

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization

International Bureau

(43) International Publication Date

10 January 2019 (10.01.2019)



(10) International Publication Number

WO 2019/007790 A1

(51) International Patent Classification:

<i>A61K 8/60</i> (2006.01)	<i>A61Q 5/02</i> (2006.01)
<i>A61Q 5/00</i> (2006.01)	<i>A61Q 5/12</i> (2006.01)
<i>A61Q 17/00</i> (2006.01)	<i>A61Q 19/10</i> (2006.01)
<i>A61Q 19/00</i> (2006.01)	<i>A61K 8/06</i> (2006.01)
<i>A61K 31/7004</i> (2006.01)	

Published:

— with international search report (Art. 21(3))

(21) International Application Number:

PCT/EP2018/067368

(22) International Filing Date:

28 June 2018 (28.06.2018)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

17180056.8 06 July 2017 (06.07.2017) EP

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

(54) Title: NOVEL USE

(57) Abstract: The present invention relates to the use of erythrulose as antimicrobial agent as well as to composition comprising said agent.

Novel use

Case 32518-WO-PCT

5 The present invention relates to the use of erythrulose as antimicrobial agent as well as to composition comprising said agent.

To protect cosmetic compositions, household products, plastics, paper and/ or paints against mold and bacteria, most products currently on the market contain preservatives. While these preservatives protect against bacteria and fungi, studies have linked daily exposure to many of these substances to an increased risk of skin irritation, cancer and/ or endocrine problems. Thus, many manufactures are searching for alternative antimicrobial actives which allow reducing the amount of preservatives and don't appear to pose any health risks.

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Antimicrobial active compounds furthermore play a key role for many cosmetic applications:

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Acne is taken to mean a skin disorder which is evident in inflamed papules, pustules or nodules, caused by increased talc production and impaired keratinization of the skin. The inflammation may be associated with reddening, swelling and pressure pain. Besides genetic predisposition, possible causes of acne formation can be androgens, comedogenic substances (for example in cosmetics), smoking, stress or excessive colonization of the skin by bacteria. Acne can be triggered, for example, by microorganisms, such as *Propionibacterium acnes*, or *Staphylococcus epidermidis*. *Propionibacterium acnes* is a bacterium which usually colonizes the skin and lives on sebum. Acne may arise, for example, if the number of these bacteria is increased. The presence of bacteria in the follicles results in inflammation reactions, which is evident in the form of red nodules or pustules. The production of free fatty acids by the bacteria furthermore promotes the inflammation reaction in the follicle.

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Besides water and salt, axillary sweat contains many other substances (such as fats, amino acids, sugars, lactic acid, urea, etc.). Freshly formed sweat is odorless; the typical sweat odor only forms due to the action of skin bacteria on the sweat, which decompose the latter. Examples of such bacteria are *Staphylococcus* or *Corynebacterium*. For this reason, antimicrobial substances are usually also

employed besides aroma substances and antiperspirants in deodorants, with the aim of controlling the bacteria which are involved in the odor formation.

Surprisingly, it has now been found that erythrulose exerts a particularly pronounced anti-microbial activity against certain microbes such as in particular *Propionibacterium acnes*, *Staphylococcus epidermidis*, *Corynebacterium xerosis*, and/or *Aspergillus brasiliensis*.

Thus, the present invention relates to the use of erythrulose as antimicrobial agent,

i.e. an agent which exhibits an antimicrobial activity. In particular the present invention is directed to the use of erythrulose as anti-fungal and/or anti-bacterial agent, more in particular as an agent for killing and/or inhibiting the growth of *Propionibacterium acnes* (*P. acnes*), *Staphylococcus epidermidis* (*S. epidermidis*), *Corynebacterium xerosis* (*C. xerosis*), *Aspergillus brasiliensis* (*A. brasiliensis*), *Candida albicans* (*C. albicans*), *Pseudomonas aeruginosa* (*P. aeruginosa*), *Escherichia coli* (*E. coli*) and/or *Staphylococcus aureus* (*S. aureus*), such as most in particular *Propionibacterium acnes*, *Staphylococcus epidermidis*, *Corynebacterium xerosis*, and/or *Aspergillus brasiliensis*.

In another embodiment, the invention relates to a method for killing and/or inhibiting growth of microbial cells, in particular fungal and/or bacterial cells, said method comprising contacting said microbial cells with erythrulose. In a preferred embodiment the microbial cells are selected from the group consisting of *Propionibacterium acnes* (*P. acnes*), *Staphylococcus epidermidis* (*S. epidermidis*), *Corynebacterium xerosis* (*C. xerosis*), *Aspergillus brasiliensis* (*A. brasiliensis*), *Candida albicans* (*C. albicans*), *Pseudomonas aeruginosa* (*P. aeruginosa*), *Escherichia coli* (*E. coli*) and/or *Staphylococcus aureus* (*S. aureus*) as well as mixtures thereof. Preferably, in all embodiments of the present invention erythrulose is used as agent against *Propionibacterium acnes*, *Staphylococcus epidermidis*, *Corynebacterium xerosis*, and/or *Aspergillus brasiliensis*.

In all embodiments of the present invention erythrulose is preferably used for killing and/or inhibiting the growth of *Staphylococcus epidermidis* and/or *Corynebacterium xerosis* as it is particularly efficient against these microbes, which makes it particularly suitable for deodorant applications.

The term "erythrulose" refers to erythrulose in D- or L-form or as the racemate. Preferably L-(+)-Erythrulose [533-50-6] is used. Erythrulose is e.g. commercially available at DSM Nutritional Products Ltd, Kaiseraugst.

5 The term "antimicrobial activity" (or "antimicrobial effect") as used herein means a capability of killing and/or inhibiting the growth of microbial cells such as in particular bacteria and fungi and more in particular *P. acnes*, *S. epidermidis*, *C. xerosis*, *A. brasiliensis*, *C. albicans*, *P. aeruginosa*, *E. coli* and/ or *S. aureus*.

