SPRAY-DRIED COMPOSITION COMPRISING A BENEFIT AGENT

The present invention relates to a spray-dried composition comprising a benefit agent that is entrapped in a water-soluble matrix, to a process for making such a composition, to a consumer product containing such a composition and to a use of a substantially odorless, biodegradable antioxidant to increase the self-heating and/or the GREWER temperature of a spray-dried composition.

BACKGROUND OF THE INVENTION

It is known to incorporate encapsulated benefit agents in consumer products, such as household care, personal care and fabric care products. Benefit agents include for example perfumes, flavors, cosmetic actives, and biologically active ingredients, such as biocides and drugs.

Spray-drying is a well-known technique for the encapsulation of benefit agents, especially volatile benefit agents, such as perfume and flavors. Such spray-dried compositions are commonly prepared from an emulsion of the benefit agent, which is sprayed into a drying chamber. In this process, biopolymers with surface active properties are generally used as emulsifiers which, upon spray-drying, form a water-soluble matrix in which the perfume becomes entrapped.

Such spray-dried compositions provide a powder format which is simple to manufacture and shows good benefit agent protection and release profile. Furthermore, since nowadays consumers are more aware of environmental and resource protection, those encapsulates have become even more attractive, as they are often based on bio-based and/or biodegradable materials. The spray-dried compositions thus have a low ecological footprint and allow for encapsulation of perfumes with high efficiency. They also exhibit beneficial release properties.

However, spray-dried compositions are obtained in powder form with a particle sizes from 1 to 100 µm, consisting essentially of carbonaceous materials. Such powdery materials may show high self-heating potential, with self-heating onset temperature of, for example, below 130 °C or even below 125 °C, or less. As a consequence, the temperature of spray-dryer devices may have to be reduced to such an extent that the overall drying process is

affected. This may have a deleterious impact on the drying speed and completeness, and on the dryer throughput. Furthermore, stock pilings of low self-heating temperature powders may induce critical safety concerns, such as spontaneous combustion of the powder, for example on hot surfaces. The self-heating temperature is the lowest temperature above which the powder spontaneously auto reacts, resulting in a smoldering combustion of the powder in the absence of any external source of ignition. The smoldering combustion can then lead to powder fires or even explosion.

The self-heating onset temperature and the self-heating temperature of a bulk powder is measured calorimetrically in a so-called GREWER oven.

Furthermore, if a powder sample in the GREWER oven reaches, owing to self-heating mechanisms, a temperature that is 60 °C higher than the temperature of a reference graphite powder at the same oven temperature, then this sample may self-ignite.

WO 2003/043728 A1 claims perfuming or flavoring microcapsule characterized in that the microcapsule further comprises an effective amount of a fireproofing agent susceptible of reducing the dust hazard explosive class of the microcapsule to St-1. The fireproofing agent is selected from the group consisting of sodium silicate, potassium silicate, sodium carbonate, sodium hydrogenecarbonate, monoammonium phosphate or carbonate, diammonium phosphate, mono-, di- or trisodium phosphate, sodium hypophosphite, melamine cyanurate, chlorinated hydrocarbons and mixtures thereof.

EP 1 796 621 A1 discloses spray-dried compositions comprising explosion suppressants consisting of C1 to C12 carboxylic acids, their salts and mixtures of these.

Whereas these documents specifically address the potential issue of dust explosion, as measured by the so-called explosion St-class, and the possibility of reducing the dust hazard of a spray-dried composition, they remain silent about the self-heating potential of such compositions and, in particular, about the temperature where self-heating occurs.

There remains therefore a need to increase the self-heating temperature of spray-dried powders containing a perfume or a flavor composition, more

particularly spray-dried powders containing a fragrance or a flavor composition to a value higher than 125 °C, preferably higher than 130 °C.

This problem is solved by the subject-matter of the independent claims.

SUMMARY OF THE INVENTION

In a first aspect, the present invention provides a spray-dried composition comprising from 30 wt.-% to 60 wt.-%, more particularly from 35 wt.-% to 55 wt.-% of a benefit agent, wherein the benefit agent comprises more than 10 wt.-%, more particularly more than 12 wt.-%, still more particularly more than 14 wt.-% of total aldehydes, monoterpenes, or mixtures thereof; and wherein the spray-dried composition comprises a substantially odorless, biodegradable antioxidant, wherein the level of the antioxidant is 0.01 wt.-% to 10 wt.-% of the benefit agent.

In preferred embodiments, the at least one antioxidant is bio-based and is soluble in the fragrance or flavor composition.

In preferred embodiments, the antioxidant is carnosic acid, carnosol or a mixture thereof.

In a second aspect, the present invention provides a method for obtaining a spray-dried composition according to the present invention, the method comprising the steps of:

a) Forming an emulsion, wherein the benefit agent is dispersed in an aqueous phase, the aqueous phase comprising an encapsulating material and the emulsion comprising an antioxidant;

b) Spray-drying the emulsion formed in a) in order to form a powder, wherein the benefit agent is encapsulated in the encapsulating material; and

wherein the level of benefit agent is from 30 wt.-% to 60 wt.-%, more particularly from 35 wt.-% to 55 wt.-% of the spray-dried composition; and the level of the antioxidant is 0.01 wt.-% to 10 wt.-% of the benefit agent.

In a third aspect, the present invention provides a consumer product, preferably a fabric care product, a home care product or a personal care product, comprising a spray-dried composition according to the present invention.

In a fourth aspect, the present invention provides the use of a substantially odorless, biodegradable antioxidant, more particularly a bio-sourced and oil-soluble antioxidant to increase the self-heating temperature of a spray-dried composition.

DEFINITIONS

In the context of the present invention, the "benefit agent" is a lipophilic ingredient or a mixture of lipophilic ingredients forming an oil phase.

By "entrapped" it is meant that the benefit agent is dispersed in a solid encapsulating material. Typically, the benefit agent is dispersed in the encapsulated material in the form of droplets. Such system may also be referred to as a "dry emulsion".

The "self-heating" temperature is the lowest temperature above which the powder spontaneously auto reacts, resulting in a smoldering combustion of the powder in the absence any external source of ignition. The smoldering combustion can then lead to powder fires or even explosion.

The "self-heating onset temperature" or "GREWER temperature" is the point in the thermogram where a positive deviation of the linear relationship between the sample temperature and the oven temperature occurs. Such a deviation is the sign that an exothermic reaction spontaneously occurs within the sample. The GREWER temperature is lower than the "self-heating" temperature.

In the context of the present invention, the GREWER temperature is measured by using a GREWER oven, as described Example 2. The output of the measurement is a thermogram showing the temperature of the sample as a function of the oven temperature (or heating time as the oven temperature increases linearly with heating time).

This measurement applies only on samples that are in the solid state over the full range of temperature within which the test is performed.

The term "substantially odorless" means that the antioxidant exhibits little discernible odor and that, to the extent odor is present, it is sufficiently low/mild not to interfere with the odor of the benefit agent, especially in the case the benefit agent is a fragrance. Additionally, the antioxidant would not be overtly detectible to a user of a "fragrance free" cosmetic or other product. The term "substantially odorless" also encompasses virtually completely odor free and completely odor free within its scope.

In the context of the present invention, the pass criteria for "readily biodegradable" are assessed according to OECD Method 301F, which refers to manometric respirometry. In this method the pass level for "ready biodegradability" is to reach 60 % of theoretical oxygen demand and/or chemical oxygen demand. This pass value has to be reached in a 10-day window within the 28-day period of the test. The 10-day window begins when the degree of biodegradation has reached 10% of theoretical oxygen demand and/or chemical oxygen demand and must end before day 28 of the test. A preferred way of conducting OECD Method 301F is provided herein below.

Given a positive result in a test of ready biodegradability, it may be assumed that the chemical will undergo rapid and ultimate biodegradation in the environment (Introduction to the OECD 25 Guidelines for the Testing of Chemicals, Section 3, Part 1: Principles and Strategies Related to the Testing of Degradation of Organic Chemicals; Adopted: July 2003).

For assessment of the pass criteria for "inherently biodegradable", the biodegradation study can be OECD Method 302C, but also OECD Method 301F can be used, although with different pass criteria. Also these methods are suitable for volatile materials.

OECD Method 302C is described in the OECD Guidelines for the Testing of Chemicals, Section 3,5 Test No. 302C: Inherent Biodegradability: Modified MITI Test (II) (Adopted: 12 May 1981; Corrected 8 September 2009; https://doi.org/10.1787/9789264070400-en).

In the context of the present invention, the pass criteria for "inherently biodegradable" are assessed by OECD Method 302C. In this method the pass level for "inherently biodegradability" is then to reach 70 % of theoretical oxygen demand. There is no time limit to reach this level.

Biodegradation rates above 70 % may be regarded as evidence of inherent, ultimate biodegradability (OECD Guidelines for the Testing of Chemicals, Section 3, Part 1: Principles and Strategies Related to the Testing of Degradation of Organic Chemicals; Adopted: July 2003).

If OECD Method 301F is used for assessment of the pass criteria for "inherently biodegradable", the pass level is 60 % of theoretical oxygen demand and/or chemical oxygen demand. This pass value can be reached after the 28-day period of the test, which is usually extended to 60 days. No 10-day window applies.

In the present context, if an ingredient is an essential oil, it is considered to be a "biodegradable ingredient" if all of its constituents present at a level ≥ 1 wt.-% fall under the definition of "inherently biodegradable" and/or "readily biodegradable" as defined herein above. However, the essential oil can also be subjected to the above-mentioned biodegradation tests.

The term "bio-based" relates to the origin of a material and refers to materials intentionally made from substances derived from living (or once-living) organisms, as opposed to petroleum-derived materials. The definition includes both natural materials, such as naturally-extracted essential oils, and materials that have undergone some degree of processing, such as essential oils fractions.

The term "water-soluble" indicates that the material dissolves in water at a temperature above about 10 °C when admixed to water at claimed level.

The term "soluble in the benefit agent" indicates that the material dissolves in the benefit agent at a temperature above about 10 °C when admixed to the benefit agent at claimed level. In the context of the present invention, the benefit agent is lipophilic and therefore dissolve materials that are oil-soluble.

DETAILED DESCRIPTION

Preferred and/or optional features of the invention will now be set out. Any aspect of the invention may be combined with any other aspect of the invention unless the context demands otherwise. Any of the preferred or optional features of any aspect may be combined, singly or in combination, with any aspect of the invention, as well as with any other preferred or optional features, unless the context demands otherwise.

Typically, any lipophilic benefit agent, more particularly a liquid, lipophilic benefit agent may be encapsulated in a hydrophilic encapsulating material, or matrix, by spray drying, yielding a powder comprising various amount of such compositions dispersed and entrapped in this matrix. Such powder is solid under dry environment and up to 70 % relative humidity. Typically, the benefit agent is emulsified in an aqueous phase in which the hydrophilic encapsulating material is dissolved, forming thereby an oil-in-water emulsion. The water is then removed by spraying this emulsion in a drying tower, where a multitude of emulsion drops enter in contact with air heated at a temperature of from 80 °C to 220 °C, more particularly from 150 °C to 210 °C. The outlet temperature is from 50 °C to 100 °C.

