

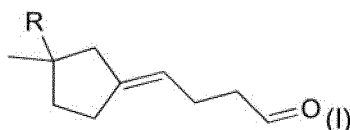
FRAGRANCE COMPOUNDS AND COMPOSITIONS

The present invention relates to substituted 4-cyclopentylidenebutanals having floral, green odor notes, and to their use as flavor and fragrance ingredient and to compositions and products comprising them. It furthermore relates to a method of their production.

Floral, green odor characteristics are important scents in perfumery. Albeit a wide range of compounds possessing floral, green odor notes are known, there is a constant demand for new compounds that enhance, modify or improve on odor notes.

It has now been found that certain substituted 4-cyclopentylidenebutanals have much sought-after floral, muguet and green odour notes.

Accordingly, in a first aspect there is provided the use as flavour or fragrance of a compound of formula (I)



wherein R is methyl or ethyl.

The compounds of formula (I) may be used alone, as mixtures thereof, or in combination with a base material. As used herein, the "base material" includes all known odorant molecules selected from the extensive range of natural products and synthetic molecules currently available, such as essential oils, alcohols, aldehydes and ketones, ethers and acetals, esters and lactones, macrocycles and heterocycles, and/or in admixture with one or more ingredients or excipients conventionally used in conjunction with odorants in fragrance compositions, for example, carrier materials, and other auxiliary agents commonly used in the art.

As used herein, "fragrance composition" means any composition comprising at least one compound of formula (I) and a base material, e.g. a diluent conventionally used in conjunction with odorants, such as dipropylene glycol (DPG), isopropyl myristate (IPM), triethyl citrate (TEC) and alcohol (e.g. ethanol), and known odorants.

The following list comprises examples of known odorant molecules, which may be combined with the compounds of the present invention:

- essential oils and extracts, e.g. castoreum, costus root oil, oak moss absolute,
5 geranium oil, tree moss absolute, basil oil, fruit oils such as bergamot oil and mandarine oil, myrtle oil, palmarose oil, patchouli oil, petitgrain oil, jasmine oil, rose oil, sandalwood oil, wormwood oil, lavender oil or ylang-ylang oil;
- alcohols, e.g. cinnamic alcohol, *cis*-3-hexenol, citronellol, EbanolTM, eugenol,
10 farnesol, geraniol, JavanolTM, linalool, menthol, nerol, phenylethyl alcohol, rhodinol, SandaloreTM, Super MuguetTM, terpineol or TimberolTM;
- aldehydes and ketones, e.g. Azurone[®] (7-(3-methylbutyl)-1,5-benzodioxepin-3-one), anisaldehyde, α -amylcinnamaldehyde, GeorgywoodTM, hydroxycitronellal, Iso E[®]
15 Super, Isoraldeine[®], Hedione[®], Lilial[®], maltol, methyl cedryl ketone, methylionone, verbenone or vanillin;
- ethers and acetals, e.g. AmbroxTM, geranyl methyl ether, rose oxide or SpirambreneTM;
20
- esters and lactones, e.g. benzyl acetate, cedryl acetate, γ -decalactone, Helvetolide[®], γ -undecalactone or vetivenyl acetate;
- macrocycles, e.g. Ambrettolide[®], ethylene brassylate or Exaltolide[®];
25
- heterocycles, e.g. isobutylquinoline.

The compounds according to formula (I) may be used in a broad range of perfumed products, e.g. in any field of fine and functional perfumery, such as perfumes, air care
30 products, household products, laundry products, body care products and cosmetics. The compounds can be employed in widely varying amounts, depending upon the specific application and on the nature and quantity of other odorant ingredients. The proportion is typically from 0.0001 to 5 weight percent of the application. In one embodiment, compounds of the present invention may be employed in a fabric softener
35 in an amount of from 0.0001 to 0.05 weight percent. In another embodiment,

compounds of the present invention may be used in fine perfumery in amounts from 0.01 to 3 weight percent, more preferably between 0.5 and 2 weight percent. However, these values are given only by way of example, since the experienced perfumer may also achieve effects or may create novel accords with lower or higher concentrations, e.g. up to about 10 weight percent based on the perfumed product.

The compounds as described hereinabove may be employed in a consumer product base simply by directly mixing at least one compound of formula (I), or a fragrance composition with the consumer product base, or they may, in an earlier step, be entrapped with an entrapment material, for example, polymers, capsules, microcapsules and nanocapsules, liposomes, film formers, absorbents such as carbon or zeolites, cyclic oligosaccharides and mixtures thereof, or they may be chemically bonded to substrates, which are adapted to release the fragrance molecule upon application of an external stimulus such as light, enzyme, or the like, and then mixed with the consumer product base.

