

(19)



(11)

EP 3 686 265 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
29.07.2020 Bulletin 2020/31

(51) Int Cl.:
C11D 1/83 (2006.01) C11D 3/386 (2006.01)

(21) Application number: **19382046.1**

(22) Date of filing: **23.01.2019**

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
 GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
 PL PT RO RS SE SI SK SM TR**
 Designated Extension States:
BA ME
 Designated Validation States:
KH MA MD TN

(71) Applicant: **BlueSun Consumer Brands, S.L.**
08302 Mataro (ES)

(72) Inventor: **Osset Hernández, Miquel**
08445 Cànoves i Samalús (ES)

(74) Representative: **Isern Patentes y Marcas S.L.**
Avda. Diagonal, 463 Bis, 2°
08036 Barcelona (ES)

(54) **DETERGENT COMPOSITION WITH SOPHOROLIPIDS**

(57) The present invention relates to a liquid laundry detergent composition comprising anionic surfactant, soap, non-ionic surfactant, a biosurfactant comprising a sophorolipid, at least one enzyme selected from consist-

ing of protease, α -amylase, lipase, cellulase, pectinase, oxidase, and mannanase. It refers also to the use of the composition in laundry washing. The composition further may comprise organic solvent, polymer and additives.

EP 3 686 265 A1

Description**Technical Field**

5 **[0001]** The present invention belongs to the field of liquid laundry detergents, which contains a biosurfactant selected from the group of sophorolipids.

Background art

10 **[0002]** Laundry detergent compositions are used to clean fabrics in the wash. Solid compositions are progressively substituted by liquid formulations, which are gaining increasing acceptance among consumers.

[0003] Another trend seen in the detergent market is the incorporation of components of natural origin in the compositions, due to increasing environmental concerns and the advances in biotechnology.

15 **[0004]** Among the components of natural origin, biosurfactants play an important role, which may substitute partially standard surfactants providing better washing performance.

[0005] Biosurfactants include a large group of compounds produced as metabolites from microorganisms, such as, for example, phospholipids, glycolipids (Rhamnolipids, Sophorolipids, Trehalose lipids, Mannosylerythritolipids, Glucoselipids, Cellobioselipids), polyketideglycosids, isoprenoide and carotenoid glycolipids, and lipopeptides.

[0006] In the state of the art, detergent compositions including biosurfactants have been disclosed.

20 **[0007]** For example, in European patent application EP-A-0499434, it was disclosed a detergent composition, which contains a sophorolipid surfactant of specific formula. In that document, it is further disclosed that glycolipid biosurfactants can give a synergistic enhancement of oily/fatty soil detergency when used in certain combinations with each other, or jointly with another surfactant(s). Enhanced detergency has been observed even with glycolipids that exhibit poor detergency when used alone.

25 **[0008]** In European patent application EP-A-2596089 is disclosed a cleaning composition comprising: an effective amount of surfactant system, wherein the surfactant system comprises at least 1 wt.% (based on the cleaning composition) of a biosurfactant, which is a glycolipid surfactant, and at least one lipase enzyme of bacterial origin. It is further disclosed that surprising synergistic benefits on cleaning on stains and soils were found when lipases, derived from bacteria, were combined with those biosurfactants.

30 **[0009]** In European patent application EP-A-2988829 it is disclosed a fluid cleaning composition comprising: a surfactant combination comprising a synthetic surfactant; and a glycolipid biosurfactant, and an encapsulated benefit agent suspended in said fluid cleaning composition. It is further disclosed that the cleaning composition is characterized by improved dispensing and suspension properties.

35 **[0010]** In International patent application WO-A-2012/167815 it is disclosed a surfactant composition, consisting of 70 wt.% - 99.9 wt.% sophorolactone, 0 - 1 wt.% sophorolipid acid, less than 0.1 % residual substrate and remainder water.

[0011] International patent application WO-A-2013/182759 discloses a clear composition, which contains at least one non-water-soluble material solubilized by at least one sophorolipid and at least water, and for the use of that composition for cleaning hard surfaces or laundry.