The resulting product is a powder material in which the benefit agent is dispersed in the form of droplets in the encapsulating material. The droplets have typically an average size of from 0.1 to 5 micrometers.

Typically, the level of benefit agent in the spray dried powder is from 10 to 30 wt.-%. However, it may be advantageous, for cost reasons, that this level is increased to 40 wt.-% or even to 50 wt.-% or more.

For safety concerns, it is generally recommended that the GREWER temperature is 60 °C higher than the outlet temperature of the spray dryer.

Powders having a GREWER temperature of 125 °C and higher, more particularly 130 °C or higher are considered as safe, provided the outlet temperature does not exceed 65 °C, more particularly 70 °C.

However, the applicant has observed that, under certain conditions, the self-heating temperature of powder comprising from 30 to 60 wt.-%, more particularly from 35 wt.-% to 55 wt.-% of benefit agent may be below 125 °C.

This is particularly the case of benefit agents comprising relatively high levels of aldehydes and/or monoterpenes.

As a consequence, the temperature of spray-dryer devices may either have to be reduced to such an extent that the overall drying process is affected, or the level of aldehydes and monoterpenes may have to be reduced or completely suppressed.

The applicant has now surprisingly found that adding an antioxidant, even at low levels, to the emulsion comprising such relatively high levels of aldehydes and/or monoterpenes before spray drying does increase the GREWER temperature of the resulting powders comprising such critical benefit agents at a value higher than 125 °C or even higher than 130 °C.

Consumers are increasingly concerned about using materials obtained from non-renewable sources, such as synthetic petrochemicals, as well as about the processes for manufacturing the consumer products. The "clean label" concept is one of the biggest trends of the decade. The term itself has many definitions including sustainable, naturally sourced or bio-based and biodegradable ingredients as well as minimal processing and impact on the environment. Nevertheless, it is generally difficult to use natural materials or materials derived from nature to satisfy the requirements for suitable encapsulation compositions. Bio-based and biodegradable ingredients for customer formulations must provide a unique combination of performance and sustainability, so consumers feel confident in the safety and efficacy of these ingredients. Therefore, in view of increasing the environmental sustainability of the composition, it may be desirable to privilege biodegradable, more particularly biodegradable and bio-based antioxidants.

Hence, in a first aspect, the present invention provides a spray-dried composition comprising from 30 wt.-% to 60 wt.-%, more particularly from 35 wt.-% to 55 wt.-% of a benefit agent, wherein the benefit agent comprises more than 10 wt.-%, more particularly more than 12 wt.-%, still more

particularly more than 14 wt.-% of total aldehydes, monoterpenes, or mixtures thereof;

and wherein the spray-dried composition comprises an odorless, biodegradable antioxidant, wherein the level of the antioxidant is 0.01 wt.-% to 10 wt.-% of the benefit agent.

The anti-oxidant is biodegradable, more particularly biodegradable and bio-based antioxidant.

Furthermore, in cases where the benefit agent is a fragrance or a flavor composition, it is required that the antioxidant does not interfere with the overall organoleptic profile of the compositions and that, depending on the desired odor or taste characteristics of the fragrance or the flavor, certain odorous or tasty materials, such as guaiacol, cresols, vanitrope, zingerone, eugenol, dihydroeugenol, thymol, creosol are not used.Antioxidants that are suitable for the sake of the present invention are selected from phenolic compounds, such as ascorbic acid and its salts, tocopherols, , catechol, lutein, carnosic acid, carnosol, quercetin, catechin, ubiquinol 10, kaempferol, naringenin, hesperetin, curcumin, rosemarinic acid, ascorbyl fatty acid esters; or mixtures thereof.

Non-phenolic antioxidants, such as citric acid and its salts, uric acid and its salts, lipoic acid and its salts, citryl fatty acid esters, alkyl citrates, and alkyl lipoates are also suitable for the sake of the present invention.

However, although water-soluble antioxidants may be entrapped in the hydrophilic encapsulating matrix and may also contribute to mitigating self-heating phenomena, it is preferable that the antioxidant is soluble in the lipophilic benefit agent.

Thus, in preferred embodiments of the present invention, the at least one antioxidant is soluble in the benefit agent.

The level of the antioxidant in the benefit agent is 0.01 wt.-% to 10 wt.-%, based on the total weight of the benefit agent, whereas the selected level may depend on the level of aldehydes and/or monoterpenes. As a rule, the higher the level of these latter materials, the higher the required level of antioxidant.

In one embodiment, the ratio between the amount of the antioxidant to the amount of total aldehydes, monoterpenes, or mixtures thereof is between about 0.003 to about 0.027, preferably between about 0.01 to about 0.02.

In preferred embodiments, the at least one antioxidant is biodegradable and bio-based, and is selected from the group consisting of carnosic acid (5,6-dihydroxy-1,1-dimethyl-7-propan-2-yl-2,3,4,9,10,10a-hexahydro-phenanthrene-4a-carboxylic acid; carnosol (4aR,9S,10aS)-5,6-Dihydroxy-7-isopropyl-1,1-dimethyl-2,3,4,9,10,10a-hexahydro-1H-9,4a(epoxymethano)-phenanthren-12-one; tocopherols (alpha tocopherol ((2R)-2,5,7,8-tetramethyl-2-[(4R,8R)-4,8,12-trimethyl-tridecyl]-3,4-dihydro-2H-chromen-6-ol); beta-tocopherol (2,5,8-trimethyl-2-(4,8,12-trimethyltridecyl)-3,4-dihydro-2H-1-benzopyran-6-ol); delta tocopherol ((2R)-2,8-dimethyl-2-[(4R,8R)-4,8,12-trimethyltridecyl]-3,4-dihydrochromen-6-ol); and gamma tocopherol (2,7,8-trimethyl-2-(4,8,12-trimethyltridecyl)-3,4-dihydro-2H-1-benzopyran-6-ol); quecertin (2-(3,4-Dihydroxyphenyl)-5,7-dihydroxy-4H-1-benzopyran-4-one); lutein (β,ε-carotene-3,3'-diol); catechin ((2R,3S)-2-(3,4-dihydroxyphenyl)-3,4-dihydro-2H-chromene-3,5,7-triol), ubiquinol 10 ([(2E,6E,10E,14E,18E,22E,26E,30E,34E)-3,7,11,15,19,23,27,31,35,39-Decamethyltetraconta-2,6,10,14,18,22,26,30,34,38-decaenyl]-5,6-dimethoxy-3-methylcyclohexa-2,5-diene-1,4-dione); kaempferol (3,5,7-trihydroxy-2-(4-hydroxyphenyl)-4H-1-benzopyran-4-one); naringenin ((2S)-5,7-Dihydroxy-2-(4-hydroxyphenyl)-2,3-dihydro-4H-1-benzopyran-4-on); hesperetin ((2S)-5,7-Dihydroxy-2-(3-hydroxy-4-methoxyphenyl)-2,3-dihydro-4H-1-benzopyran-4-one); lipoic acid ((R)-5-(1,2-dithiolan-3-yl)pentanoic acid); curcumin ((1E,6E)-1,7-bis(4-hydroxy-3-methoxyphenyl)-1,6-heptadiene-3,5-dione); ascorbyl fatty acid esters; or mixtures thereof.

The applicant has found that, among the biodegradable and bio-based antioxidants mentioned hereinabove, mixtures of carnosic acid and carnosol, were especially efficient in increasing the GREWER temperature of spray dried powder comprising aldehydes, monoterpenes or mixtures thereof. Surprisingly, these antioxidants proved to be as efficient at a level of 0.1 to 0.3 wt.-% as non-biodegradable Tinogard TS® (octadecyl 3-(3,5-di-tert-butyl-4-hydroxyphenyl)propionate (ex BASF) at a level of 2 wt.-% (see

composition **6** versus composition **2** in Example 2). The same advantage is observed over BHT, BHA and their derivatives.

Carnosic acid and carnosol have the advantage of being odorless and readily available from a number of essential oils.

In preferred embodiments of the present invention, the total level of carnosic acid, carnosol, or mixtures thereof is at a level of from 0.02 wt.-% to 5.0 wt.-%, preferably from 0.08 wt.-% to 2.0 wt.-%, even more preferably from 0.1 wt.-% to 1.0 wt.-% of the benefit agent.

Both carnosic acid and carnosol may be used in solid form or in the form of an essential oil, an extract, an absolute or a resinoid containing these materials. However, essential oils, extracts, absolutes or resinoids may dissolve more easily in the benefit agent.

In preferred embodiments, carnosic acid and carnosol are used in the form of essential oils, extracts or absolutes, preferably obtained from Lamiaceae species, preferably sage (*Salvia officinalis L.*, rosemary (*Rosmarinus officinalis L), basil (Ocimum basilicum L.), oregano (Origanum vulgare L.), thyme (Thymus vulgaris L.),* wild carrot *(Daucus carota L.)*, *and* fennel *(Foeniculum vulgare* Mill), more preferably from rosemary (*Rosmarinus officinalis L).*

In preferred embodiments, the essential oils, extracts or absolutes, or fractions thereof comprising enriched levels of carnosic acid and carnosol are deodorized by any means known to the art.

In preferred embodiments, the benefit agent is a fragrance or a flavor composition, more particularly a fragrance composition. Such compositions typically comprise aldehydes and, optionally, terpenes, which, as mentioned hereinabove may impact the GREWER temperature.

Fragrance aldehydes include but are not limited to 2,6,10-trimethylundec-9-enal (e.g. Adoxal); 2-decenal; 4-decenal; 6-decenal; 7-decenal; 9-decenal; 2-methyldecanal (e.g. Undecylenic Aldehyde MOA); undecanal; dodecanal; 2-methylundecanal (e.g. Lauric Aldehyde MNA); hexanal; heptanal; ocatanal; nonanal; decanal; benzaldehyde; 3-(4-(tert-butyl)phenyl)propanal (e.g. Bourgeonal); 2,4-dimethylcyclohex-3-ene-1-carbaldehyde (e.g. Cyclal C); 3-(4-isopropylphenyl)-2-methylpropanal (e.g. Cyclamen Aldehyde); (E)-4-