Thus, the invention additionally provides a method of manufacturing a perfumed product, comprising the incorporation of a compound of formula (I), as a fragrance ingredient, either by directly admixing the compound to the consumer product base or by admixing a fragrance composition comprising a compound of formula (I), which may then be mixed with a consumer product base, using conventional techniques and methods. Through the addition of an olfactorily acceptable amount of at least one compound of the present invention as hereinabove described the odor notes of a consumer product base will be improved, enhanced, or modified.

Thus, the invention furthermore provides a method for improving, enhancing or modifying a consumer product base by means of the addition thereto of an olfactorily acceptable amount of at least one compound of formula (I).

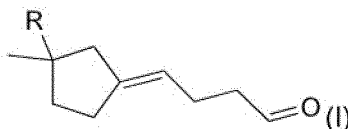
- The invention also provides a perfumed product comprising:
- a) as odorant at least one compound of formula (I); and
 - b) a consumer product base.

As used herein, "consumer product base" means a composition for use as a consumer product to fulfill specific actions, such as cleaning, softening, caring or the like.

Examples of such products include fine perfumery, e.g. perfume and eau de toilette; fabric care, household products and personal care products such as laundry care detergents, rinse conditioner, personal cleansing composition, detergent for dishwasher, surface cleaner; laundry products, e.g. softener, bleach, detergent; body-care products, e.g. shampoo, shower gel; air care products and cosmetics, e.g. deodorant, vanishing creme. This list of products is given by way of illustration and is not to be regarded as being in any way limiting.

To the best of our knowledge none of the compounds falling within the definition of formula (I) are described in the literature and are thus novel in their own right.

Accordingly, the present invention refers in a further aspect to compounds of formula (I)



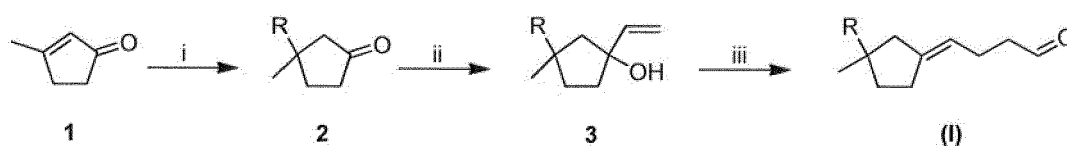
wherein R is methyl or ethyl.

The compounds of formula (I) may comprise a chiral center and as such may exist as a mixture of stereoisomers, or may be resolved in isomerically pure forms. Resolving stereoisomers adds to the complexity of manufacture and purification of these compounds and so it is preferred to use the compound as mixture of their stereoisomers simply for economic reasons. However, if it is desired to prepare individual stereoisomers, this may be achieved according to methods known in the art, e.g. preparative HPLC and GC, crystallization or stereoselective synthesis

In particular embodiments compounds of formula (I) are selected from the group consisting of 4-(3,3-dimethylcyclopentylidene)butanal [(Z)-4-(3,3-dimethylcyclopentylidene)butanal and (E)-4-(3,3-dimethylcyclopentylidene)butanal) or mixtures thereof] and 4-(3-ethyl-3-methylcyclopentylidene)butanal [(Z)-4-(3-ethyl-3-methylcyclopentylidene)butanal and (E)-4-(3-ethyl-3-methylcyclopentylidene)butanal or mixtures thereof].

The compounds of formula (I) may be prepared starting from 3-methylcyclopent-2-enone (**1**). Conjugate addition of the respective alkyl group by standard synthetic procedures affords **2**. The allylic alcohols **3** are formed by reaction of the ketone carbonyl (**2**) with vinyl organometallic reagent e.g. Grignard reagent and then transformed into vinyl ethers, which rearrange to compounds of formula (I) as depicted in Scheme 1. Further particulars as to reaction conditions are provided in the examples.

Scheme 1:



i) Cu(II), RMgCl; ii) CH₂CHMgBr; iii) CH₂CHOEt, H⁺.

Pure or enriched E- or Z-isomers can be obtained via appropriate synthetic procedures or physical separation of the mixture. Optically pure or enriched stereoisomers (enantiomers) may be obtained by resolution of racemates or by asymmetric synthesis methodologies known to one skilled in the art.

The invention is 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.