40 **[0012]** in International patent application WO-A-2015/091250 discloses a microemulsion containing 1 to 50 wt.% of at least one biosurfactant, 1 to 50 wt.% of at least one other surfactant, 10 to 80 wt.% water and 10 to 80 wt.% of at least one triglyceride (fat) or a mixture of a triglyceride and one or more of the group consisting of waxes, lipids, terpenes, triterpenes and fatty acids.

45 **[0013]** In International patent application WO-A-2016/050439 it is disclosed a formulation comprising: at least one biosurfactant, selected from the group of sophorolipids, at least one additional surfactant selected from the group of betaines, alkoxyated fatty alcohol sulphates and alkylamine oxides, at least a fatty acid, selected from the group of dimeric β -hydroxydecanoic acid, oleic acid, palmitic acid, stearic acid and linoleic acid, wherein the weight ratio between sophorolipid in lactone form and component c) is from 50:1 to 80:1.

50 **[0014]** In International patent application WO-A-2016/139032 discloses a method of protecting a coloured or dyed substrate (e.g. a fabric) from dye transfer during exposure to an aqueous cleansing solution, which comprises the step of treating said substrate with a composition comprising a surfactant system, which comprises a glycolipid surfactant in the range 50-100 wt.% of the total surfactant system.

55 **[0015]** In International patent application WO-A-2016/146497 it is disclosed a composition comprising: at least one peptidase selected from der group of proteases, at least one biosurfactant selected from the group comprising rhamnolipids and sophorolipids, at least one anionic surfactant, and water. It is further disclosed that the biosurfactant stabilizes the enzymatic activity of at least one peptidase.

[0016] In International patent application WO-A-2017/036902 it is disclosed a composition comprising a psychrophilic lipase and a biosurfactant.

[0017] in European patent application EP-A-3290500 it is disclosed a composition comprising a specific ratio of at

least one alkoxyated surfactant from the group of polyoxyalkylene carboxylates defined by a general formula and at least one glycolipid biosurfactant comprising rhamnolipids, sophorolipids, mannosylerythritolololides, cellobioselipids and trehaloselipids.

[0018] In European patent application EP-A-3290501 it is disclosed a composition comprising at least one alkoxyated fatty acid amide defined by a general formula and at least one glycolipid biosurfactant comprising specific rhamnolipids, sophorolipids, mannosylerythritolol-lipids, cellobioselipids and trehaloselipids.

[0019] Sophorolipids are also mentioned usually in lists of additional components suitable for laundry detergent compositions, such as, for example, in the following International patent applications WO-A-00/18860, WO-A-02/48302, WO-A-2013/043803, WO-A-2014/160821, WO-A-2016/040248, WO-A-2017/011733, WO-A-2018/087105.

[0020] Despite the various proposals available in the state of the art, there is still a need to have new and highly performing detergent compositions for the use in laundry washing, which comprise biosurfactants.

Object of the invention

[0021] The object of the present invention is a detergent composition.

[0022] Another aspect of the invention is the use of this composition in laundry washing.

Detailed description of the invention

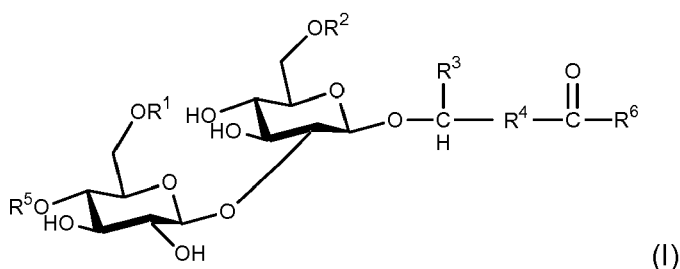
[0023] The object of the present invention is a liquid laundry detergent composition comprising:

a) at least one anionic surfactant selected from the group consisting of alkali, ammonium and alkanolamine salts of alkyl ether sulphate, alkyl sulphate and alkylbenzene sulphonate,

b) at least one soap having saturated or unsaturated, hydroxylated or non-hydroxylated hydrocarbon chain having 8 to 18 carbon atoms,

c) at least one non-ionic surfactant selected from the group consisting of ethoxylated fatty alcohol C₁₂₋₁₈, amine oxide, alkyl polyglycoside, fatty acid methylglucamide, alkyl xyloside, and glycerine polyalkoxylated fatty ester,

d) a biosurfactant comprising a sophorolipid according to general formula (I)



wherein:

R¹ and R² are individually H or an acetyl group;

R³ is a saturated or unsaturated, hydroxylated or non-hydroxylated hydrocarbon group having 1 to 9 carbon atoms;

R⁴ is a saturated or unsaturated, hydroxylated or non-hydroxylated hydrocarbon group having 1 to 19 carbon atoms, with the proviso that the total number of carbon atoms in the groups R³ and R⁴ does not exceed 20;

R⁵ is H or a lactone ring formed with R⁶; and

R⁶ is OH or a lactone ring formed with R⁵.

e) at least one enzyme selected from the group consisting of protease, α -amylase, lipase, cellulase, pectinase, oxidase, and mannanase, and

f) water.

[0024] The authors of the present invention have developed a liquid laundry detergent composition comprising a biosurfactant selected from the group of sophorolipids, which, surprisingly, shows at least one of the following improvements: enhancement of the stability of enzymes, in particular the stability of any one of amylases, lipases, cellulases or mannanases, enhancement of the performance of enzymes, in particular the performance of any one of amylases, lipases, cellulases or mannanases the content of organic solvents is significantly reduced, control of the rheological

behaviour, enhancement of fragrance, synergistic removal of fatty soil in combination with anionic and/or non-ionic surfactants, enhancement of the performance of the optical brightener agent, enhanced bactericidal effect in combination with bactericidal actives of natural origin, in particular, botanical essential oils or extracts.

[0025] Throughout the present description, unless otherwise specified, the concentrations expressed as percentages always refer to the percentage weight/weight (w/w), that is, grams of a certain component per 100 g of composition, and the percentages of the different components of a composition are adjusted so that their sum is 100%.

[0026] In the context of the invention, the active matter of a surfactant, a hydrotropic agent, or a detergent composition refers to the residue that remains after removing the water and the possible cosolvents present in the product. The active matter of an enzyme is that indicated by the manufacturer in the corresponding technical sheet.

[0027] The term "approximately" refers to a deviation of plus/minus 10%, preferably plus/minus 5%.

[0028] In the present description, as well as in the claims, the singular forms "a", "an" and "the" include the plural reference unless the context clearly indicates otherwise. The ranges defined by the preposition "between" include also the two ends thereof.

[0029] The detergent composition of the invention is a substantially aqueous detergent composition, that is, water constitutes the major solvent therein, and can be at least 50% by weight of the total weight of the composition.

Anionic surfactant

[0030] The composition of the invention comprises an anionic surfactant selected from the group consisting of alkali, ammonium and alkanolamine salts of alkyl ether sulphate, alkyl sulphate and alkylbenzene sulphonate.

[0031] The alkyl ether sulphates are esters of sulfuric acid with fatty alcohols with a carbon chain of between 10 and 20 carbon atoms, preferably between 12 and 18, more preferably between 12 and 14, comprising between 0.5 and 10 moles of ethylene oxide, preferably between 0.5 and 5, and more preferably between 0.5 and 2. One of the most used is sodium lauryl sulphate (LES) with 2 moles of ethylene oxide.

[0032] The alkyl sulphates are esters of sulfuric acid with fatty alcohols with a carbon chain of between 10 and 20 carbon atoms, preferably between 12 and 18, more preferably between 12 and 14. One of the most used is sodium lauryl sulphate.

[0033] The alkylbenzene sulfonates derive from the sulfonation of alkylbenzenes and are generally used in the form of alkali metal or alkanolamine salts. The alkyl group in the alkylbenzene sulfonate preferably contains a carbon chain of between 8 and 16 carbon atoms, preferably between 10 and 15. One of the most used is dodecylbenzene sulfonate (LAS) sodium salt.

[0034] Companies such as BASF, Huntsman, Croda, or Kao, market a wide range of such anionic surfactants.