10 Due to the antimicrobial activity, erythrulose is also suitable to maintain skin homeostasis and/ or balance the skin microbiome by treating overpopulation of microorganisms on the skin such as *P. acnes* (acne control application) and *S. epidermidis* and *C. xerosis* (antiperspirant/ deodorant applications) and/or reducing unwanted microorganisms such as *S. aureus*.

15 In all embodiments of the present invention erythrulose as an antimicrobial agent is preferably used in an amount selected in the range of about 0.005 to 0.75 wt.-%, more preferably in the range of about 0.01 to 0.6 wt.-% and most preferably in the range of 0.025 to 0.5 wt.-% such as in the range of 0.04 to 0.5 wt.-%, based on the 20 total weight of the composition. Further particular suitable ranges include 0.01 to 0.2 wt.-% or 0.05 to 0.2 wt.-%, in particular for the selective treatment of *P. acnes*, *A. Brasiliensis*, *S. epidermidis* and/ or *C. xerosis*.

25 To make use of the anti-microbial activity of erythrulose, it can be used in a multiplicity of formulations or applications, such as, for example, cosmetic or pharmaceutical compositions, medicinal products, household products, plastics, 30 plastics, paper and/or paints.

In particular the present invention relates to the use of erythrulose for improving 35 preservation, in particular of a product selected from the group of cosmetic compositions, household products, plastics, paper and/ or paints compared to the product not containing erythrulose and optionally appreciating the effect, preferably in view of *Aspergillus brasiliensis*.

35 Thus, in another embodiment, the invention relates to a method of preventing microbial decay and breakdown in particular caused by molds such as most in particular by *Aspergillus brasiliensis*, of cosmetic and/ or pharmaceutical

compositions, household products, plastics, paper and/ or paints, wherein said method comprises adding to the compositions, products, plastics, papers and/ or paints erythrulose in an amount of 0.005 to 0.75 wt.-%, more preferably in the range of about 0.01 to 0.6 wt.-%, most preferably in the range of about 0.025 to 0.5 wt.-%

5 such as in the range of 0.04 to 0.5 wt.-% as an antimicrobial agent. Further particular ranges include 0.01 to 0.2 wt.-% or 0.05 to 0.2 wt.-%, respectively 0.01 to 0.15 or 0.05 to 0.15 wt.-% as erythrulose is particularly active against *A. brasiliensis* in such low amounts. In a particular embodiment, the method also encompasses the step of appreciating the result.

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In a particular advantageous embodiment, the invention relates to a method of preventing microbial decay and breakdown of cosmetic or pharmaceutical compositions, in particular caused by molds such as most in particular by *Aspergillus brasiliensis*, which compositions furthermore comprise water and at least one further 15 agent selected from the group consisting of surfactants, emulsifiers, thickeners, and oils as such compositions are particular sensitive to microbial growth.

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Thus, in another embodiment, the invention is also directed to cosmetic or pharmaceutical compositions comprising water and at least one agent selected from the group consisting of surfactants, emulsifiers, thickeners and oils, wherein the 25 composition furthermore comprises erythrulose in an amount of 0.005 to 0.75 wt.-%, more preferably in the range of about 0.01 to 0.6 wt.-%, most preferably in the range of about 0.025 to 0.5 wt.-% such as in the range of 0.04 to 0.5 wt.-%, and most preferably in the range of 0.04 to 0.2 wt.-%, e.g. in the range of 0.05 to 0.1 wt.-%, based on the total weight of the composition. Further particular ranges include 0.01 to 0.2 wt.-% or 0.05 to 0.2 wt.-%, respectively 0.01 to 0.15 or 0.05 to 0.15 wt.-%.

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The present invention furthermore relates to the use of erythrulose as anti-acne, deodorant or antiperspirant active compound. In particular, erythrulose is suitable for the treatment or prophylaxis of acne which is triggered by *P. Acnes* or *S. epidermidis*.

35

Thus, in another advantageous embodiment the cosmetic or pharmaceutical compositions according to the present invention are anti-acne compositions comprising erythrulose in an amount of 0.01 to 0.15 wt.-%, preferably in the range of 0.05 to 0.15 wt.-%, based on the total weight of the composition as these compositions are particularly suitable treat acne caused by *S. epidermidis* and/ or *P.*

acnes by killing respectively significantly inhibiting the growth of these specific bacteria selectively at this concentration range.

Also advantageous is the use of erythrulose as active compound in deodorants or
5 antiperspirants as it has an antimicrobial action against the bacteria which are responsible for the decomposition of sweat and thus for the formation of the odour, i.e. *S. epidermidis* and *C. xerosis* as erythrulose is particularly active against the bacteria responsible for the unwanted odor formation, even at very low concentrations of less than 0.15 wt.-%.

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Thus, in another advantageous embodiment the cosmetic or pharmaceutical compositions according to the present invention are deodorant compositions comprising erythrulose in an amount of 0.01 to 0.15 wt.-%, preferably in the range of 0.05 to 0.15 wt.-%, based on the total weight of the composition as these
15 compositions are particularly suitable to avoid the unpleasant odor formation caused by *S. epidermidis* and/ or *C. xerosis* by killing respectively significantly inhibiting the growth of these specific bacteria selectively at this concentration range.

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Advantageously, erythrulose can also be used in combination with traditional preservatives to improve the preservative activity thereof.

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The use according to the invention of erythrulose can take place both in the cosmetic sense and also in the pharmaceutical sense. A pharmaceutical application is conceivable, for example, in the case of anti-acne compositions. In all embodiments of the present invention, the use is however preferably cosmetic (non-therapeutic).

The cosmetic or pharmaceutical compositions according to the present invention are in particular topically applied to mammalian keratinous tissue such as in particular to human skin or the human scalp and hair.