((3aS,7aS)-hexahydro-1H-4,7-methanoinden-5(6H)-ylidene)butanal (e.g. Dupical); 3-(4-methoxyphenyl)-2-methylpropanal (e.g. Fennaldehyde); 3-(3-isopropylphenyl)butanal (e.g. Florhydral); (E)-hex-2-enal (e.g. Hexenal-2-Trans); 2-phenylpropanal (e.g. Hydratropic Aldehyde); 3-(4-(tert-butyl)phenyl)-2-methylpropanal (e.g. Lilial); 3-methyl-5-phenylpentanal (e.g. Mefranal); 2,6-dimethylhept-5-enal (e.g. Melonal); (Z)-2-methyl-3-phenylacrylaldehyde (e.g. Methyl Cinnamic Aldehyde); (3aR,4R,6S,7R,7aR)-6-methoxyoctahydro-1H-4,7-methanoindene-1-carbaldehyde (e.g. Scentenal); 4-methyl-benzaldehyde (e.g. para tolyl aldehyde); 3-(benzo[d][1,3]dioxol-5-yl)-2-methylpropanal (e.g. Tropional); 3,5,5-trimethylhexanal (e.g. isononyl Aldehyde); (E)-3,7-dimethylocta-2,6-dienal (e.g. Citral); 3,7-dimethyloct-6-enal (e.g. Citronellal); (E)-dec-2-enal (e.g. Trans-2-Decenal); (E)-dodec-2-enal (e.g. dodecenal); (2E,6E)-3,7-dimethylnona-2,6-dienal (e.g. Ethyl Citral); 7-hydroxy-3,7-dimethyloctanal (e.g. Hydroxycitronellal); 2,4,6-trimethylcyclohex-3-enecarbaldehyde (e.g. Isocyclocitral); 3-methylbutanal (e.g. Isovaleraldehyde); 2-methyl-3-(4-methylphenyl)propanal (e.g. Jasmorange); (4E)-9-hydroxy-5,9-dimethyl-4-decenal (e.g. Mahonial); 7-methoxy-3,7-dimethyloctanal (e.g. Melonia); 6-methoxy-2,6-dimethylheptanal (e.g. Methoxymelonal); (Z)-2-methyl-4-(2,6,6-trimethyl-1-cyclohex-2-enyl)but-2-enal (e.g. Methyl Ional Beta); 5-methyl-2-phenylhex-2-enal, (E)-5-methyl-2-phenylhex-2-enal, (Z)-5-methyl-2-phenylhex-2-enal (e.g. Methyl Phenyl Hexenal); 4-(4-methylpent-3-en-1-yl)cyclohex-3-enecarbaldehyde (e.g. Myraldene); (2E,6Z)-nona-2,6-dienal (e.g. Nonadienal); (Z)-non-6-enal (e.g. Nonenal-6-Cis); 3-(4-(2-methylpropyl)-2-methylphenyl)propanal (e.g. Nympheal); (E)-2,6,10-trimethylundeca-5,9-dienal (e.g. Oncidal); 2-phenoxyacetaldehyde (e.g. Phenoxy Acetaldehyde); 3-phenylpropanal (e.g. Phenyl Propionic Aldehyde); 1-methyl-4-(4-methylpent-3-en-1-yl)cyclohex-3-enecarbaldehyde (e.g. Precyclemone B); 2,6,6-trimethylcyclohexa-1,3-dienecarbaldehyde (e.g. Safranal); 4-vinylcyclohex-1-enecarbaldehyde (e.g. Shisolia); 2-methyl-3-[4-(2-methylpropyl)phenyl]propanal (e.g. Silvial); 2-(p-tolyl)acetaldehyde (e.g. Syringa Aldehyde); 3,7-dimethyloctanal (e.g. Tetrahydro Citral); 2,4-dimethylcyclohex-3-enecarbaldehyde (e.g. Tricyclal); (E)-tridec-2-enal (e.g. Trans-2-Tridecenal); and 3-phenylbutanal (e.g. Trifernal).

Fragrance terpenes include but are not limited to 1-methyl-4-prop-1-en-2-yl-cyclohexene (e.g. Limonene); 2,6,6-trimethylbicyclo[3.1.1]hept-2-ene (e.g. Pinene Alpha); 6,6-dimethyl-2-methylenebicyclo[3.1.1]heptane (e.g. Pinene Beta); 7-methyl-3-methyleneocta-1,6-diene (e.g. Myrcene); 1- (E)-3,7-dimethylocta-1,3,6-triene (e.g. Ocimene); 1-methyl-4-propan-2-ylbenzene (e.g. Cymene Para); 1-methyl-4-propan-2-ylbenzene (e.g. Alloocimene); (1S,4R)-2,2-dimethyl-3-methylenebicyclo[2.2.1]heptane (e.g. Camphene); 3,7,7-trimethylbicyclo[4.1.0]hept-3-ene (e.g. Delta-3-Carene); 1-methyl-4-propan-2-ylcyclohexene (e.g. Menthene Para); methyl-4-(propan-2-ylidene)cyclohex-1-ene (e.g. Terpinolene); 1-methyl-4-propane-2-yl-cyclohexadiene (e.g. Terpinene); citrus oils; and distilled orange terpenes.

These aldehydes and monoterpenes may be combined with other fragrance ingredients, such as (E)-1-(2,6,6-trimethylcyclohex-2-en-1-yl)but-2-en-1-one (e.g. Damascone Alpha); 1-(2,6,6-trimethyl-1-cyclohex-3-enyl)but-2-en-1-one (e.g. Damascone Delta); 5-hexyloxolan-2-one (e.g. Decalactone Gamma); 2,6-dimethyloct-7-en-2-ol (e.g. Dihydro Myrcenol); 2-methyl-1-phenylpropan-2-yl butanoate (e.g. Dimethyl Benzyl Carbinyl Butyrate); oxydibenzene (e.g. Diphenyl Oxide); (E)-3-methyl-5-(2,2,3-trimethylcyclopent-3-en-1-yl)pent-4-en-2-ol (e.g. Ebanol); ethyl cyclohexyl carboxylate (e.g. Esterly); ethyl 3-oxobutanoate (e.g. Ethyl Acetoacetate); ethyl hexanoate (e.g. Ethyl Hexanoate); ethyl 2-methylpropanoate (e.g. Ethyl Isobutyrate); 2-ethyl-3-hydroxy-4H-pyran-4-one (e.g. Ethyl Maltol); ethyl 2-methylbutanoate (e.g. Ethyl Methyl-2-Butyrate); ethyl heptanoate (e.g. Ethyl Oenanthate); 1,4-dioxacycloheptadecane-5,17-dione (e.g. Ethylene Brassylate); (3aR,6S,7aS)-3a,4,5,6,7,7a-hexahydro-1H-4,7-methanoinden-6-yl propanoate (e.g. Florocyclene); 4,6,6,7,8,8-hexamethyl-1,3,4,6,7,8-hexahydrocyclopenta[g]isochromene (e.g. Galaxolide); (E)-3,7-dimethylocta-2,6-dien-1-ol (e.g. Geraniol Intermediate 60); (E)-3,7-dimethylocta-2,6-dien-1-yl acetate (e.g. Geranyl Acetate Synthetic); methyl 3-oxo-2-pentylcyclopentaneacetate (e.g. Hedione); (Z)-hex-3-en-1-ol (e.g. Hexenol-3-Cis); (Z)-hex-3-en-1-yl acetate (e.g. Hexenyl-3-Cis Acetate); (Z)-hex-3-en-1-yl butanoate (e.g. Hexenyl-3-Cis Butyrate); hexyl acetate (e.g. Hexyl Acetate); hexyl 2-methylpropanoate (e.g. Hexyl Isobutyrate); hexyl 2-hydroxybenzoate (e.g. Hexyl Salicylate); (E)-4-(2,6,6-trimethylcyclohex-1-

en-1-yl)but-3-en-2-one (e.g. Ionone Beta); 3-methylbutyl acetate (e.g. Isoamyl Acetate Extra); 3-methylbutyl butanoate (e.g. Isoamyl Butyrate Fr); 2-methylpropanoic acid (e.g. Isobutyric Acid); isopropyl 2-methylbutanoate (e.g. Isopropyl Methyl-2-Butyrate); (E)-3-methyl-4-(2,6,6-trimethylcyclohex-2-en-1-yl)but-3-en-2-one (e.g. Isoraldeine 70); (3aR,6S,7aS)-3a,4,5,6,7,7a-hexahydro-1H-4,7-methanoinden-6-yl acetate (e.g. Jasmacyclene); (3E,6E)-2,4,4,7-tetramethylnona-6,8-dien-3-one oxime (e.g. Labienoxime 1%/Ipm-Tec); (2E,6Z)-3,7-dimethylnona-2,6-dienenitrile (e.g. Lemonile); (Z)-hex-3-en-1-yl methyl carbonate (e.g. Liffarome Giv); 3,7-dimethylocta-1,6-dien-3-ol (e.g. Linalool Synthetic); ethyl 2-methylpentanoate (e.g. Manzanate); 3-methyl-5-phenylpentan-1-ol (e.g. Mefrosol); methyl 2-aminobenzoate (e.g. Methyl Anthranilate Extra); methyl benzoate (e.g. Methyl Benzoate); methyl 2-hydroxybenzoate (e.g. Methyl Salicylate); 2-(2-(4-methylcyclohex-3-en-1-yl)propyl)cyclopentan-1-one (e.g. Nectaryl); 5-pentyloxolan-2-one (e.g. Nonalactone Gamma); 5-butyloxolan-2-one (e.g. Octalactone Gamma); 1-(2-naphtalenyl)-ethanone (e.g. Oranger Crystals); (2-methoxyethyl)benzene (e.g. Pandanol); 5-heptyldihydrofuran-2(3H)-one (e.g. Peach Pure); 3,7-dimethyloctan-1-ol (e.g. Pelargol); 2-cyclohexylhepta-1,6-dien-3-one (e.g. Pharaone); 2-phenylethyl acetate (e.g. Phenyl Ethyl Acetate); 2-phenylethanol (e.g. Phenyl Ethyl Alcohol); 3-methylbut-2-en-1-yl acetate (e.g. Prenyl Acetate); 4-(4-hydroxyphenyl)butan-2-one (e.g. Raspberry Ketone); 2,2,2-trichloro-1-phenylethyl acetate (e.g. Rosacetol); 4-(dodecylthio)-4-methylpentan-2-one (e.g. Scentaurus Juicy); 1-phenylethyl acetate (e.g. Styrallyl Acetate); (E)-2-((3,5-dimethylhex-3-en-2-yl)oxy)-2-methylpropyl cyclopropanecarboxylate (e.g. Sylkolide); 2-(4-methylcyclohex-3-en-1-yl)propan-2-ol (e.g. Terpineol Pure); 3,7-dimethyloctan-3-ol (e.g. Tetrahydro Linalool); oxacyclohexadecan-2-one (e.g. Thibetolide); (E)-4-methyldec-3-en-5-ol (e.g. Undecavertol); and 2-methoxynaphtalene (e.g. Yara Yara).

Further fragrance aldehydes, monoterpenes, ethers and other fragrance ingredients may also be found in the perfumery literature, for example "Perfume & Flavor Chemicals", S. Arctander (Allured Publishing, 1994).

In preferred embodiments of the present invention, the fragrance composition comprises at least one, preferably at least two, more preferably

at least four, even more preferably at least eight, even still more preferably at least twelve biodegradable ingredient(s), and wherein the biodegradable ingredient(s) is/are present at a total concentration of at least 75 wt.-%, preferably at least 80 wt.-%, more preferably at least 85 wt.-%, even more preferably at least 90 wt.-%, even still more preferably at least 95 wt.-%, relative to the total weight of the perfume composition.