[0035] In a preferred embodiment, the composition comprises a mixture of alkyl ether sulphate and alkylbenzene sulphonate, or alkyl ether sulphate and alkyl sulphate, in the form of alkali, ammonium or alkanolamine salts. In a more preferred embodiment, the composition comprises a mixture of a sodium lauryl sulphate with 2 moles of ethylene oxide and dodecylbenzene sulfonate sodium salt. In another preferred embodiment, the composition comprises a mixture of a sodium lauryl sulphate with 2 moles of ethylene oxide and sodium lauryl sulphate.

[0036] The content of anionic surfactant in the composition of the invention is usually comprised between 1% and 25% by weight, preferably between 3% and 22% by weight, more preferably between 5% and 20% by weight, more preferably between 6% and 15% by weight, and yet more preferably between 7% and 10% by weight on the total weight of the composition.

Non-ionic surfactant

[0037] The composition of the invention comprises a non-ionic surfactant selected from the group consisting of ethoxylated fatty alcohol C₁₂₋₁₈, amine oxide, alkyl polyglycoside, fatty acid methylglucamide, alkyl xyloside, and glycerine polyalkoxylated fatty ester.

[0038] The ethoxylated fatty alcohol C₁₂₋₁₈ is obtained by a catalysed reaction of ethylene oxide and a fatty alcohol C₁₂₋₁₈. The addition of ethylene oxide does not produce a single product, but a mixture of homologues containing different ratios of ethylene oxide. The reaction product is described by the average molar ratio of ethylene oxide to alcohol, corresponding to the number of moles added. The number of moles of ethylene oxide is usually comprised between 2 and 12, preferably between 4 and 10, more preferably between 6 and 8, and more preferably is 7. These surfactants are available from companies such as BASF and Kao, for example.

[0039] The amine oxide is a surfactant that is obtained by oxidation of tertiary amines, generally alkyldimethylamines, with hydrogen peroxide, and generally have foaming properties. The alkyl chain generally comprises between 10 and 18 carbon atoms, preferably between 12 and 14. Commercially they can be found, for example, under the names Genaminox® (Clariant), Chemoxide® (Lubrizol), or Standamox (BASF).

[0040] The alkylpolyglycoside, APG, is produced from fatty alcohols and glucose, the molar ratio of glucose:alcohol

in the products is termed the degree of polymerisation and these products are typically produced as 50% aqueous solutions, with a degree of polymerisation in the range 1.2-1.6. Usually the alcohol is a saturated fatty chain of 10 to 14 carbon atoms, preferably of 12 to 14 carbon atoms. These surfactants are available from companies such as BASF, for example.

[0041] A fatty acid methylglucamide is produced from methylglucamine and a derivative of a fatty acid. Usually the alkyl chain is a saturated fatty chain of 8 to 22 carbon atoms, preferably of 8 to 10 carbon atoms, or 12 to 14 carbon atoms, or 12 to 18 carbon atoms. In a preferred embodiment the fatty chain proceeds from coconut oil. These surfactants are available from companies such as Clariant, for example.

[0042] An alkyl xyloside is produced from fatty alcohols and xylose. The alkyl chain is preferably selected from the group consisting of amyl, capryl, lauryl and mixtures thereof. These surfactants are available from the company Waelteoleo, for example.

[0043] A glycerine polyalkoxylated fatty ester is produced by alkoxylation with ethylene oxide or propylene oxide, preferably ethylene oxide, of a triglyceride. Usually the fatty chain of the triglyceride is comprised from 8 to 18 carbon atoms, preferably from 8 to 14 carbon atoms or from 12 to 18 carbon atoms. More preferably the fatty chain corresponds to coconut fatty chain. These surfactants are available from companies such as Kao, for example.

[0044] In a preferred embodiment, the non-ionic surfactant is an ethoxylated fatty alcohol C₁₂₋₁₈, wherein the moles of ethylene oxide are comprised between 2 and 12.

[0045] In a further preferred embodiment, the non-ionic surfactant is a combination of an ethoxylated fatty alcohol C₁₂₋₁₈, wherein the moles of ethylene oxide are comprised between 2 and 12 and a glycerine polyalkoxylated fatty ester.