30

The term "cosmetic composition" as used in the present application refers to cosmetic compositions as defined under the heading "Kosmetika" in Römpf Lexikon Chemie, 10th edition 1997, Georg Thieme Verlag Stuttgart, New York as well as to cosmetic compositions as disclosed in A. Domsch, "Cosmetic Compositions", Verlag für chemische Industrie (ed. H. Ziolkowsky), 4th edition, 1992.

Suitable surfactants, emulsifiers, thickeners, and oils for the purpose of the present inventions are all surfactants, emulsifiers, thickeners, and oils commonly used in cosmetic applications and which are e.g. listed in CTFA Cosmetic Ingredient Handbook, First edition 1988. Such suitable surfactants, emulsifiers, thickeners, and 5 oils are well known to a person skilled in the art.

The compositions according to the present invention are generally prepared by admixing erythrulose in an amount selected in the range of 0.005 to 0.75 wt.-%, more 10 preferably in the range of about 0.01 to 0.6 wt.-%, most preferably in the range of about 0.025 to 0.5 wt.-% such as in the range of 0.04 to 0.5 wt.-% based on the total weight of the composition with a suitable carrier. Other suitable ranges include 0.04 to 0.2 wt.-% and 0.05 to 0.1 wt.-%. Further particular ranges include 0.01 to 0.2 wt.-% or 0.05 to 0.2 wt.-%, respectively 0.01 to 0.15 or 0.05 to 0.15 wt.-%.

15 The cosmetic or pharmaceutical compositions according to the present invention preferably further comprise a physiologically acceptable medium, that is to say a medium compatible with keratinous substances, such as the skin, mucosa, and keratinous fibres. In particular the physiologically acceptable medium is a 20 cosmetically or pharmaceutically acceptable carrier.

The term cosmetically or pharmaceutically acceptable carrier refers to all carriers and/or excipients and/ or diluents conventionally used in cosmetic compositions or pharmaceutical compositions.

25 Preferably, the cosmetic or pharmaceutical compositions according to the invention are in the form of a suspension or dispersion in solvents or fatty substances, or alternatively in the form of an emulsion or micro emulsion (in particular of O/W- or W/O-type), PIT-emulsion, nano emulsion, multiple emulsion (e. g. O/W/O- or W/O/W-type), pickering emulsion, hydrogel, lipogel, one- or multiphase solution or vesicular 30 dispersion.

The cosmetic or pharmaceutical compositions in accordance with the invention can be in the form of a liquid, lotion, a thickened lotion, a gel, a cream, a milk, an ointment or a paste.

35 The cosmetic or pharmaceutical compositions according to the invention have a pH in the range of 3-10, preferably in the range of pH of 3-8, most preferred in the range

of pH 3.5-6.5. The pH is adjusted by methods known to a person skilled in the art, e.g. by using an acid such as a hydroxy acid including glycolic acid, lactic acid, malic acid, citric acid and tartaric acid or a base such as e.g. sodium or potassium hydroxide or ammonium hydroxide as well as mixtures thereof.

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Preferably, in the compositions according to the invention citric acid is used in an amount of at least 0.0001 wt.-%, such as e.g. in an amount of 0.01-1 wt.-%, in particular in an amount of 0.01 to 0.5 wt.-% is used for pH adjustment.

10 The cosmetic compositions according to the present invention are in particular skin care preparations, functional preparations and/ or hair care preparations such as most in particularly skin or hair care preparations.

15 Examples of skin care preparations are, in particular, light protective preparations, anti-ageing preparations, preparations for the treatment of photo-ageing, body oils, body lotions, body gels, treatment creams, skin protection ointments, moisturizing preparations such as moisturizing gels or moisturizing sprays, face and/or body moisturizers, as well as skin lightening preparations.

20 Preferably in all embodiments of the present invention the skin care preparation is a deodorant, an anti-perspirant, or an anti-acne composition.

25 Examples of functional preparations are cosmetic compositions containing active ingredients such as hormone preparations, vitamin preparations, vegetable extract preparations, anti-ageing preparations, and/or antimicrobial (antibacterial or antifungal) preparations without being limited thereto.

30 Examples of hair care preparations which are suitable according to the invention and which may be mentioned are shampoos, hair conditioners (also referred to as hair rinses), hairdressing compositions, hair tonics, hair regenerating compositions, hair lotions, water wave lotions, hair sprays, hair creams, hair gels, hair oils, hair pomades or hair brilliantines. Accordingly, these are always preparations which are applied to the hair and the scalp for a shorter or longer time depending on the actual purpose for which they are used.

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If the hair care preparations according to the invention are supplied as shampoos, these can be clear liquids, opaque liquids (with pearly luster effect), in cream form,

gel-like or else in powder form or in tablet form, and as aerosols. The surfactant raw materials on which these shampoos are based can be anionic, cationic, nonionic and amphoteric in nature and also be present in combinations of these substances.

5 Examples of anionic surfactants suitable for the incorporation into the shampoo preparations according to the present invention are C₁₀₋₂₀ alkyl- and alkylolenecarboxylates, alkyl ether carboxylates, fatty alcohol sulfates, fatty alcohol ether sulfates, alkylolamide sulfates and sulfonates, fatty acid alkylolamide polyglycol ether sulfates, alkanesulfonates and hydroxyalkanesulfonates, olefinsulfonates, acyl 10 esters of isothionates, alpha-sulfo fatty acid esters, alkylbenzenesulfonates, alkylphenol glycol ether sulfonates, sulfosuccinates, sulfosuccinic monoesters and diesters, fatty alcohol ether phosphates, protein-fatty acid condensation products, alkyl monoglyceride sulfates and sulfonates, alkyl glyceride ether sulfonates, fatty acid methyltaurides, fatty acid sarcosinates, and sulforicinoleates. These compounds 15 and their mixtures are used in the form of their salts which are soluble in water or dispersible in water, for example the sodium, potassium, magnesium, ammonium, mono-, di- and triethanolammonium and analogous alkylanunonium salts.