All products described in the examples were obtained starting from 3-methylcyclopent-2-enone (**1**) and are racemic mixtures of diastereomers or E/Z isomers.

The reported NMR spectra were measured in CDCl₃ at 400 MHz if not otherwise stated; chemical shifts (δ) are reported in ppm downfield from TMS; coupling constants *J* in Hz. The GC/MS analyses were run using a ZB-5 column, if not stated otherwise. Flash chromatography: Merck silica gel 60 (230 - 400 mesh). Samples for olfactory evaluation were purified by bulb-to-bulb distillation. All purified products were isolated as colorless oils, the purity of which was confirmed by GC/MS.

Example 1. (E/Z)-4-(3,3-Dimethylcyclopentylidene)butanal (**1a**)

a) 3,3-Dimethylcyclopentanone (**2a**)

The reactor was charged with 3-methylcyclopent-2-enone (**1**, 150 g, 1.56 mol) and THF (1.6 l) and CuCl₂ (2 g, 0.02 mol) was added. The solution was cooled to 10 °C and
5 MeMgCl 3M in THF (520 ml, 1.56 mol) was added dropwise over 1 hour. The mixture was warmed to room temperature and stirred for 30 minutes. The reaction mixture was poured onto aqueous NH₄Cl (25%, 300 g) and the mixture was stirred vigorously. Aqueous NH₃ (25%, 50 ml) was added and stirring was continued for 30 minutes. The deep blue mixture was placed in a separating funnel and the organic layer was
10 removed. The aqueous layer was extracted with *tert*-butyl methyl ether (2 x 100 ml). The combined organic layers were washed with brine (200 ml) and concentrated in *vacuo*. The residue was purified by distillation over a 20 cm Vigreux column (b.p. 80 °C at 12 Torr) to afford **2a** (78 g, 45% yield) as a colorless liquid.

15 ¹H NMR: δ 2.31 (t, *J* = 7.8, 2H); 2.05 (s, 1H); 1.79 (t, *J* = 7.8, 2H); 1.12 (s, 6H). ¹³C NMR: δ 219.9 (s), 53.3 (t), 37.2 (t), 36.8 (t), 36.3 (s), 28.1 (2q).
MS: 112 (32, M⁺), 97 (15), 83 (37), 69 (22), 57 (24), 56 (100), 55 (49), 42 (11), 41 (38), 39 (19).

20 b) 3,3-Dimethyl-1-vinylcyclopentanol (**3a**)

The reactor was charged with vinylmagnesium bromide (0.6M in THF, 245 ml, 147 mmol) and the solution was cooled to 5-10 °C. 3,3-Dimethylcyclopentanone (**2a**, 15.0 g, 134 mmol) in THF (50 ml) was added over 10 minutes while keeping the temperature of the reaction mixture between 5-10 °C by means of an ice bath. The mixture was
25 stirred for 30 minutes, then quenched with 10% AcOH (150 ml) and extracted with hexane (2 x 100 ml). The combined organic phases were washed with water, dried (MgSO₄), concentrated and distilled bulb-to-bulb to afford **3a** (14.3 g, 76% yield) as a colorless liquid.

30 ¹H NMR: δ 6 (dd, *J* = 17.2, 10.6, 1H); 5.23 (dd, *J* = 17.2, 1.3, 1H); 4.99 (dd, *J* = 10.6, 1.3, 1H); 1.93-1.45 (m, 6H); 1.17 (s, 3H); 1.02 (s, 3H). ¹³C NMR: δ 145.3 (d), 110.5 (t), 83.1 (s), 55.0 (t), 40.4 (t), 40.0 (t), 38.6 (s), 31.1 (q), 30.7 (q).
MS: 140 (3, M⁺), 97 (21), 84 (89), 83 (54), 70 (30), 69 (28), 57 (31), 56 (22), 55 (100), 43 (30), 41 (34).

c) (E/Z)-4-(3,3-Dimethylcyclopentylidene)butanal (**1a**)

In a pressure vessel with stirrer (PARR 4842, 25 ml) a mixture of 3,3-dimethyl-1-vinylcyclopentanol (**3a**, 2 g, 14 mmol), ethyl vinyl ether (3.1 g, 43 mmol) and H₃PO₄ (0.01 g) were heated to 100 °C (pressure 2.5 - 2.7 bar) for 30 minutes. The temperature was then raised to 180 °C (pressure 5 bar) and maintained for 50 minutes. The reaction mixture was concentrated in *vacuo* and purified by flash chromatography (ethyl acetate/hexane 1:9) to afford **1a** (1.5 g, 1:1 mixture of E/Z isomers, 63% yield) as a colorless liquid.