Suitable biodegradable fragrance ingredients include, but are not limited to 1-phenylethanone (e.g. Acetophenone Extra); 2,6,10-trimethylundec-9-enal (e.g. Adoxal); 2-(tert-butyl)cyclohexyl acetate (e.g. Agrumex); hexan-1-ol (e.g. Alcohol C 6 Hexylic); decanal (e.g. Aldehyde C 10 Decylic); 2-methyldecanal (e.g. Aldehyde C 11 Moa); undec-10-enal (e.g. Aldehyde C 11 Undecylenic); undecanal (e.g. Aldehyde C 110 Undecylic); dodecanal (e.g. Aldehyde C 12 Lauric); 2-methylundecanal (e.g. Aldehyde C 12 Mna Pure); hexan-1-al (e.g. Aldehyde C 6 Hexylic Food Grade); octanal (e.g. Aldehyde C 8 Octylic Food Grade); 3,5,5-trimethylhexanal (e.g. Aldehyde C 9 Isononylic); nonanal (e.g. Aldehyde C 9 Nonylic Food Grade); decanal (e.g. Aldehyde C 10 Decylic); undec-10-enal (e.g. Aldehyde C 11 Undecylenic); 2-methylundecanal (e.g. Aldehyde C 12 Mna); (E)-undec-9-enal (e.g. Aldehyde Iso C 11); prop-2-enyl 2-(3-methylbutoxy)acetate (e.g. Allyl Amyl Glycolate); prop-2-enyl hexanoate (e.g. Allyl Caproate); prop-2-enyl 3-cyclohexylpropanoate (e.g. Allyl Cyclohexyl Propionate); prop-2-enyl heptanoate (e.g. Allyl Oenanthate); 3,8,8,11a-tetramethyldodecahydro-1H-3,5a-epoxynaphtho[2,1-c]oxepine (e.g. Amberketal Ipm); (Z)-oxacycloheptadec-10-en-2-one (e.g. Ambrettolide); (3aR,5aS,9aS,9bR)-3a,6,6,9a-tetramethyl-2,4,5,5a,7,8,9,9b-octahydro-1H-benzo[e][1]benzofuran (e.g. Ambrofix); pentyl butanoate (e.g. Amyl Butyrate); (Z)-2-benzylideneheptanal (e.g. Amyl Cinnamic Aldehyde); pentyl 2-hydroxybenzoate (e.g. Amyl Salicylate); (E)-1-methoxy-4-(prop-1-en-1-yl)benzene (e.g. Anethole Synthetic); 4-methoxybenzyl acetate (e.g. Anisyl Acetate); 1-(3,3-dimethylcyclohexyl)ethyl formate (e.g. Aphermate); 4-methoxybenzaldehyde (e.g. Aubepine Para Cresol); (E)-methyl 2-((7-hydroxy-3,7-dimethyloctylidene)amino)benzoate (e.g. Aurantiol Pure); benzaldehyde (e.g. Benzaldehyde); benzyl acetate (e.g. Benzyl Acetate); 4-phenylbutan-2-one (e.g. Benzyl Acetone); phenylmethanol (e.g. Benzyl

Alcohol Extra); benzyl benzoate (e.g. Benzyl Benzoate); benzyl 3-phenylprop-2-enoate (e.g. Benzyl Cinnamate); benzyl 2-hydroxybenzoate (e.g. Benzyl Salicylate); octahydro-2H-chromen-2-one (e.g. Bicyclo Nonalactone); (1S,2S,4S)-1,7,7-trimethylbicyclo[2.2.1]heptan-2-ol (e.g. Borneol Crystals); (2S,4S)-1,7,7-trimethylbicyclo[2.2.1]heptan-2-yl acetate (e.g. Bornyl Acetate Liquid); 3-(4-(tert-butyl)phenyl)propanal (e.g. Bourgeonal); butyl acetate (e.g. Butyl Acetate); 4-(tert-butyl)cyclohexyl acetate (e.g. Butyl Cyclohexyl Acetate Para); (1S,4S)-1,7,7-trimethylbicyclo[2.2.1]heptan-2-one (e.g. Camphor Synthetic); (5R)-2-methyl-5-prop-1-en-2-ylcyclohex-2-en-1-one (e.g. Carvone Laevo); (1R,6S,8aS)-6-methoxy-1,4,4,6-tetramethyloctahydro-1H-5,8a-methanoazulene (e.g. Cedryl Methyl Ether); (E)-1-(2,6,6-trimethylcyclohex-2-en-1-yl)hepta-1,6-dien-3-one (e.g. Cetone V); (E)-3-phenylprop-2-en-1-ol (e.g. Cinnamic Alcohol Synthetic); (2E)-3-phenylprop-2-enal (e.g. Cinnamic Aldehyde); (E)-3-phenylprop-2-en-1-yl acetate (e.g. Cinnamyl Acetate); (Z)-hex-3-en-1-ol (e.g. Cis-3-Hexenol); (Z)-3-methyl-2-(pent-2-en-1-yl)cyclopent-2-enone (e.g. Cis Jasmone); (E)-3,7-dimethylocta-2,6-dienal (e.g. Citral Tech); 3,7-dimethyloct-6-enal (e.g. Citronellal Synthetic); 3,7-dimethyloct-6-en-1-ol (e.g. Citronellol Extra); 3,7-dimethyloct-6-en-1-yl acetate (e.g. Citronellyl Acetate); 3,7-dimethyloct-6-en-1-yl formate (e.g. Citronellyl Formate); 3,7-dimethyloct-6-enenitrile (e.g. Citronellyl Nitrile); dodecanenitrile (e.g. Clonal); 4-cyclohexyl-2-methylbutan-2-ol (e.g. Coranol); 2-hydroxy-3-methylcyclopent-2-enone (e.g. Corylone Dried); (Z)-3-methylcyclotetradec-5-enone (e.g. Cosmone); 2H-chromen-2-one (e.g. Coumarin Pure Crystals); 1-methoxy-4-methylbenzene (e.g. Cresyl Methyl Ether Para); 4-isopropylbenzonitrile (e.g. Cumin Nitrile); 2,4-dimethylcyclohex-3-ene-1-carbaldehyde (e.g. Cyclal C); 3-(4-isopropylphenyl)-2-methylpropanal (e.g. Cyclamen Aldehyde Extra); (E)-1-(2,6,6-trimethylcyclohexa-1,3-dien-1-yl)but-2-en-1-one (e.g. Damascenone Giv); (E)-1-(2,6,6-trimethylcyclohex-2-en-1-yl)but-2-en-1-one (e.g. Damascone Alpha); 5-hexyloxolan-2-one (e.g. Decalactone Gamma); (E)-dec-4-enal (e.g. Decenal-4-Trans); 1-methoxy-4-propylbenzene (e.g. Dihydro Anethole); 2,6-dimethyloct-7-en-2-ol (e.g. Dihydro Myrcenol); 2-methyl-1-phenylpropan-2-yl acetate (e.g. Dimethyl Benzyl Carbinyl Acetate); 2-methyl-1-phenylpropan-2-yl butanoate (e.g. Dimethyl Benzyl Carbinyl

Butyrate); 2,6-dimethylheptan-2-ol (e.g. Dimetol); oxydibenzene (e.g. Diphenyl Oxide); (E)-dodec-2-enal (e.g. Dodecenal 10%/Tec); (E)-3-methyl-5-(2,2,3-trimethylcyclopent-3-en-1-yl)pent-4-en-2-ol (e.g. Ebanol); ethyl cyclohexyl carboxylate (e.g. Esterly); ethyl acetate (e.g. Ethyl Acetate); ethyl 3-oxobutanoate (e.g. Ethyl Acetoacetate); ethyl 3-phenylprop-2-enoate (e.g. Ethyl Cinnamate); ethyl hexanoate (e.g. Ethyl Hexanoate); (E)-3,7-dimethylnona-1,6-dien-3-ol (e.g. Ethyl Linalool); 2-ethyl-3-hydroxy-4H-pyran-4-one (e.g. Ethyl Maltol); ethyl 2-methylbutanoate (e.g. Ethyl Methyl-2-Butyrate); ethyl heptanoate (e.g. Ethyl Oenanthate); 3-ethoxy-4-hydroxybenzaldehyde (e.g. Ethyl Vanillin); 1,4-dioxacycloheptadecane-5,17-dione (e.g. Ethylene Brassylate); (1s,4s)-1,3,3-trimethyl-2-oxabicyclo[2.2.2]octane (e.g. Eucalyptol Natural); 4-allyl-2-methoxyphenol (e.g. Eugenol); methyl 2,4-dihydroxy-3,6-dimethylbenzoate (e.g. Evernyl); (1S,2R,4R)-1,3,3-trimethylbicyclo[2.2.1]heptan-2-ol (e.g. Fenchyl Alcohol); 3-(4-methoxyphenyl)-2-methylpropanal (e.g. Fennaldehyde); 3-(3-isopropylphenyl)butanal (e.g. Florhydral); tetrahydro-4-methyl-2-(2-methylpropyl)-2H-pyran-4-ol (e.g. Florosa Hc); 2-(sec-butyl)cyclohexanone (e.g. Freskomenthe); 2-methyldecanenitrile (e.g. Frutonile); 1-(5,5-dimethylcyclohex-1-en-1-yl)pent-4-en-1-one (e.g. Galbanone Pure); (E)-3,7-dimethylocta-2,6-dien-1-ol (e.g. Geraniol); (E)-3,7-dimethylocta-2,6-dien-1-yl acetate (e.g. Geranyl Acetate Synthetic); (E)-6,10-dimethylundeca-5,9-dien-2-one (e.g. Geranyl Acetone); (E)-oxacyclohexadec-12-en-2-one (e.g. Habanolide); methyl 3-oxo-2-pentylcyclopentaneacetate (e.g. Hedione); benzo[d][1,3]dioxole-5-carbaldehyde (e.g. Heliotropine Crystals); (E)-hex-2-enal (e.g. Hexenal-2-Trans); (Z)-hex-3-en-1-ol (e.g. Hexenol-3-Cis); (Z)-hex-3-en-1-yl acetate (e.g. Hexenyl-3-Cis Acetate); (Z)-hex-3-en-1-yl 2-methylpropanoate (e.g. Hexenyl-3-Cis Isobutyrate); (Z)-hex-3-en-1-yl 2-hydroxybenzoate (e.g. Hexenyl-3-Cis Salicylate); hexyl acetate (e.g. Hexyl Acetate); (E)-2-benzylideneoctanal (e.g. Hexyl Cinnamic Aldehyde); hexyl 2-methylpropanoate (e.g. Hexyl Isobutyrate); hexyl 2-hydroxybenzoate (e.g. Hexyl Salicylate); 7-hydroxy-3,7-dimethyloctanal (e.g. Hydroxycitronellal Synthetic); 1H-indole (e.g. Indole Pure); (E)-4-(2,6,6-trimethylcyclohex-1-en-1-yl)but-3-en-2-one (e.g. Ionone Beta); (E)-4-(2,6,6-trimethylcyclohex-2-en-1-yl)but-3-en-2-one (e.g. Irisone Alpha); 3-methylbutyl acetate (e.g.