Examples of suitable cationic surfactants are quaternary ammonium salts such as 20 di(C₁₀-C₂₄alkyl)dimethylammonium chloride or bromide, preferably di (C₁₂-C₁₈alkyl)-dimethylammonium chloride or bromide; C₁₀-C₂₄-alkyldimethylmethylethylammonium chloride or bromide; C₁₀-C₂₄-alkyltrimethylammonium chloride or bromide, preferably cetyltrimethylammonium chloride or bromide and C₂₀-C₂₄-alkyltrimethylammonium chloride or bromide; C₁₀-C₂₄-alkyldimethylbenzylammonium chloride or bromide, 25 preferably C₁₂-C₁₈-alkyldime methylbenzylammoniumchloride; N-(C₁₂-C₁₈-alkyl)pyridinium chloride or bromide, preferably N- (C₁₂-C₁₆-alkyl)pyridinium chloride or bromide; N-(C₁₂-C₁₈-alkyl)isoquinolinium chloride, bromide or monoalkyl sulfate; N-(C₁₂-C₁₈-alkyloylcolaminoformylmethyl)pyridinium chloride; N-(C₁₂-C₁₈-alkyl)-N-30 methylmorpholinium chloride, bromide or monoalkyl sulfate; N-(C₁₂-C₁₈-alkyl)-N-ethylmorpholinium chloride, bromide or monoalkyl sulfate; C₁₆-C₁₈-alkypentaoxethylammonium chloride; isobutylphenoxyethoxyethyldimethylbenzylammonium chloride; salts of N,N-diethylaminoethylstearylamide and oleylamine with hydrochloric acid, acetic acid, lactic acid, citric acid, phosphoric acid; N-acylamidoethyl-N,N-diethyl-N-methylammonium chloride, bromide or 35 monoalkylsulfate and N-acylaminoethyl-N,N-diethyl-N-benzylammonium chloride, bromide or monoalkyl sulfate, where acyl is preferably stearyl or oleyl.

Examples of suitable nonionic surfactants which can be used as detergent substances are fatty alcohol ethoxylates (alkylpolyethylene glycols); alkylphenol polyethylene glycols; alkyl mercaptan polyethylene glycols; fattyamine ethoxylates (alkylaminopolyethylene glycols); fatty acid ethoxylates (acylpolyethylene glycols); 5 polypropylene glycol ethoxylates (Pluronic); fatty acid alkylolamides (fatty acid amide polyethylene glycols); sucrose esters; sorbitol esters and polyglycol ether.

Examples of amphoteric surfactants which can be added to the shampoos are N-(C₁₂-C₁₈-alkyl)-.beta.-aminopropionates and N-(C₁₂-C₁₈-alkyl)-.beta.-10 iminodipropionates as alkali metal and mono-, di- and trialkylammonium salts; N-acylamidoalkyl-N,N-dimethylacetobetaine, preferably N-(C₈-C₁₈-acyl)amidopropyl-N, N-dimethylacetobetaine; C₁₂-C₁₈-alkyldimethylsulfopropylbetaine; amphoteric surfactants based on imidazoline (commercial name: Miranol[®], Steinapon[®]), preferably the sodium salt of 1-(β-carboxymethoxyethyl)-1-(carboxymethyl)-2-15 laurylimidazolinium; amine oxide, for example C₁₂-C₁₈-alkyldimethylamine oxide, fatty acid amidoalkyldimethylamine oxide.

The hair care preparations according to the invention can additionally contain further additives customary in hair care such as for example perfumes, colorants, also those 20 which simultaneously dye or tint the hair, solvents, opacifying agents and pearly luster agents, for example esters of fatty acids with polyols, magnesium and zinc salts of fatty acids, dispersions based on copolymers, thickening agents such as sodium, potassium and ammonium chloride, sodium sulfate, fatty acid alkylolamides, cellulose derivatives, natural rubbers, also plant extracts, protein derivatives such as 25 gelatin, collagen hydrolysates, polypeptides with a natural or synthetic basis, egg yolk, lecithin, lanolin and lanolin derivatives, fats, oils, fatty alcohols, silicones, deodorizing agents, substances with antimicrobial activity, substances with antiseborrhoeic activity, substances with keratolytic and keratoplastic effect, such as, for example, sulfur, salicylic acid and enzymes as well as further anti-dandruff agents 30 such as olamine, climbazol, zink pyrithion, ketoconazole, salicylic acid, sulfur, tar preparations, derivatives of undecenic acid, extracts of nettel, rosemary, cottonwood, birch, walnut, willow bark and/ or arnica.

For the preparation of the hair care preparations the erythrulose is dissolved under 35 stirring at a temperature in the range between 20 and 40°C, preferably at room temperature. Subsequently, the further additives are added.

In the event of alcohol containing scalp respectively hair care preparations erythrulose is dissolved in the alcohol at a temperature in the range between 20 and 40°C, preferably at room temperature. Subsequently, the further additives are added.

5 In the event of hair rinses and oil-in-water emulsions the active substance is added to the final emulsion below 40°C under stirring.

The shampoos are produced in a manner known per se by mixing the individual components and where necessary further processing appropriate for the particular type of preparation.

10 Examples of hair care preparations in which the erythrulose can be used according to the invention and which may be mentioned are hair conditioners, hair tonics and hair regenerating compositions, which are rinsed off from the hair after a certain time or, depending on the formulation, can also remain on the hair. These products contain, 15 inter alia, substances from the group of the above mentioned cationic substances which display a reviving and antistatic property on the hair.

All these preparations are also produced as already mentioned for the shampoo in a manner known per se with the addition of the erythrulose.