¹H NMR; mixture of E/Z isomers: δ 9.76 (m, 2H); 5.19 (m, 2H); 2.46 (m, 4H); 2.30 (m, 8H); 2.02 (s, 4H); 1.45 (m, 4H); 1.0 (s, 6H); 0.96 (s, 6H). ¹³C NMR; mixture of E/Z isomers: δ 202.6 (2d), 144.8 (s), 144.7 (s), 118.6 (d), 118.5 (d), 48.5 (t), 44.1 (t), 43.8 (t), 43.7 (t), 39.9 (t), 39.8 (t), 38.6 (s), 38.3 (s), 31.5 (2t), 28.1 (2q), 27.4 (2q), 22.5 (t), 22.1 (t).

MS; sum of E/Z isomers: 166 (1, M⁺), 151 (43), 133 (46), 107 (100), 95 (70), 91 (29), 81 (51), 79 (49), 67 (46), 55 (55), 41 (55).

Odour description (mixture of E/Z isomers): floral, aldehydic, green, fatty, muguet.

Odour description (E isomer): floral, aldehydic, watery, fruity.

Odour description (Z isomer): floral, aldehydic, fresh, green, fatty, waxy.

Example 2. (E/Z)-4-(3-Ethyl-3-methylcyclopentylidene)butanal (**1b**)a) 3-Ethyl-3-methylcyclopentanone (**2b**)

3-Methylcyclopent-2-enone (**1**, 35.0 g, 0.36 mol) was reacted with ethylmagnesium chloride (2M in THF, 218 ml, 0.44 mol) in the presence of 1 mol% CuCl₂ in THF (200 ml) as described in Example 1a. The crude product was distilled over a 15 cm Vigreux column (B.p. 50 °C at 5 Torr) to give **2b** (32.0 g, 69% yield) as a colorless liquid.

¹H NMR: δ 2.28 (m, 2H); 2.14-1.93 (m, 2H); 1.87-1.70 (m, 2H); 1.45 (dd, *J* = 14.9, 7.3, 2H); 1.04 (s, 3H); 0.90 (t, *J* = 7.58, 3H). ¹³C NMR: δ 220.0 (s), 51.8 (t), 39.7 (s), 36.7 (t), 34.6 (t), 33.9 (t), 24.4 (q), 8.9 (2q).

MS: 126 (41, M⁺), 97 (68), 70 (47), 69 (71), 56 (55), 55 (100), 42 (20), 41 (63), 39 (30), 27 (18).

b) 3-Ethyl-3-methyl-1-vinylcyclopentanol (**3b**)

5 3-Ethyl-3-methylcyclopentanone (**2b**, 30.0 g, 0.24 mol) was reacted with vinylmagnesium bromide (0.6M in THF, 285 ml, 0.29 mol), as described in Example 1b, to afford **3b** (22.0 g, 2:1 mixture of diastereomers, 60% yield) as a colorless liquid.

¹H NMR, mixture of diastereomers: δ 5.99 (m, 2H); 5.25 (m, 1H); 5.21 (m, 1H); 5.00 (m, 10 1H); 4.98 (m, 1H); 1.90-1.28 (m, 18H); 1.13 (s, 3H); 0.96 (s, 3H); 0.90-0.82 (m, 6H). ¹³C NMR, mixture of diastereomers: δ 145.3 (d), 145.2 (d), 110.5 (2t), 82.7 (s), 82.6 (s), 53.2 (t), 53.0 (t), 42.1 (s), 41.9 (s), 40.2 (t), 39.8 (t), 38.1(t), 37.8 (t), 36.1(t), 35.7 (t), 27.8 (q), 26.9 (q), 9.5 (q), 9.3 (q).

MS, sum of diastereomers: 154 (1, M⁺), 125 (30), 107 (34), 84 (91), 83 (45), 71 (26), 70 15 (31), 69 (40), 55 (100), 43 (37), 41 (30).

c) (E/Z)-4-(3-Ethyl-3-methylcyclopentylidene)butanal (**1b**)

3-Ethyl-3-methyl-1-vinylcyclopentanol **3b** (8.0 g, 52 mmol) was reacted with ethyl vinyl ether in a pressure reactor in the presence of H₃PO₄ (0.03 g), as described in Example 20 1c. Purification of the crude product by flash chromatography (ethyl acetate/hexane 1:9) afforded **1b** (6.0 g, 1:1 mixture of E/Z isomers, 64% yield) as a colorless liquid.