Isoamyl Acetate Extra); (E)-2-methoxy-4-(prop-1-en-1-yl)phenol (e.g. Isoeugenol); 2-isopropyl-5-methylcyclohexanone (e.g. Isomenthone Dl); isopropyl 2-methylbutanoate (e.g. Isopropyl Methyl-2-Butyrate); (E)-3-methyl-4-(2,6,6-trimethylcyclohex-2-en-1-yl)but-3-en-2-one (e.g. Isoraldeine 70); (Z)-3-methyl-2-(pent-2-en-1-yl)cyclopent-2-enone (e.g. Jasmone Cis); 3-butyl-5-methyltetrahydro-2H-pyran-4-yl acetate (e.g. Jasmonyl); 3-pentyltetrahydro-2H-pyran-4-yl acetate (e.g. Jasmopyrane Forte); (Z)-hex-3-en-1-yl methyl carbonate (e.g. Liffarome Giv); 3-(4-(tert-butyl)phenyl)-2-methylpropanal (e.g. Lilial); 1-methyl-4-prop-1-en-2-yl-cyclohexene (e.g. Limonene, Limonene Laevo, Limonene Dextro); 2-(5-methyl-5-vinyltetrahydrofuran-2-yl)propan-2-ol (e.g. Linalool Oxide); 3,7-dimethylocta-1,6-dien-3-ol (e.g. Linalool Synthetic); 3,7-dimethylocta-1,6-dien-3-yl acetate (e.g. Linalyl Acetate Synthetic); (4E)-9-hydroxy-5,9-dimethyl-4-decenal (e.g. Mahonial); 3-hydroxy-2-methyl-4H-pyran-4-one (e.g. Maltol); ethyl 2-methylpentanoate (e.g. Manzanate); (4-isopropylcyclohexyl)methanol (e.g. Mayol); 3-methyl-5-phenylpentan-1-ol (e.g. Mefrosol); 2,6-dimethylhept-5-enal (e.g. Melonal); 2-isopropyl-5-methylcyclohexanol (e.g. Menthol, Menthol Laevo, Menthol Racemic); 2-isopropyl-5-methylcyclohexanone (e.g. Menthone, Isomenthone, Menthone Laevo, Menthone Racemic); methyl 2-aminobenzoate (e.g. Methyl Anthranilate Extra); methyl benzoate (e.g. Methyl Benzoate); methyl 3-phenylprop-2-enoate (e.g. Methyl Cinnamate); 2-ethoxy-4-(methoxymethyl)phenol (e.g. Methyl Diantilis); methyl 2-hexyl-3-oxocyclopentane-1-carboxylate (e.g. Methyl Dihydro Isojasmonate); 6-methylhept-5-en-2-one (e.g. Methyl Heptenone Pure); 8-methyl-1-oxaspiro[4.5]decan-2-one (e.g. Methyl Laitone); methyl non-2-ynoate (e.g. Methyl Octyne Carbonate); methyl 2-hydroxybenzoate (e.g. Methyl Salicylate); (Z)-3-methylcyclopentadec-5-enone (e.g. Muscenone); 4-(4-methylpent-3-en-1-yl)cyclohex-3-enecarbaldehyde (e.g. Myraldene); 7-methyl-3-methyleneocta-1,6-diene (e.g. Myrcene 90); 2-methylundecanoic acid (e.g. Mystikal); 2-(2-(4-methylcyclohex-3-en-1-yl)propyl)cyclopentanone (e.g. Nectaryl); (E)-methyl non-2-enoate (e.g. Neofolione); (2Z)-3,7-dimethylocta-2,6-dien-1-ol (e.g. Nerolex); (E)-3,7,11-trimethyldodeca-1,6,10-trien-3-ol (e.g. Nerolidol Synthetic); 2-ethoxynaphthalene (e.g. Neroline Crystals); (Z)-3,7-dimethylocta-2,6-dien-

1-yl acetate (e.g. Neryl Acetate Hc); (E)-13-methyloxacyclopentadec-10-en-2-one (e.g. Nirvanolide); (2E,6Z)-nona-2,6-dienal (e.g. Nonadienal); (2Z,6E)-2,6-nonadien-1-ol (e.g. Nonadienol-2,6); 5-pentyloxolan-2-one (e.g. Nonalactone Gamma); (Z)-non-6-enal (e.g. Nonenal-6-Cis); (Z)-non-6-en-1-ol (e.g. Nonenol-6-Cis); 2-(6,6-dimethylbicyclo[3.1.1]hept-2-en-2-yl)ethyl acetate (e.g. Nopyl Acetate); 3-(4-(2-methylpropyl)-2-methylphenyl)propanal (e.g. Nympheal); octan-2-one (e.g. Octanone-2); 1-(2-naphtalenyl)-ethanone (e.g. Oranger Crystals); (2-methoxyethyl)benzene (e.g. Pandanol); 5-heptyldihydrofuran-2(3H)-one (e.g. Peach Pure); 3,7-dimethyloctan-1-ol (e.g. Pelargol); 2-cyclohexylhepta-1,6-dien-3-one (e.g. Pharaone); 2-(phenoxy)ethyl 2-methylpropanoate (e.g. Phenoxy Ethyl Isobutyrate); 2-phenyl-ethanal (e.g. Phenyl Acetaldehyde); 2-phenylethyl acetate (e.g. Phenyl Ethyl Acetate); 2-phenylethanol (e.g. Phenyl Ethyl Alcohol); 2-phenylethyl 2-methylpropanoate (e.g. Phenyl Ethyl Isobutyrate); 2-phenylethyl 2-phenylacetate (e.g. Phenyl Ethyl Phenyl Acetate); 3-phenylpropan-1-ol (e.g. Phenyl Propyl Alcohol); 6,6-dimethyl-2-methylenebicyclo[3.1.1]heptane (e.g. Pinene Beta); 3-(6,6-dimethylbicyclo[3.1.1]hept-2-en-2-yl)propanal (e.g. Pinoacetaldehyde); (2E,5E)-5,6,7-trimethylocta-2,5-dien-4-one (e.g. Pomarose); 1-methyl-4-(4-methylpent-3-en-1-yl)cyclohex-3-enecarbaldehyde (e.g. Precyclemone B); 3-methylbut-2-en-1-yl acetate (e.g. Prenyl Acetate); (E)-2-ethyl-4-(2,2,3-trimethylcyclopent-3-en-1-yl)but-2-en-1-ol (e.g. Radjanol); 4-(4-hydroxyphenyl)butan-2-one (e.g. Raspberry Ketone); 4-methyl-2-(2-methylprop-1-en-1-yl)tetrahydro-2H-pyran (e.g. Rose Oxide Co); 4-methyl-2-phenyl-3,6-dihydro-2H-pyran (e.g. Rosyrane Super); 3-methyl-5-(2,2,3-trimethylcyclopent-3-en-1-yl)pentan-2-ol (e.g. Sandalore Extra); ethyl (Z)-2-acetyl-4-methyltridec-2-enoate (e.g. Scentaurus Clean); 4-(dodecylthio)-4-methylpentan-2-one (e.g. Scentaurus Juicy); cyclopentadecanone, hexadecanolide (e.g. Silvanone Supra); 1-phenylethyl acetate (e.g. Styrallyl Acetate); (E)-6-ethyl-3-methyloct-6-en-1-ol (e.g. Super Muguet); (E)-2-((3,5-dimethylhex-3-en-2-yl)oxy)-2-methylpropyl cyclopropanecarboxylate (e.g. Sylkolide); 1-methyl-4-propan-2-ylcyclohexa-1,4-diene (e.g. Terpinene Gamma); 2-(4-methyl-1-cyclohex-3-enyl)propan-2-ol (e.g. Terpineol Alpha); 2-(4-methylcyclohex-3-en-1-yl)propan-2-ol (e.g. Terpineol Pure); 1-methyl-4-(propan-2-ylidene)cyclohex-1-ene (e.g. Terpinolene); 2-(4-

methyl-1-cyclohex-3-enyl)propan-2-yl acetate (e.g. Terpinyl Acetate); 3,7-dimethyloctan-3-ol (e.g. Tetrahydro Linalool); oxacyclohexadecan-2-one (e.g. Thibetolide); 2-isopropyl-5-methylphenol (e.g. Thymol); 1-(cyclopropylmethyl)-4-methoxybenzene (e.g. Toscanol); (E)-tridec-2-enenitrile (e.g. Tridecene-2-Nitrile); 3-phenylbutanal (e.g. Trifernal); 3-(benzo[d][1,3]dioxol-5-yl)-2-methylpropanal (e.g. Tropional); undecan-2-one (e.g. Methyl Nonyl Ketone); (3E,5Z)-undeca-1,3,5-triene (e.g. Undecatriene); (E)-4-methyldec-3-en-5-ol (e.g. Undecavertol); 4-hydroxy-3-methoxybenzaldehyde (e.g. Vanillin); (Z)-cyclohexadec-5-enone (e.g. Velvione); (2E,6Z)-nona-2,6-dienenitrile (e.g. Violet Nitrile 10%/Tec); and 2-methoxynaphtalene (e.g. Yara Yara).

In preferred embodiments, the spray-dried compositions of the present kind typically have a proportion of benefit agent of from 10 wt.-% to 70 wt.-%, preferably from 25 wt.-% to 60 wt.-%, more preferably from 35 wt.-% to 55 wt.-%, even more preferably from 40 wt.-% to 50 wt.-%, relative to the total weight of the composition.

More generally, if the level of benefit agent (payload) is too high, additional risk may emerge, such as the risk of explosion. Additionally, the proportion of non-encapsulated benefit agent, which is often referred to as "surface oil" may be too high. Conversely, low payloads increase the cost of the spray-dried composition.

The water-soluble matrix can comprise at least one material selected from the group consisting of starch, in particular water-soluble modified starch, maltodextrin, mannitol, chitosan, gum Arabic, alginate, cellulose, pectins, gelatin, polyvinyl alcohol and mixtures thereof. The resulting perfume encapsulates are facile and cost-effective in manufacture. Furthermore, they are prepared of naturally-based materials, which are non-toxic and biodegradable. Such encapsulates therefore have an increased consumer-appeal.

When the starch is a water-soluble modified starch, such starch can be made from raw starch or pre-gelatinized starch. It can be derived from tubers, legumes, cereals and grains, for example corn starch, wheat starch, rice starch, waxy corn starch, oat starch, cassava starch, waxy barley starch,

waxy rice starch, sweet rice starch, amioca starch, potato starch, tapioca starch and mixtures thereof.

The water-soluble modified starch can be selected from the group consisting of bleached starch, hydroxypropyl starch, hydroxypropyl distarch phosphate, dydroxypropyl distarch glycerol, acetylated distarch phosphate, starch acetate esterified with acetic anhydride, starch acetate esterified with vinyl acetate, acetylated distarch adipate, acetylated distarch glycerol, starch sodium octenyl succinate and mixtures thereof.

Preferably, the modified starch is a sodium octenyl succinate dextrin, this dextrin being obtained by chemical or enzymatic degradation of starch. Such modified dextrins, also referred to under the generic term "OSA-modified starch" are available under various trademarks, such as Purity Gum®, HiCap® 100 and Capsul®, all of them ex Ingredion.