20 Particular suitable hair care preparations according to the present invention are shampoo preparations comprising (i) erythrulose in an amount selected in the range of 0.005 to 0.75 wt.-%, more preferably in the range of about 0.01 to 0.6 wt.-%, most preferably in the range of about 0.025 to 0.5 wt.-% such as in the range of 0.04 to 0.5 wt.-%, based on the total weight of the composition, (ii) water and (iii) at least one anionic surfactant. Preferably, the anionic surfactant is selected from the group consisting of sodium lauryl sulfate, ammonium lauryl sulfate, sodium lauryl ether sulfate, ammonium lauryl ether sulfate, sodium lauroyl sarcosinate, sodium oleylsuccinate, ammonium lauryl sulfosuccinate, sodium dodecylbenzol sulfonate 25 and/ or triethanolamine dodecylbenzol sulfonate or mixtures thereof, such as in particular sodium lauryl sulfate, ammonium lauryl sulfate, sodium lauryl ether sulfate and/ or ammonium lauryl ether sulfate. The total amount of the anionic surfactant in the compositions according to the invention ranges from 0.5 to 45 wt.-%, preferably from 1.5 to 35 wt.-%, more preferably from 7 to 25 wt.-%, in particular from 7 to 15 30 wt.-% based on the total weight of the composition.

Particular suitable hair conditioners according to the present invention may be rinse off or leave on conditioners, preferably rinse-off conditioners. Particular advantageous hair conditioners according to the present invention comprise (i) erythrulose in an amount selected in the range of 0.005 to 0.75 wt.-%, more 5 preferably in the range of about 0.01 to 0.6 wt.-%, most preferably in the range of about 0.025 to 0.5 wt.-% such as in the range of 0.04 to 0.5 wt.-%, most preferably in the range of 0.05 to 0.5 wt.-%, based on the total weight of the composition, (ii) water and (iii) at least one conditioning agent such as e.g. silicone oils, quaternary polymers, naturally derived conditioning agents, etc.

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The quaternary polymer is preferably selected from e.g. Polyquaternium-6 (e.g. commercialized under the trade name TILAMAR® Quat 640 or 641), Polyquaternium-22 (e.g. commercialized under the trade name TILAMAR® Quat 2240 or 2241), Polyquaternium-7 (e.g. commercialized under the trade name TILAMAR® Quat 710, 15 711 or 712), etc. The naturally derived conditioning agents are preferably selected from e.g. sugar based polymers such as Guar Hydroxypropyltrimonium Chloride (e.g. commercialized under the trade name Jaguar C-17, Jaguar C-1000, Jaguar C-13S), but not limited hereto.

20 In principal any silicone oil is suitable for use in the hair conditioner. However, the silicone oil is preferably selected from dimethicones, dimethiconols, polydimethylsiloxanes, arylated silicones, cyclic silicones, silicone surfactants and aminated silicones and may be volatile or non volatile. Particular suitable silicone oils are dimethicone, dimethiconol, polydimethylsiloxane which are available from various 25 suppliers such as Dow Corning. The total amount of the at least one silicone oil and/or quaternary polymer and/or naturally derived conditioning agent in the hair conditioner is preferably selected is in the range of 0.01 to 10 wt.-%, preferably 0.02 to 7.5 wt.-%, more preferably 0.05 to 5 wt.-% and most preferably 0.1 to 3 wt.-%, based on the total weight of the composition.

30

In another preferred embodiment, the cosmetic compositions according to the present invention are O/W emulsions, W/O emulsions and/ or gels such as shower gels or hair gels.

35 The O/W emulsions according to the present invention advantageously comprise (i) erythrulose in an amount selected in the range of 0.005 to 0.75 wt. %, more preferably in the range of about 0.01 to 0.6 wt.-%, most preferably in the range of

about 0.025 to 0.5 wt.-% such as in the range of 0.04 to 0.5 wt.-%, based on the total weight of the composition, (ii) water and (iii) at least one O/W- or Si/W-emulsifier selected from the list of glycerylstearatcitrate, glycerylstearate (self emulsifying), stearic acid, salts of stearic acid, polyglyceryl-3-methylglycosedistearate, ceteareth-5, 20, steareth-2, steareth-12, PEG-40 stearate, phosphate esters and the salts thereof such as cetyl phosphate (Amphisol® A), diethanolamine cetyl phosphate (Amphisol® DEA), potassium cetyl phosphate (Amphisol® K), sodiumcetearylulfat, sodium glyceryl oleate phosphate, hydrogenated vegetable glycerides phosphate, sorbitan oleate, sorbitan sesquioleate, sorbitan isostearate, sorbitan trioleate, lauryl glucoside, 10 decyl glucoside, sodium stearoyl glutamate, sucrose polystearate and Hydrated Polyisobuten as well as mixtures thereof. Also, one or more synthetic polymers may be used as an emulsifier such as for example, PVP eicosene copolymer, acrylates/C10-30 alkyl acrylate crosspolymer, acrylates/steareth-20 methacrylate copolymer, PEG-22/dodecyl glycol copolymer, PEG-45/dodecyl glycol copolymer, 15 and mixtures thereof. In a particular preferred embodiment the O/W-emulsifier is selected from the group of cetyl phosphates such as in particular potassium cetyl phosphate (commercially available as Amphisol® K), glyceryl stearate (and) PEG-100 stearate (commercially available as Arlacel® 165) and/ or polyalkylenglycolether such as in particular laureth-35 (lauryl alcohol with 35 EO units; commercially 20 available as Brij® 35). The at least one O/W emulsifier is preferably used in an amount of about 0.001 to 10 wt.-%, more preferably in an amount of 0.1 to 7 wt.-% with respect to the total weight of the composition. Additionally, the cosmetic composition in the form of a O/W emulsion contains advantageously at least one co-emulsifier selected from the list of alkyl alcohols such as Cetyl Alcohol (Lorol C16, 25 Lanette 16) Cetearyl Alcohol (Lanette® O), Stearyl Alcohol (Lanette® 18), Behenyl Alcohol (Lanette® 22), Glyceryl Monostearate, Glyceryl Myristate (Estol® 3650), Hydrogenated Coco- Glycerides (Lipocire Na10) without being limited to this and mixtures thereof.

