-methoxyphenol

A) 4-((E)(benzhydrylimino)methyl)-2-methoxyphenol
In a 250mL flask, fitted with magnetic stirrer and Dean and Stark trap (under N_2), 10.0g of diphenylmethanamine and 8.3g of vanillin are dissolved in 150mL of hexane and the mixture is heated at reflux for 3h. At the end of the reaction, about 1mL of water was trapped by the Dean and Strak apparatus. The mixture was oiled out in the cold and the residue was recrystallized from MTBE/Hexane to yield 8.32g of yellowish crystals. The mother liquor was further crystallized to yield a second crop of 4.9g of white crystals for a total yield of 76%.

^{1}H NMR (300 MHz; $CDCl_3$) δ: 8.30 (s, 1H), 7.55 (d, 1H), 7.4-7.15 (multiple, 12H), 6.92 (d, 1H), 5.87 (d, 1H), 5.58 (s, 1H), 3.96 (s, 3H)

^{13}C NMR (75 MHz; $CDCl_3$) δ: 200.6, 160.95, 144, 138.3, 127.7, 113.8, 56.0

B) 4-((benzhydrylamino)methyl)-2-methoxyphenol

In a 250mL flask, fitted with magnetic stirrer (under N2), 8.3g of 4-((benzhydrylimino)-methyl)-2-methoxyphenol was dissolved in 150mL of methanol and 1.7g of sodium borohydride were added and stirred at room temperature for overnight.

The orange solution was concentrated and partitioned twice between MTBE and brine. The organic layers were washed with brine, dried over MgSO4 and concentrated. The residue was recrystallized in MTBE to give 7.80g of white crystals having a melting point of 115 – 118°C (93% yield).

^{1}H NMR (300 MHz; $CDCl_3$) δ: 7.43 (d, 4H), 7.32 (t, 4H), 7.3-7.2 (multiple, 2H), 6.85-6.75 (multiple, 3H), 5.58 (br. s, 1H), 4.84 (s, 1H), 3.86 (s, 3H), 3.67 (s, 2H), 1.83 (br. s, 1H)

^{13}C NMR (75 MHz; $CDCl_3$) δ: 146.5, 144.6, 144, 132.4, 128.4, 127.4, 126.9, 121, 114.2, 110.9, 66.2, 55.9, 51.7

Example 2: 4-((bis(4-methoxyphenyl)methylamino)methyl)-2-methoxyphenol

The procedure outlined in Example 1 & 2 is repeated with bis(4-methoxyphenyl)-methylamine resulting in 4-((bis(4-methoxyphenyl)methylamino)methyl)-2-methoxyphenol.

^{1}H NMR ($CDCl_3$, 300 MHz) δ in ppm: 7.4 (m, 4H), 6.9-6.7(m, 7H), 4.7 (s, 2H), 3.9 (s, 3H), 3.8 (s, 6H), 3.5 (s, 2H)

^{13}C NMR ($CDCl_3$, 75MHz) δ in ppm: 158.6, 146.5, 144.6, 136.5, 130.3, 128.3, 127.9120.9, 114.2, 113.8, 110.9, 64.9, 55.9, 55.2, 51.6

MS (EI) : 255, 243, 242, 227, 212, 198, 184, 169, 152, 135, 109, 94, 77

Example 3: 4-((1,2-diphenylethylamino)methyl)-2-methoxyphenol

The procedure outlined in Example 1 is repeated with 1,2-diphenylethanamine resulting in 4-((1,2-diphenylethylamino)methyl)-2-methoxyphenol.

$_1$H NMR ($CDCl_3$, 300 MHz) δ in ppm: 7.3-7.1 (m, 10H), 6.8(d, 1H), 6.6 (m, 2H), 3.8 (dd, 1H), 3.7(s, 3H), 3.5 (d, 1H), 3.4 (d, 1H), 2.9 (m, 2H)
^{13}C NMR ($CDCl_3$, 75MHz) δ in ppm: 146.4, 144.5, 143.7, 138.9, 132.3, 129.3, 128.4, 128.3, 127.4, 127.1, 126.3, 120.8, 114.1, 110.5, 63.3, 55.8, 49.5, 45.2,
MS (EI) : 242, 196, 181, 165, 137, 122, 106, 91, 77

Example 4: 4-((benzhydryloxy)methyl)-2-methoxyphenol

In a 500mL flask, fitted with magnetic stirrer (under N2), 9.21 g of benzhydrol, 7.70g of vanillyl alcohol and 27.91g of cerium ammonium nitrate are dissolved in 100mL of acetonitrile. The mixture is stirred for 4 hours at reflux. The reaction mixture was partitioned between MTBE and water. The organic layer was washed with water and brine, dried over MgSO4, concentrated and purified by column chromatography to give 1.2g of colorless oil (7.5% yield).

^{1}H NMR ($CDCl_3$, 300 MHz) δ in ppm: 7.4-7.2 (m, 10H), 6.9-6.8(m, 3H), 5.6 (s, 1H), 5.4 (s, 1H), 4.5 (s, 2H), 3.9 (s, 3H)
^{13}C NMR ($CDCl_3$, 75MHz) δ in ppm: 146.5, 145.2, 142.2, 130.2, 128.4, 127.4, 127.1, 121.1, 114.1, 110.7, 82.1, 70.5, 55.9
MS (EI) : 242, 228, 213, 195, 167, 165, 138, 137

Example 5: 4-((9H-fluoren-9-ylamino)methyl)-2-methoxyphenol

The procedure outlined in Example 1 is repeated with 9H-fluoren-9-amine and vanillin resulting in 4-((9H-fluoren-9-ylamino)methyl)-2-methoxyphenol (mp: 148 – 150°C).