Water-soluble OSA-modified starches, more particularly OSA-modified dextrins have emulsifying and emulsion-stabilizing capacity. They have the ability to entrap droplets of benefit agent in the form of oil-in-water emulsions due to the hydrophobic character of the starch modifying agent. The modified starches as described herein above bring numerous advantages including high emulsification and encapsulation performance, low viscosity, even at high solids content, and excellent oxidation resistance to ensure good fragrance and/or cosmetic preservation and stabilization of sensitive ingredients.

When the water-soluble matrix comprises a water-soluble modified starch, it can additionally comprise a material selected from the group consisting of maltodextrin, mannitol and mixtures thereof. Maltodextrin and mannitol both increase the glass transition temperature of the matrix. Furthermore, maltodextrin is a film forming agent.

Maltodextrins are characterized by their dextrin equivalent (DE). The higher the DE, the lower is the molecular weight of the maltodextrin. In the context of the present invention, maltodextrin having different DE may be combined to provide optimized encapsulation properties. Without being bound by any theory, it is supposed that mixtures of low and high DE maltodextrins improve the packing of the water-soluble matrix.

Further to the materials stated herein above, the water-soluble matrix can additionally comprise a hemicellulose. In the context of the present invention, the expression *"hemicellulose"* is to be understood as a polysaccharide selected from the group consisting of glucans, in particular xyloglucans, mannans, in particular glucomannans, and xylans, in particular arabinoxylans and glucuronoxylans.

It has been found that addition of a hemicellulose to a water-soluble matrix, in particular a starch matrix, leads to a modification of the matrix, improving its perfume release properties under moisture and mechanical (e.g. friction) activation.

The hemicellulose is preferably a xyloglucan, in particular a xyloglucan obtainable from tamarind seeds. Xyloglucans are the most abundant hemicellulose in the primary walls of non-graminaceous plants, often comprising 20 wt.-% of the dry mass of the wall. A xyloglucan has a backbone composed of 1,4-linked β-D-glucose residues. Up to 75 % of the backbone residues are substituted at C6 with mono-, di-, or trisaccharide sidechains. Preferably, the hemicellulose is a xyloglucan obtainable from tamarind seeds, in particular obtained from tamarind seeds, also known as *"tamarind kernel powder"* or *"tamarind gum"*. In tamarind gum, the side chains consist of one or two α-D-xylopyranosyl units, optionally capped with β-D-galactopyranosyl, α-L-arabinofuranosyl or β-D-xylopyranosyl.

In preferred embodiments, the water-soluble encapsulating material comprises at least one material selected from the group consisting of starch, in particular water-soluble modified starch, more particularly starch sodium octenyl succinate, maltodextrin, mannitol, chitosan, gum Arabic, alginate, pectins, gelatin, polyvinyl alcohol and mixtures thereof.

In the context of the present invention, the benefit agent can be at least partially encapsulated in core-shell microcapsules comprising a core and a shell surrounding the core.

By "encapsulated core" it is meant that droplets of benefit agent are surrounded by solid walls/shells. Such microcapsules typically range in size from 5 to 500 micrometres. The technology behind benefit agent-containing microcapsules and their preparation is well known and much used, and any

known microcapsules are suitable for use in the compositions of this disclosure. Typical examples of suitable microcapsules are those with shells of acrylic polymer, polyurea and aminoplast polymer, such as urea-and melamine-formaldehyde. Natural and biodegradable materials such as gelatin, optionally crosslinked, may also be used. These are well known to the art and may be prepared by any of the known methods.

In a particular embodiment, benefit agent-containing microcapsules with walls of biodegradable materials, such as gelatin, are dispersed within a biodegradable solid material such as starch, optionally with free benefit agent droplets also encapsulated within.

In a second aspect, the present invention provides a method for obtaining a spray-dried composition according to any of the preceding claims, the method comprising the steps of:

a) Forming an emulsion, wherein the benefit agent is dispersed in an aqueous phase, the aqueous phase comprising a water-soluble encapsulating material and the emulsion comprising an antioxidant;

b) Spray-drying the emulsion formed in a) in order to form a powder, wherein the benefit agent is entrapped in the encapsulating material; and

wherein the level of benefit agent is from 30 wt.-% to 60 wt.-%, more particularly from 35 wt.-% to 55 wt.-% of the spray-dried composition; and the level of the antioxidant is 0.01 wt.-% to 10 wt.-% of the benefit agent.

The benefit agent, encapsulating material and the antioxidant are as described hereinabove.

In respect to step a), the antioxidant may be admixed to both the benefit agent and the aqueous phase or added to the system prior to or during emulsification, or after the emulsion has been formed. The benefit agent is emulsified under high shear mixing in order to form an oil-in-water emulsion having average droplet size preferably below 5 micrometers, more preferably below 2 micrometers and most preferably below 1 micrometer. Preferably, the emulsion comprises less than 60 wt% water, more preferably less than 55 wt% and most preferably less than 51 wt% water; whereas the remaining

part of the emulsion comprises both benefit agent and carbohydrate-based matrix components in hereinabove mentioned proportions.

In respect to step b), spray-drying may be performed using rotating disk or nozzle atomizers such as air pressure nozzles or two-fluid nozzles or a rotating disk, into a co-current hot air drying chamber. As mentioned hereinabove, the air inlet temperature is typically from 80 °C to 220 °C, more particularly from 150 °C to 200 °C. The outlet temperature is from 50 °C to 100 °C. Alternatively, spray-drying may be performed in a fluid bed dryer or a drum drying, and the like, meaning anywhere where the emulsion is dried by contact with hot air.

In preferred embodiments,

a) the antioxidant is carnosic acid and/or carnosol; and

b) the encapsulating material is octenyl succinate-modified starch dextrin in combination with maltodextrin, mannitol or mixtures thereof.

In particularly preferred embodiments, the benefit agent is a fragrance or a flavor composition and the method comprises the steps of:

a) Forming an emulsion comprising, based on the total weight of the emulsion:

   i. 15 wt.-% to 35 wt.-%, preferably 20 wt.-% to 30 wt.-% of a fragrance or a flavor composition,

   ii. 15 wt.-% to 30 wt.-%, preferably 20 wt.-% to 25 wt.-% of octenyl succinate modified starch dextrin;

   iii. 0 to 10 wt.-%, preferably y 4 wt.-% to 6 wt.-% of maltodextrin, mannitol or a mixture thereof; and

   iv. 25 wt.-% to 70 wt.-%, preferably 39 wt.-% to 56 wt.-% of water;

   wherein the fragrance or flavor composition comprises, based on the total weight of the fragrance of flavor composition:

i. more than 10 wt.-%, more particularly more than 12 wt.-%, still more particularly more than 14 wt.-% of total aldehydes, monoterpenes, or mixtures thereof; and

ii. from 0.01 wt.-% to 10 wt.-%, optionally, from 0.02 wt.-% to 5.0 wt.-%, preferably from 0.08 wt.-% to 2.0 wt.-%, even more preferably from 0.1 wt.-% to 1.0 wt.-% of carnosic acid, carnosol, or mixtures thereof; and

b) Spray-drying the emulsion formed in a) in order to form a powder, wherein the benefit agent is encapsulated in the encapsulating material.

In particular embodiments, the method comprises the additional step of diluting the spray dried composition obtained in step b) in a solid carrier.

In particular embodiments, the solid carrier is selected from urea, sodium chloride, sodium sulphate, sodium acetate, zeolite, sodium carbonate, sodium bicarbonate, clay, talc, calcium carbonate, magnesium sulfate, gypsum, calcium sulfate, magnesium oxide, zinc oxide, titanium dioxide, calcium chloride, potassium chloride, magnesium chloride, zinc chloride, saccharides, polyethylene glycol, polyvinylpyrrolidone, citric acid or any water soluble solid acid, fatty alcohols, fatty acids and mixtures thereof.

Diluting such a powder in a carrier material allows for providing formulations that are compliant with dust explosion regulations, as it is known that the explosion risk increases with the concentration of the perfume ingredients in the powder.

When a solid carrier is used, the proportion of the spray-dried composition can be 0.1 to 50 wt.-%, preferably 1 to 30 wt.-%, even more preferably 3 to 15 wt.-%, relative to the total weight of the powder formulation. The proportion of the solid carrier can be 10 to 99.9 wt.-%, preferably 30 to 97 wt.-%, even more preferably 50 to 95 wt.-%, relative to the total weight of the powder formulation. Under such conditions, the powder may be maintained below critical explosion values, in terms of explosivity class and minimal ignition energy value.

As alternative or in addition a solid carrier, a powder formulation according to the present invention can also comprise a flowing agent. The flowing agent is selected from the group consisting of silicon dioxide, sodium salts, calcium

salts and zeolites. Flowing agents limit the risk of powder agglomeration and clogging, and ease the transfer of the encapsulated composition from one vessel to another.

In a third aspect, the present invention provides consumer products comprising a spray-dried composition according to the present invention, wherein the consumer product is anhydrous or in which the water activity is lower than 0.25, preferably lower than 0.1.

A water activity in the consumer product exceeding 0.25 may be induce an excessive moisture in the product, which could plasticize or dissolve the hydrophilic encapsulating matrix and, therefore, affect the storage stability of the spray-dried composition.

Such consumer products include laundry care powder detergents and solid single dose detergent, such as tablets, laundry care conditioner sheets, solid scent boosters, dry personal cleansing compositions, shampoo, water-free deodorant and antiperspirant compositions, home care compositions, such as hard surface powder cleaners and dish washing tablets.

A consumer product can contain the undiluted spray-dried composition as described herein above, preferably at a level of 0.005 to 5 wt.-%, more preferably from 0.01 to 1 wt.-%, and still more preferably from 0.02 to 0.5 wt.-%, of the consumer product.

In a fourth aspect, the present invention provides the use of a substantially odorless, biodegradable antioxidant, more particularly of bio-based and biodegradable antioxidants, even more preferably of carnosic acid, carnosol or mixtures thereof, to increase the self-heating and/or the GREWER temperature of spray-dried powders containing more than 10 wt.-%, more particularly more than 12 wt.-%, still more particularly more than 14 wt.-% of total aldehydes, monoterpenes, or mixtures thereof.

Further features and particular advantages of the present invention become apparent from the following examples.

Example 1: Fragrance compositions

Perfume (fragrance) compositions A, B, C and D, without antioxidant, were prepared by mixing the perfume ingredients listed in Tables 1 to 4 at the given concentrations.