30 The W/O emulsions according to the present invention advantageously comprise (i) erythrulose in an amount selected in the range of 0.005 to 0.75 wt.-%, more preferably in the range of about 0.01 to 0.6 wt.-%, most preferably in the range of about 0.025 to 0.5 wt.-% such as in the range of 0.04 to 0.5 wt.-%, based on the total weight of the composition, (ii) water and (iii) at least one W/O- or W/Si-emulsifier selected from the list of polyglyceryl-2-dipolyhydroxystearat, PEG-30 dipolyhydroxystearat, cetyl dimethicone copolyol, polyglyceryl-3 diisostearate polyglycerol esters of oleic/isostearic acid, polyglyceryl-6 hexaricinolate, polyglyceryl-

4-oleate, polyglyceryl-4 oleate/PEG-8 propylene glycol cocoate, magnesium stearate, sodium stearate, potassium laurate, potassium ricinoleate, sodium cocoate, sodium tallowate, potassium castorate, sodium oleate, and mixtures thereof. Further suitable W/Si-emulsifiers are Lauryl Polyglyceryl-3 Polydimethylsiloxyethyl Dimethicone and/or PEG-9 Polydimethylsiloxyethyl Dimethicone and/or Cetyl PEG/PPG-10/1 Dimethicone and/or PEG-12 Dimethicone Crosspolymer and/or PEG/PPG-18/18 Dimethicone. The at least one W/O emulsifier is preferably used in an amount of about 0.001 to 10 wt.-%, more preferably in an amount of 0.2 to 7 wt.-% with respect to the total weigh of the composition.

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The gel preparations according to the present invention advantageously comprise (i) erythrulose in an amount selected in the range of 0. 0.005 to 0.75 wt.-%, more preferably in the range of about 0.01 to 0.6 wt.-%, most preferably in the range of about 0.025 to 0.5 wt.-% such as in the range of 0.04 to 0.5 wt.-%, most preferably in the range of 0.05 to 0.5 wt.-%, based on the total weight of the composition, (ii) water and (iii) at least one water soluble thickener. Such water-soluble thickeners are well known to a person skilled in the art and are e.g. listed in the "Handbook of Water soluble gums and resins" by Robert L. Davidson (Mc Graw Hill Book Company (1980)). Particularly suitable water soluble thickeners are selected from the group consisting of polyacrylic acids (e.g. commercially available under the tradename Carbomer or Carbopol[®]), homopolymers of 2-Acrylamido-2-methylpropansulfonic acid (e.g. commercially available as Rheothik[®]11-80), acrylate copolymers (e.g. commercially available under the tradename Pemulen[®] or Aculyn[®] 33), branched Poly(methacryloyloxyethyltrimethylammoniumchlorid) (INCI-name Polyquaternium-37), non-modified guar gums (e.g. commercially available under the tradename Jaguar), starch or derivatives thereof and/ or hydroxyalkylcellulosen. Preferably the water-soluble thickener is used in an amount of about 0.001 to 10 wt.-%, more preferably in an amount of 0.1 wt.-% to 7 wt.-%, based on the total weigh of the composition.

30

The following examples are provided to further illustrate the compositions and effects of the present invention. These examples are illustrative only and are not intended to limit the scope of the invention in any way.

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Example 1: Antimicrobial Efficacy

The antimicrobial efficacy is assessed in analogy to the regulatory challenge test method (NF EN ISO11930). Thus, a solution of Erythrulose from DSM Nutritional

products in two different concentrations was prepared under sterile conditions. For this the Erythrulose was solubilized in physiological serum with 0.85 wt.-% NaCl. Phenoxyethanol was solubilized in a physiological serum with 0.85 wt.-% NaCl further comprising 5 wt.-% ethanol to ensure solubility. The solutions were deposited 5 in 96-deep well plates (1.6 ml/well). The wells were contaminated with the respective bacterial or the fungal strains at 1.9×10^5 to 8.1×10^5 cfu/ml for the bacteria and 3.3×10^3 to 3.8×10^4 cfu/ml for the fungi to obtain the initial contamination as outlined in table 1 and 2. After contamination each well was thoroughly mixed to ensure a homogeneous distribution of the microorganism. Then each plate was incubated at 10 22°C for 24h. The counting of the (remaining) population was carried out 24h after contamination.

Table 1 Erythrulose, 0.4% active

Bacteria/ fungi	Erythrulose (0.4 wt.-%)		Phenoxyethanol (0.5wt.-%)	
	colony counts [cfu/ml]		colony counts [cfu/ml]	
	0h	24h	0h	24h
P. Acnes (acne, gram+)	500000	55000	500000	260000
S. epidermidis (deo, gram+)	500000	0	500000	3300
C. xerosis (deo, gram+)	810000	0	810000	0
A. brasiliensis (preserv., mold)	38000	330	38000	78
C. albicans (preserv., yeast)	19000	78	19000	1000
P. aeruginosa (preserv., gram-)	810000	0	810000	280000
E. coli (preserv., gram-)	440000	280000	440000	530000
S. aureus (preserv., gram+)	190000	0	190000	78000

Table 2: Erythrulose, 0.08% active

	t0	24h
Propionibacterium acnes (acne, gram+)	310000	3300
Staphylococcus epidermidis (deo, gram+)	560000	0
Corynebacterium xerosis (deo, gram+)	250000	55
Aspergillus brasiliensis (preserv., mold)	10000	10
Pseudomonas aeruginosa (preserv., gram-)	450000	530000
Escherichia coli (preserv., gram-)	250000	530000

As can be retrieved from table 1 erythrulose exhibits an equal or even better activity against microbes as the preservative phenoxyethanol, a well-known preservative in cosmetics, even at lower concentrations (0.4 wt.-% vs 0.5 wt.%).