^{1}H NMR ($CDCl_3$, 300 MHz) δ in ppm: 7.7 (d, 2H), 7.6 (d, 2H), 7.3(m, 4H), 6.8 (m, 3H), 5.0 (s, 1H), 3.9 (s, 3H), 3.4 (s, 2H)

^{13}C NMR ($CDCl_3$, 75MHz) δ in ppm: 146.4, 145.6, 144.6, 140.8, 132.6, 128.1, 127.3, 124.8, 120.9, 119.9, 114.1, 110.9, 63.2, 55.9, 48.4

MS (EI) : 317, 207, 193, 180, 165, 152, 137, 123, 106, 94

Example 6: 4-((benzhydrylamino)methyl)-2-ethoxyphenol

The procedure outlined in Example 1 is repeated with 3-ethoxy-4-hydroxybenzaldehyde resulting in 4-((benzhydrylamino)methyl)-2-ethoxyphenol (mp: 89 – 91°C).

^{1}H NMR ($CDCl_3$, 300 MHz) δ in ppm: 7.4 (d, 2H), 7.3-7.1 (m, 4H), 6.9-6.7 (m, 3H), 5.6 (s, 1H), 4.8 (s, 1H), 4.1 (dd, 2H), 3.6 (s, 2H), 1.8 (s, 1H), 1.4 (t, 3H)

^{13}C NMR ($CDCl_3$, 75MHz) δ in ppm: 145.7, 144.7, 144.0, 132.4, 128.5, 127.4, 127.0, 120.9, 114.1, 111.8, 66.2, 64.5, 51.7, 14.9

MS (EI) : 331, 316, 256, 194, 182, 167, 151, 123, 106, 94, 77

Example 7: Cooling intensity

A small group of panelists was asked to taste various aqueous solutions of compounds of formula (I) and indicate which solutions had a cooling intensity similar to or slightly higher than that of a solution of menthol at 2ppm. The results are shown in Table 1.

Table 1:

Chemical	Concentration	Odor
Comparison: l-Menthol	2.0ppm	Minty
Comparison: N-ethyl p-menthanecarboxamide (WS-3)	1.5 ppm	None
4-((benzhydrylamino)methyl)-2-methoxyphenol	0.5ppm	None
4-((benzhydryloxy)methyl)-2-methoxyphenol	1.0 ppm	None

As can be seen from the results above the compounds of the present invention are at least 2 times stronger than *l*-menthol and also stronger than WS-3.

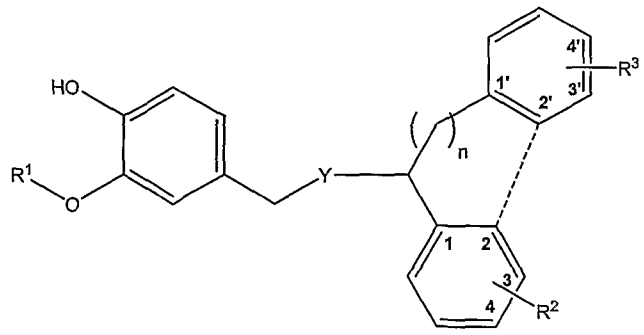
Example 8: Application in toothpaste

Opaque toothgel	99.50 g
Compound of example 4 as a 10% solution in Ethanol	0.10g
Peppermint oil, Terpeneless	0.25g
Saccharin	0.20g

The chemicals are mixed in the toothgel, a piece of toothgel is put on a toothbrush and a panelist's teeth are brushed. The mouth is rinsed with water and the water is spat out. An intense cooling sensation is felt by the panelist in all areas of the mouth, with a slight bitterness. The cooling perception lasts for 45 minutes.

Claims

1. A compound of formula (I)



(I)

wherein

R^1 is methyl or ethyl;

Y is, NH, O, or S;

R^2 and R^3 are independently selected from at least one of hydrogen, or C_{1-3} alkoxy;

n is 0 or 1; and

the dotted line between C–2 and C–2' represents at least one of no bond, a single bond, or a $-(CH_2)_m-$ group, wherein m is 1 or 2.

2. A compound according to claim 1 comprising at least one of
4-((benzhydrylamino)methyl)-2-methoxyphenol,
4-((bis(4-methoxyphenyl)-methylamino)-methyl)-2-methoxyphenol,
4-((1,2-diphenylethylamino)methyl)-2-methoxyphenol,
4-((benzhydryloxy)methyl)-2-methoxyphenol,
4-((9H-fluoren-9-ylamino)methyl)-2-methoxyphenol or
4-((benzhydrylamino)methyl)-2-ethoxyphenol.

3. The use as cooling agent of a compound of formula (I) as defined in any of the preceding claims.

4. A method of providing a cooling effect to the mouth or skin by applying thereto a product comprising a compound of formula (I) as defined in any one of the claims 1 or 2.

5. A product selected from at least one of products that are applied to the oral mucosa or products that are applied to the skin, the product comprising a product base and an

effective amount of a cooling compound of formula (I) as defined in any one of the claims 1 or 2.