Table 1: Fragrance Composition A

Perfume ingredient	**wt.-%**
2-(tert-butyl)cyclohexyl acetate	13.2
1-(2,3,8,8-tetramethyl-1,2,3,4,5,6,7,8-octahydronaphthalen-2-yl)ethanone	9.6
(E)-2-benzylideneoctanal	8.4
3,7-dimethyloctan-3-ol	8.4
(3aR,6S,7aS)-3a,4,5,6,7,7a-hexahydro-1H-4,7-methanoinden-6-yl propanoate	6.6
2,6-dimethyloct-7-en-2-ol	6.0
(E)-4-methyldec-3-en-5-ol	5.8
hexyl 2-hydroxybenzoate	5.4
4-(tert-butyl)cyclohexyl acetate	4.8
3-(4-(2-methylpropyl)-2-methylphenyl)propanal	2.4
2-methyl-1-phenylpropan-2-yl acetate	4.0
(3aR,6S,7aS)-3a,4,5,6,7,7a-hexahydro-1H-4,7-methanoinden-6-yl acetate	3.3
3-(4-isopropylphenyl)-2-methylpropanal	4.8
3,7-dimethyloct-6-en-1-ol	2.9
ethyl 2-methylbutanoate	2.6
1-(2,6,6-trimethyl-1-cyclohex-3-enyl)but-2-en-1-one	2.6
(E)-3,7-dimethylocta-2,6-dien-1-ol	4.3
5-heptyldihydrofuran-2(3H)-one	1.8
methyl 3-oxo-2-pentylcyclopentaneacetate	1.8

hexyl acetate	1.3
total	100.0

Table 2: Fragrance composition B

Fragrance ingredient	**wt.-%**
2-(tert-butyl)cyclohexyl acetate	20
5-heptyldihydrofuran-2(3H)-one	10
Orange terpenes distilled	12
3,7-dimethyloctan-3-ol	6
(E)-4-methyldec-3-en-5-ol	4
3,7-dimethylocta-1,6-dien-3-ol	6
2-(2-(4-methylcyclohex-3-en-1-yl)propyl)cyclopentan-1-one	5
benzyl acetate	5
2-(4-methylcyclohex-3-en-1-yl)propan-2-ol	5
(E)-3,7-dimethylocta-2,6-dien-1-ol	7
hexanal	3
oxacyclohexadecan-2-one	3
oxydibenzene	2
2-phenylethyl acetate	2
3,7-dimethyloct-6-enal	2
(E)-2-((3,5-dimethylhex-3-en-2-yl)oxy)-2-methylpropyl cyclopropanecarboxylate	1
3-(4-(2-methylpropyl)-2-methylphenyl)propanal	2
1-methyl-4-(propan-2-ylidene)cyclohex-1-ene	4
3-ethoxy-4-hydroxybenzaldehyde	1
total	100

Table 3: Fragrance composition C

Fragrance ingredient	**Wt.-%**
Dodecanal	8
Hexanal	0.3
(E)-2-hexanal	0.2
3-(3-isopropylphenyl)butanal	2
3-(4-(2-methylpropyl)-2-methylphenyl)propanal	5
Eucalyptol ((1s,4s)-1,3,3-trimethyl-2-oxabicyclo[2.2.2]octane)	7
4-(tert-butyl)cyclohexyl acetate	15
(3aR,6S,7aS)-3a,4,5,6,7,7a-hexahydro-1H-4,7-methanoinden-6-yl propanoate	4
2-(tert-butyl)cyclohexyl acetate	14
1-(2,6,6-trimethyl-1-cyclohex-3-enyl)but-2-en-1-one	4
4-methyl-2-(2-methylprop-1-en-1-yl)tetrahydro-2H-pyran	0.5
ethyl 2-methylpentanoate	1.5
Patchouli oil	2.5
2-cyclohexylidene-2-(o-tolyl)acetonitrile	5
pentyl 2-hydroxybenzoate	9
3,7-dimethyloctan-3-ol	22
Total	100.00

Table 4: Fragrance composition D

Fragrance ingredient	**wt.-%**
3,7-dimethylocta-1,6-dien-3-ol	10
2-(4-methylcyclohex-3-en-1-yl)propan-2-ol	8
pentyl 2-hydroxybenzoate	14
(E)-2-benzylideneoctanal	4
2-(tert-butyl)cyclohexyl acetate	5
hexyl 2-hydroxybenzoate	8
2,6-dimethyloct-7-en-2-ol	6
5-heptyldihydrofuran-2(3H)-one	2
Orange terpenes	3

1,4-dioxacycloheptadecane-5,17-dione	5
(E)-3,7-dimethylocta-2,6-dien-1-ol	5
3-methyl-5-phenylpentan-1-ol	1
Eucalyptus oil	3
1-phenylethyl acetate	3
(2S,4S)-1,7,7-trimethylbicyclo[2.2.1]heptan-2-yl acetate	10
methyl 3-oxo-2-pentylcyclopentaneacetate	5
2-phenylethanol	5
Patchouli oil	1
(E)-3-methyl-5-(2,2,3-trimethylcyclopent-3-en-1-yl)pent-4-en-2-ol	1
(E)-3-phenylprop-2-en-1-ol	1
total	100

As summarized in Table 5, Perfume A comprises 15.6 wt.-% aldehydes, i.e. more than 15 wt.-%, and therefore falls into the group of fragrance compositions that may results in powders having a low GREWER temperature.

Perfume B comprises 8 wt.-% total aldehydes and 12 wt.-% of monoterpenes. Perfume B falls therefore in the group of fragrance compositions that may results in powders having a low GREWER temperature.

Perfume C comprises 15.5 wt.-% of aldehydes. Perfume C falls therefore in the group of fragrance compositions that may results in powders having a low GREWER temperature.

Perfume D comprises 7 wt.-% of aldehydes (4 wt.-% hexyl cinnamic aldehyde ((E)-2-benzylideneoctanal) and monoterpenes (3 wt.-% orange terpenes). This perfume is not critical according to the present invention.

Table 5

Perfume composition	Sum aldehydes, wt%	Sum monoterpenes, wt%	Sum aldehydes and monoterpenes, wt%
A	15.6	0	15.6
B	8	12	20
C	15.5	0	15.5
D	4	3	7

Example 2: Preparation of spray-dried compositions and measurement of their GREWER temperature

Spray-dried compositions comprising perfume compositions as prepared in Example 1 have been prepared as follows:

Tap water (45.3 g) is weighted into a stainless steel beaker. Starch sodium octenyl succinate E1450 (21.9 g) and mannitol (5.5 g) are subsequently weighted into the same beaker. The resulting mixture is first manually stirred with a stainless steel rod and then homogenized with an IKA T25 Ultra-Turrax Homogenizer at 13,500 rpm to obtain a homogeneous solution. To this resulting mixture, a perfume composition (27.4 g (or 26.3 g for comparative composition **2**)), comprising a known amount of neat perfume A, B, C or D, and a known amount of antioxidant, where indicated, was added (Tables 6 and 7). High shear mixing was then carried out for 20-30 min at 22,000-24,000 rpm using the same homogenizer to produce an emulsion. The droplet size distribution was measured by dynamic light scattering and was between 0.5 and 2 µm.

The emulsion has been subjected to spray drying using a LabPlant SD-06 Spray Dryer. The spray drying process parameters were as follows:

- Inlet Temperature: 190 °C
- Outlet Temperature: 90 °C
- Peristaltic pump speed: 485 mL/h
- Air flow rate: 3.7 m/s

The resulting spray dried powder was mixed with silicon dioxide Aerosil 200 (1.0 g) in a closed mixing vessel.

The GREWER temperature of the spray-dried samples was measured calorimetrically in a Grewer oven (manufactured by Tüv Süd). Six 8-ml wire-mesh baskets were placed in a heated air stream (2 L/min), five of them containing the spray dried composition to measure and one containing a reference graphite sample. Each of the six baskets was affixed with a thermocouple to monitor the internal temperature of the samples. The temperature of the air stream was than ramped from ambient temperature to 400 °C at a rate of 1 °C/min, and the temperature of each sample was monitored. The temperature at which the average temperature of the spray dried samples started to diverge from that of the reference graphite sample was taken as the self-heating temperature and reported in Table 6 and Table 7.

Spray-dried compositions containing fragrance composition C (Sample C) and three additional fragrance compositions derived from this perfume (C1, C2 and C3) with varying levels of aldehydes and monoterpenes, as reported in Table 6 have also been prepared.

Table 6 Fragrance compositions C, C1, C2 and C3

	Wt.-%	**Wt.-%**	**Wt.-%**	**Wt.-%**
Fragrance ingredient	**C**	**C1**	**C2**	**C3**
Dodecanal	8	0	4	8
Hexanal	0.3	0.3	0.3	
(E)-2-hexanal	0.2	0.2	0.2	
3-(3-isopropylphenyl)butanal	2	0	1	2
3-(4-(2-methylpropyl)-2-methylphenyl)propanal	5	4.5	4.5	5.5
Eucalyptol ((1s,4s)-1,3,3-trimethyl-2-oxabicyclo[2.2.2]octane)	7	7	7	7
4-(tert-butyl)cyclohexyl acetate	15	17	17	15
(3aR,6S,7aS)-3a,4,5,6,7,7a-hexahydro-1H-4,7-methanoinden-6-yl propanoate	4	4	4	4
2-(tert-butyl)cyclohexyl acetate	14	16.5	14	14

1-(2,6,6-trimethyl-1-cyclohex-3-enyl)but-2-en-1-one	4	4	4	4
4-methyl-2-(2-methylprop-1-en-1-yl)tetrahydro-2H-pyran	0.5	0.5	0.5	0.5
ethyl 2-methylpentanoate	1.5	1.5	1.5	1.5
Patchouli oil	2.5	2.5	2.5	2.5
2-cyclohexylidene-2-(o-tolyl)acetonitrile	5	5	5	5
pentyl 2-hydroxybenzoate	9	12	12	9
3,7-dimethyloctan-3-ol	22	25	23	22
Total	100.00	100.00	100.50	100.00
Sum aldehydes and terpenes	15.50	5.00	10.00	15.50

Table 7 shows the GREWER temperature of all spray-dried compositions discussed above which do not contain any antioxidant.

Table 7

Spray-dried composition	**Perfume composition**	**GREWER temperature**
13	D	152
1	A	109
12	B	104
	C	116
	C1	133
	C2	123
	C3	120

As apparent from Tables 5, 6 and 7, the relatively high levels of total aldehydes and monoterpenes in a perfume composition (above 10 wt%) is critical for the GREWER temperature of the spray-dried compositions comprising these perfumes (compositions comprising perfumes A, B, C, C2 and C3, with a GREWER temperature below 125 °C).

When the level of total aldehydes and monoterpenes in a perfume composition is relatively low (i.e. below 10 wt%, compositions comprising

perfumes D and C1), the GREWER temperature (self-heating temperature) is above 130 °C, therefore not problematic.

The GREWER temperatures of spray-dried compositions containing fragrance composition A with different antioxidants and different levels of antioxidants, as well as those of fragrance compositions B and D are shown in Table 8.

Table 8. The GREWER temperature of spray-dried compositions **1** to **13**

Spray-dried composition	**1[a]**	**2[b]**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12[a]**	**13[a]**
Fragrance composition A (g)	100	98	98	98	98	96	96	94	94	94	94		
Fragrance composition B (g)												100	
Fragrance composition D (g)													100
Tinogard TS (g)		2											
NATROX™ RO CLEAR JA000036 (g)			2			4		6					
NATROX™ RO JA000034 (g)				2									
NATROX™ RO E20 JA000040 (g)					2		4		6				
N.A.S. ™										3	6		
% of perfume composition in the emulsion	27.4	26.3	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4
GREWER temperature [°C]	109	140	133	135	138	140	138	134	131	134	138	104	152

[a] comparative

[b] comparative, 4% less perfume composition was emulsified prior to spray drying.