¹H NMR; mixture of E/Z isomers: δ 9.76 (m, 2H); 5.18 (m, 2H); 2.46 (m, 4H); 2.28 (m, 8H); 2.11-1.93 (m, 4H); 1.55-1.23 (m, 8H); 0.91 (s, 3H); 0.87 (s, 3H); 0.86 (t, J = 7.58, 25 3H); 0.84 (t, J = 7.58, 3H). ¹³C NMR; mixture of E/Z isomers: δ 202.5 (2d), 144.6 (s), 144.5 (s), 118.5 (d), 118.4 (d), 46.8 (t), 43.8 (t), 43.7 (t), 42.3 (t), 42.1 (t), 41.6 (t), 37.8 (t), 37.6 (t), 33.9 (t), 33.3 (t), 31.1 (t), 27.0 (t), 24.3 (q), 23.6 (q), 22.5 (t), 22.2 (t), 9.3 (2q).

MS; sum of E/Z isomers: 180 (1, M⁺), 151 (80), 133 (58), 107 (100), 95 (38), 91 (38), 81 30 (50), 79 (52), 67 (42), 55 (55), 41 (51).

Odour description (mixture of E/Z isomers): floral, aldehydic, slightly green, piney.

Odour description (E isomer): floral, green, transparent, freesia, aldehydic, sappy.

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Odour description (Z isomer): floral, warm, fruity, peachy, leafy, violet.

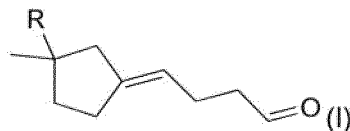
Example 3: Floral perfuming composition (unisex)

5	<u>Ingredient</u>	<u>parts per weight</u>
	Phenyl Ethyl Alcohol (2-phenylethanol)	12
	Cosmone (3-methyl-cyclotetradec-58-en-1-one)	10
	Cyclohexal	20
	Ethyl Linalool	45
10	Florosa (tetrahydro-2-isobutyl-4-methylpyran-4-ol)	55
	Hedione (methyl 2-(2-butyl-3-oxocyclopentyl)acetate)	450
	Hydroxy Citronellal	25
	Cis Jasmone	5
	Ethyl 2-Methylbutanoate @ 10 % in DPG	3
15	Orange Essence	25
	Raspberry Ketone (4-(4-hydroxyphenyl)butan-2-one) @ 10% in DPG	15
	Cis-3-Hexenyl Salicylate	55
	Serenolide (2-[1-(3,3-dimethylcyclohexyl)ethoxy]-2-methylpropyl cyclopropanecarboxylate)	80
20	(E/Z)-4-(3,3-Dimethylcyclopentylidene)butanal (Ia)	25
	<u>Dipropylene Glycol (DPG)</u>	<u>175</u>
	TOTAL	1000

25 Addition of 25 parts per weight of compound Ia to the above composition results in a vibrant opening and enhancement of the exuberant orange, increasing the exotic florality and giving the composition a touch of sophistication.

Claims

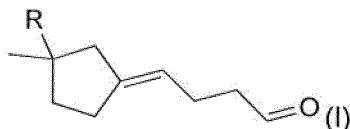
1. Compounds of formula (I)



wherein R is methyl or ethyl.

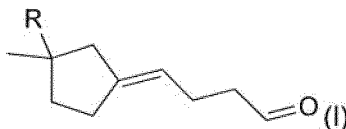
2. A compound according to claim 1 selected from 4-(3,3-dimethylcyclopentylidene)butanal and 4-(3-ethyl-3-methylcyclopentylidene)butanal.

3. The use as flavour or fragrance ingredient of a compound of formula (I)



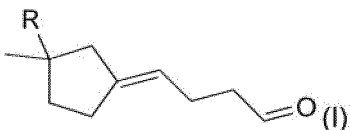
wherein R is methyl or ethyl.

4. A fragrance composition or a perfumed product comprising a compound of formula (I)



wherein R is methyl or ethyl.

5. A perfumed product according to claim 4 wherein the perfumed product is selected from fine perfumery, fabric care, household products, beauty and personal care products and air care products.
6. A method of improving, enhancing, or modifying a consumer product base comprising the step of adding thereto an olfactorily acceptable amount of at least one compound of formula (I)



wherein R is methyl or ethyl.