Furthermore, the results in table 2 illustrate that Erythrulose is particularly and selectively active against microbial cells responsible for the odor formation from sweat e.g. in the axilla, i.e. S. epidermidis and C. xerosis even at very low concentrations, which makes it particularly suitable for deodorant applications while at this concentration level it is not active anymore against other microbes such as P. aeruginosa and E. coli.

The results in table 2 furthermore illustrate that erythrulose at very low concentration still excerpts a good antimicrobial activity against P. acnes, making it suitable for a mild anti-acne treatment.

Furthermore, it is also suitable at such low concentration levels to protect products from microbial decay caused by A. brasiliensis.

Example 2: O/W Foundation

Ingredients	INCI	wt. %
Deionised Water	Aqua	Ad 100
Glycerin	Glycerin	2.00
Triethanolamine	Triethanolamine	0.80
Paratexin M	Methylparaben EP	0.20
Keltrol	Xanthan Gum	0.30
Erythrulose	Erythrulose	0.10
Titanium dioxide	C.I. 77891	4.57
SunCROMA yellow iron oxide	C.I. 77492	0.30
SunCROMA red iron oxide	C.I. 77491	0.13
SunCROMA black iron oxide	C.I. 77499	0.20
DC 556	Phenyl Trimethicone	3.60
Stearic Acid	Stearic Acid	1.4
Cetyl Alcohol	Cetyl Alcohol	3.0
Paratexin P	Propylparaben EP	0.1

Example 3: Alcohol Free Facial Tonic

Ingredients	INCI	wt. %
Polysorbate-20	Polysorbate-20	2.00
ALPAFLOR CALENDULA AO	Calendula Officinalis Extract, Glycerin, Water	0.80
ALPAFLOR BUDDLEJA AO	Buddleja Davidii Extract, Glycerin, Water	0.80
Arlasilk Phospholipd CDM	Sodium Coco PG-Dimonium Chloride Phosphate	0.50
Fragrance	Parfum	0.10
Deionised Water	Aqua	Ad 100
Citric Acid	Citric Acid	0.01
Erythrulose	Erythrulose	0.75
Paratexin FRP	Ethylparaben, Butylparaben, Propylparaben, Isobutylparaben	0.10

5 Example 4: W/O Cream

Ingredients	INCI	wt. %
Cremophor WO-7	PEG-7 Hydrogenated Castor Oil	2.50
Elfacos ST-9	PEG-45/Dodecyl Glycol Copolymer	2.00

Cirebelle 303	Synthetic Wax	5.00
Cirebelle 109L	Synthetic Wax	7.20
Miglyol 818	Caprylic/Capric/Linoleic Triglyceride	5.00
Eutanol G	Octyldodecanol	7.50
Cetiol OE	Dicaprylyl Ether	9.20
Deionised Water	Aqua	Ad 100
Glycerin	Glycerin	5.00
Propylene Glycol	Propylene Glycol	2.00
Euxyl PE 9010	Phenoxyethanol and Ethylhexylglycerin	0.80
Erythrulose	Erythrulose	0.1

Example 5: Soothing Gel

Ingredients	INCI	wt. %
Deionised Water	Aqua	Ad 100
Keltrol CG RD	Xanthan Gum	0.50
Sodium Benzoate	Sodium Benzoate	0.20
Potassium Sorbate	Potassium Sorbate	0.25
ALPAFLOR MARRABIUM AO	Glycerin, Aqua, Marrubium Vulgare, Sodium Benzoate, Potassium Sorbate	3.00
Erythrulose	Erythrulose	0.40

Example 6: O/W Lotion

Ingredients	INCI	wt. %
Deionised Water	Aqua	Ad 100
Menthol	Menthol	0.10
Keltrol CG SFT	Xanthan Gum	1.25
Ceralution ES	Ceteareth-25, Di Sodium Ethylene Dicocamide PEG-15 Disulfate	2.00
Isofol 20	Octyldodecanol	5.00
Paratexin EC5	Benzoic Acid Benzyl Alcohol, Dehydroacetic Acid, Sorbic Acid	1.00
Erythrulose	Erythrulose	0.25

Example 7: Facial Cleansing Gel

Ingredients	INCI	wt. %
Deionised Water	Aqua	Ad 100
Carbopol AQUA SF-1 Polymer	Acrylates Copolymer	7.50
Texapon NSO-BZ	Sodium Laureth Sulfate	41.00
Miranol Ultra C 32	Sodium Cocoamphoacetate	5.00
Hostapon CLG	Sodium Lauroyl Glutamate	4.50
Jaguar C 162	Hydroxypropyl Guar Hydroxypropyltrimonium Chloride	1.00
Erythrulose	Erythrulose	0.50
Euxyl K 300	Phenoxyethanol & Methylparaben & Propylparaben & Ethylparaben & Butylparaben & Isobutylparaben	0.80
ALPAFLOR MALVA AO	Glycerin, Aqua, Malva Sylvestris (Mallow) Flower Extract, Potassium Sorbate, Sodium Benzoate	2.00
Parfum Limette	Fragrance	q.s.
FD&C Yellow 5	CI 19140	0.50
Frescolat Plus	Menthyl Lactate, Menthol	0.20
Dehyton AB-30	Coco Betaine	2.00
Rewoderm LI S 80	PEG-200 Hydrogenated Glyceryl Palmitate & PEG-7 Glyceryl Cocoate	1.00
Citric Acid	Citric Acid	q.s.