Table 9: Nominal antioxidant concentration ranges in NATROX™ and [N.A.S.]™ rosemary extracts

Antioxidant	**Carnosic acid + Carnosol wt.-% (nominal)**
NATROX™ RO CLEAR JA000036	4.0 - 5.0
NATROX™ RO JA000034	5.5 - 6.5

NATROX™ RO E20 JA000040	5.5 - 7.5
N.A.S.™	5.5 – 7.5

As apparent from the results of Table 8, all antioxidants increase the self-heating temperature of the spray dried composition by a significant extent (compositions **2** to **11**), compared to the value of the comparative composition **1**, comprising no antioxidant in the spray-dried fragrance composition A, with low GREWER temperature.

As little as 2 wt.-% of bio-based and biodegradable rosemary extract NATROX™ is enough to increase the GREWER temperature of spray-dried compositions employing 20 wt% of perfume compositions in the pre-spray-dry emulsion, wherein the perfume composition comprises more than 10 wt% of total aldehydes and monoterpenes (compositions **3** to **11**), to a level of above 125 °C.

Using 2 wt.-% of rosemary extract NATROX™, or 3 wt.-% of rosemary extract [N.A.S.]™, comprising from 4.0 to 7.5 wt% carnosic acid and carnosol, in the perfume composition increases the self-heating temperature of the spray dried composition by almost the same extent as the same amount (2 wt%) of Tinogard TS (composition **2**), which is not bio-based or biodegradable.

Claims

1. A spray-dried composition comprising from 30 wt.-% to 60 wt.-%, more particularly from 35 wt.-% to 55 wt.-% of a benefit agent, wherein the benefit agent comprises more than 10 wt.-%, more particularly more than 12 wt.-%, still more particularly more than 14 wt.-% of total aldehydes, monoterpenes, or mixtures thereof;

   and wherein the spray-dried composition comprises a substantially odorless, biodegradable antioxidant, wherein the level of the antioxidant is 0.01 wt.-% to 10 wt.-% of the benefit agent.

2. The spray-dried composition according to claim 1, wherein the antioxidant is soluble in the benefit agent.

3. The spray-dried composition of claim 2, wherein the antioxidant is biodegradable and bio-based, optionally wherein the antioxidant is selected from the group consisting of carnosic acid (5,6-dihydroxy-1,1-dimethyl-7-propan-2-yl-2,3,4,9,10,10a-hexahydro-phenanthrene-4a-carboxylic acid; carnosol ((4aR- (4aalpha, 9alpha, 10abeta))-1,3,4,9,10,10a-heahydro-5,6-dihydroxy-1,1-dimethyl-7-(1-methylethyl)-2H-9,4a-(eoxymethano)phenanthren-12-one); tocopherols (alpha tocopherol ((2R)-2,5,7,8-tetramethyl-2-[(4R,8R)-4,8,12-trimethyl-tridecyl]-3,4-dihydro-2H-chromen-6-ol); beta-tocopherol (2,5,8-trimethyl-2-(4,8,12-trimethyltridecyl)-3,4-dihydro-2H-1-benzopyran-6-ol); delta tocopherol ((2R)-2,8-dimethyl-2-[(4R,8R)-4,8,12-trimethyltridecyl]-3,4-dihydrochromen-6-ol); and gamma tocopherol (2,7,8-trimethyl-2-(4,8,12-trimethyltridecyl)-3,4-dihydro-2H-1-benzopyran-6-ol); quecertin (2-(3,4-Dihydroxyphenyl)-5,7-dihydroxy-4H-1-benzopyran-4-one); lutein (β,ε-carotene-3,3'-diol); catechin ((2R,3S)-2-(3,4-dihydroxyphenyl)-3,4-dihydro-2H-chromene-3,5,7-triol), Ubiquinol 10 ([(2E,6E,10E,14E,18E,22E,26E,30E,34E)-3,7,11,15,19,23,27,31,35,39-Decamethyltetraconta-2,6,10,14,18,22,26,30,34,38-decaenyl]-5,6-dimethoxy-3-methylcyclohexa-2,5-diene-1,4-dione); Kaempferol (3,5,7-trihydroxy-2-(4-hydroxyphenyl)-4H-1-benzopyran-4-one); Naringenin ((2S)-5,7-Dihydroxy-2-(4-hydroxyphenyl)-2,3-dihydro-4H-1-benzopyran-4-on);

Hesperetin ((2S)-5,7-Dihydroxy-2-(3-hydroxy-4-methoxyphenyl)-2,3-dihydro-4H-1-benzopyran-4-one); Lipoic acid ((R)-5-(1,2-dithiolan-3-yl)pentanoic acid); curcumin ((1E,6E)-1,7-bis(4-hydroxy-3-methoxyphenyl)-1,6-heptadiene-3,5-dione); ascorbyl fatty acid esters; or mixtures thereof.

4. The spray-dried composition according to any of the preceding claims, wherein the ratio between the amount of the antioxidant to the amount of total aldehydes, monoterpenes, or mixtures thereof is between about 0.003 to about 0.027, preferably between about 0.01 to about 0.02.

5. The spray-dried composition according to any of the preceding claims, wherein the antioxidant is carnosic acid and/or carnosol, optionally wherein the total level of carnosic acid and carnosol is from 0.02 wt.-% to 5.0 wt.-%, preferably from 0.08 wt.-% to 2.0 wt.-%, even more preferably from 0.1 wt.-% to 1.0 wt.-% of the benefit agent.

6. The spray-dried composition according to any of the preceding claims, wherein carnosic acid and carnosol are used in the form of essential oils, extracts or absolutes, preferably obtained from Lamiaceae species, preferably sage (*Salvia officinalis L.*, rosemary (*Rosmarinus officinalis L), basil (Ocimum basilicum L.), oregano (Origanum vulgare L.), thyme (Thymus vulgaris L.),* wild carrot *(Daucus carota L.)*, *and* fennel *(Foeniculum vulgare* Mill), more preferably from rosemary (*Rosmarinus officinalis L).*

7. The spray-dried composition according to any of the preceding claims, wherein the benefit agent is a fragrance or a flavor composition, more particularly a fragrance composition.

8. The spray-dried composition according to claim 7, wherein the perfume or flavor composition comprises at least one, preferably at least two, more preferably at least four, even more preferably at least eight, even still more preferably at least twelve biodegradable ingredient(s), and wherein the biodegradable ingredient(s) is/are present at a total concentration of at least 75 wt.-%, preferably at least 80 wt.-%, more preferably at least 85 wt.-%, even more preferably at least 90 wt.-%,

even still more preferably at least 95 wt.-%, relative to the total weight of the perfume composition.

9. The spray-dried composition according to any of the preceding claims, wherein the proportion of benefit agent is from 10 wt.-% to 70 wt.-%, preferably from 25 wt.-% to 60 wt.-%, more preferably from 35 wt.-% to 55 wt.-%, even more preferably from 40 wt.-% to 50 wt.-%, relative to the total weight of the composition.

10. The spray-dried composition according to any of the preceding claims, wherein the water-soluble encapsulating material comprises at least one material selected from the group consisting of starch, in particular water-soluble modified starch, more particularly starch sodium octenyl succinate, maltodextrin, mannitol, chitosan, gum Arabic, alginate, pectins, gelatin, polyvinyl alcohol and mixtures thereof.

11. The spray-dried composition according to any of the preceding claims, wherein the benefit agent is at least partially encapsulated in core-shell microcapsules comprising a core and a shell surrounding the core.

12. A method for obtaining a spray-dried composition according to any of the preceding claim, the method comprising the steps of:

    a) Forming an emulsion, wherein the benefit agent is dispersed in an aqueous phase, the aqueous phase comprising an encapsulating material and the emulsion comprising an antioxidant;

    b) Spray-drying the emulsion formed in step a) in order to form a powder, wherein the benefit agent is entrapped in the encapsulating material; and

wherein the level of benefit agent is from 30 wt.-% to 60 wt.-%, more particularly from 35 wt.-% to 55 wt.-% of the spray-dried composition; and the level of the antioxidant is 0.01 wt.-% to 10 wt.-% of the benefit agent.

13. A method according to claim 12, wherein:

    a) the antioxidant is carnosic acid and/or carnosol; and

b) the encapsulating material is octenyl succinate-modified starch dextrin in combination with maltodextrin, mannitol or mixtures thereof.

14. A method according to claim 13, comprising the steps of:

a) Forming an emulsion comprising, based on the total weight of the emulsion:

i. 15 wt.-% to 35 wt.-%, preferably 20 wt.-% to 30 wt.-% of a fragrance or a flavor composition,

ii. 15 wt.-% to 30 wt.-%, preferably 20 wt.-% to 25 wt.-% of octenyl succinate modified starch dextrin;

iii. 0 to 10 wt.-%, preferably 4 wt.-% to 6 wt.-% of maltodextrin, mannitol or a mixture thereof; and

iv. 25 wt.-% to 70 wt.-%, preferably 39 wt.-% to 56 wt.-% of water;

wherein the fragrance or flavor composition comprises, based on the total weight of the fragrance of flavor composition:

i. more than 10 wt.-%, more particularly more than 12 wt.-%, still more particularly more than 14 wt.-% of total aldehydes, monoterpenes, or mixtures thereof;

ii. from 0.01 wt.-% to 10 wt.-%, optionally from 0.02 wt.-% to 5.0 wt.-%, preferably from 0.08 wt.-% to 2.0 wt.-%, even more preferably from 0.1 wt.-% to 1.0 wt.-% of carnosic acid, carnosol, or mixture thereof; and

b) Spray-drying the emulsion formed in a) in order to form a powder, wherein the fragrance or flavor composition is encapsulated in the encapsulating material.

15. The method according to claim 14, additionally comprising the step of admixing the spray dried composition with a solid carrier.

16. The method according to claim 15 , wherein the solid carrier is selected from the group consisting of urea, sodium chloride, sodium sulphate, sodium acetate, zeolite, sodium carbonate, sodium bicarbonate, clay,

talc, calcium carbonate, magnesium sulfate, gypsum, calcium sulfate, magnesium oxide, zinc oxide, titanium dioxide, calcium chloride, potassium chloride, magnesium chloride, zinc chloride, saccharides, polyethylene glycol, polyvinylpyrrolidone, citric acid or any water soluble solid acid, fatty alcohols, fatty acids and mixtures thereof.

17. A consumer product comprising a spray-dried composition according to any of claims 1 to 11, or claim 15, wherein the consumer product is anhydrous or in which the water activity is lower than 0.25, preferably lower than 0.1, optionally wherein the consumer product is selected from the group consisting of laundry care powder detergents, solid single dose detergent, such as tablets, laundry care conditioner sheets, solid scent boosters, dry personal cleansing compositions, shampoo, water-free deodorant, antiperspirant compositions, home care compositions, such as hard surface powder cleaners, and dish washing tablets.

18. The use of a substantially odorless, biodegradable antioxidant, more particularly a bio-sourced and oil-soluble antioxidant to increase the self-heating and/or the GREWER temperature of a spray-dried composition.