Example 8: Leave-on Hair and Scalp Conditioner

Ingredients	INCI	wt. %
Deionised Water	Aqua	Ad 100
Ethanol DEB 96	Alcohol denat.	30.00
PVP/VA Copolymer	PVP/VA Copolymer	2.50
Euxyl K-300	Phenoxyethanol, Methylparaben, Butylparaben, Ethylparaben, Propylparaben, Isobutylparaben	0.80
Protachem HCO-40	PEG-40 Hydrogenated Castor Oil	0.50
Fragrance ADAM	Parfum	0.10
Triethanolamine 99%	Triethanolamine	0.01
FD & C Yellow No 5 (0.5% Solution)	CI 19140, Aqua	0.10

FD & C Blue No 1 (0.5% Solution)	CI 42090, Aqua	0.10
Erythrulose	Erythrulose	0.05

Example 9: Shampoo

<i>INCI Nomenclature</i>	<i>wt. %</i>
Aqua (water)	Ad 100
Ammonium laureth sulfate	10.00
Ammonium lauryl sulfate	5.00
Glycol distearate	1.00
Dimethicone	1.00
Cetyl alcohol	0.50
Cocamide MEA	3.00
Erythrulose	0.30
ZPT	0.50
Guar hydroxypropyltrimonium chloride	0.20
Hydrogenated polydecene	1.00
Polyquaternium 10	0.30
PEG 7m	0.50
Trimethylpropane tricaprylate/ tricaprate	1.00
Preservative	q.s.
Fragrance	0.30
E 104, E 110, E 132	0.02

Example 10: Clear Shampoo with plant extracts

<i>INCI Nomenclature</i>	<i>wt. %</i>
Aqua (water)	Ad 100
Sodium laureth sulfate	10.00
Lauryl glucoside	6.00
Cocamidopropyl betaine,	2.00
Propylene glycol	2.00
Perfume oil	1.25
Sodium citrate	0.25
Sodium benzoate	0.20
Panthenol	1.00

Sodium formate	0.20
Polyquaternium-10	0.20
Hydroxypropyl guar hydroxypropyltrimonium chloride	0.05
Erythrulose	0.25
PEG-35 castor oil	1.00
Maris sal	1.25
Polysorbate 20	1.00
Tocopheryl acetate	0.20
Prunus armeniaca	0.20
Echinacea purpurea	0.05
Tocopherol	0.05
Linoleic acid	0.20
Preservative	1.00
CI77891	0.02

Example 11: Rinse-off Hair and Scalp Conditioner

<i>INCI Nomenclature</i>	<i>wt. %</i>
Aqua (water)	Ad 100
Stearyl alcohol	2.50
Cetyl alcohol	2.50
Behentrimonium chloride	1.30
Dimethicone	2.00
Erythrulose	0.50
Fragrance	0.50
Butylene glycol	2.00
Methyl parabene	0.30

Claims

1. Use of erythrulose as antimicrobial agent, wherein erythrulose inhibits the growth of *Propionibacterium acnes*, *Staphylococcus epidermidis*, *Corynebacterium xerosis*, and/ or *Aspergillus brasiliensis*,
5
2. The use according to claim 1, wherein erythrulose inhibits the growth of *Staphylococcus epidermidis* and *Corynebacterium xerosis*.
3. The use according to claim 1, wherein erythrulose inhibits the growth of
10 *Aspergillus brasiliensis*.
4. The use according to any one of claims 1 to 3 in a product selected from the group of cosmetic compositions, household products, plastics, paper and/ or paints.
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5. The use according to claim 3 and 4 for improving preservation compared to a product not containing erythulose.
6. Non-therapeutic use of erythrulose as deodorant active compound.
20
7. Erythrulose for use as anti-acne compound.
8. A method of preventing microbial decay and breakdown caused by *A. brasiliensis* of cosmetic compositions, household products, plastics, paper and/ or paints, wherein said method comprises adding to the cosmetic compositions, household products, plastics, paper and/ or paints erythrulose in an amount selected in the range of 0.005 to 0.75 wt.-%, based on the total weight of the composition.
25
9. The method according to claim 8, wherein the amount of erythrulose is selected in the range of 0.01 to 0.6 wt.-%, preferably in the range of 0.025 to 0.5 wt.-%, most preferably in the range of 0.04 to 0.5 wt.-%, based on the total weight of the composition.
30
- 35 10. The method according to claim 8 or 9, wherein the composition furthermore comprises water and at least one agent selected from the group consisting of surfactants, emulsifiers, thickeners and oils.

11. The method according to any one of claims 8 to 10, wherein the composition is a cosmetic composition in the form of a shampoo preparation, a hair conditioner, an O/W emulsion, a W/O emulsion or a gel.

5 12. A cosmetic or pharmaceutical composition for topical application comprising water and at least one agent selected from the group consisting of surfactants, emulsifiers, thickeners, and oils, wherein the composition furthermore comprises erythrulose in an amount of 0.04 to 0.2 wt.-%, preferably 0.05 to 0.1 wt.-%, based on the total weight of the composition.

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13. The cosmetic composition according to claim 12, wherein the composition is a shampoo preparation, a hair conditioner, an O/W emulsion, a W/O emulsion, a deodorant composition or a gel.

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14. The cosmetic composition according to claim 12 or 13, wherein the composition is a topical composition applied to the human skin, scalp and/ or hair.

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15. Process for the preparation of a composition according to claims 12 to 14, wherein erythrulose in an amount selected in the range of 0.005 to 0.75 wt.-%, more preferably in the range of about 0.01 to 0.6 wt.-% and most preferably in the range of 0.025 to 0.5 wt.-% such as in the range of 0.04 to 0.5 wt.-%, based on the total weight of the composition is admixed with a suitable carrier.

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/067368

A. CLASSIFICATION OF SUBJECT MATTER				
INV.	A61K8/60	A61Q5/00	A61Q17/00	A61Q19/00
	A61Q5/02	A61Q5/12	A61Q19/10	A61K31/7004

ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A61K A61Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data, CHEM ABS Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"&" document member of the same patent family

Date of the actual completion of the international search

Date of mailing of the international search report

6 August 2018

11/09/2018

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/067368

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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