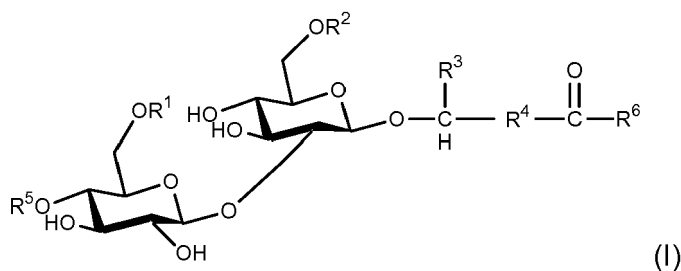
[0046] In a further preferred embodiment, the non-ionic surfactant is a combination of an ethoxylated fatty alcohol C₁₂₋₁₈, wherein the moles of ethylene oxide are comprised between 2 and 12 and an alkyl xyloside.

[0047] In a further preferred embodiment, the non-ionic surfactant is a combination of an ethoxylated fatty alcohol C₁₂₋₁₈, wherein the moles of ethylene oxide are comprised between 2 and 12 and a fatty acid methylglucamide.

[0048] The content of non-ionic surfactant in the composition of the invention is usually comprised between 1% and 25% by weight, preferably between 2% and 22% by weight, more preferably between 3% and 15% by weight, more preferably between 4% and 12% by weight, and yet more preferably between 5% and 10% by weight on the total weight of the composition.

Biosurfactant

[0049] The composition of the invention comprises a biosurfactant comprising a sophorolipid according to general formula (I)



wherein:

R¹ and R² are individually H or an acetyl group;

R³ is a saturated or unsaturated, hydroxylated or non-hydroxylated hydrocarbon group having 1 to 9 carbon atoms;

R⁴ is a saturated or unsaturated, hydroxylated or non-hydroxylated hydrocarbon group having 1 to 19 carbon atoms, with the proviso that the total number of carbon atoms in the groups R³ and R⁴ does not exceed 20;

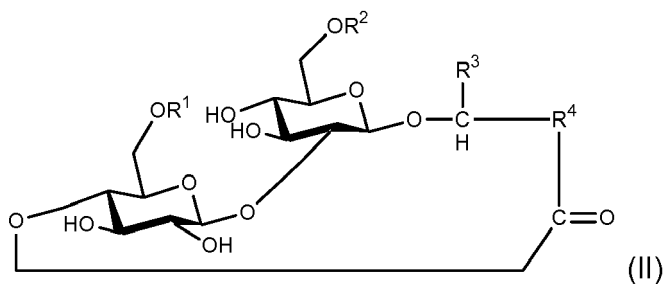
R⁵ is H or a lactone ring formed with R⁶; and

R⁶ is OH or a lactone ring formed with R⁵.

[0050] The sophorolipid may be incorporated into the composition as either the open chain free acid form, where R⁵ is H and R⁶ is OH, or in its lactone form, where the lactone ring is formed between R⁵ and R⁶ as shown by general formula (II):

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wherein R^1 , R^2 , R^3 and R^4 are as defined above, with the proviso that at least one of R^1 or R^2 is an acetyl group.

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[0051] In a preferred embodiment, the biosurfactant consists of a sophorolipid of formula (I) or formula (II). Preferably the composition comprises a sophorolipid defined by a mixture of compound of formula (I) and compound of formula (II), wherein

R^1 and R^2 are individually H or an acetyl group, R^3 is a methyl group, R^4 is a $-\text{CH}_2-(\text{CH}_2)_5-\text{CH}=\text{CH}-(\text{CH}_2)_6-\text{CH}_2-$, R^5 is H and R^6 is OH in compound of formula (I), and

wherein

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R^1 and R^2 are individually H or an acetyl group, R^3 is a methyl group, R^4 is a $-\text{CH}_2-(\text{CH}_2)_5-\text{CH}=\text{CH}-(\text{CH}_2)_6-\text{CH}_2-$, and R^5 is a lactone ring formed with R^6 in compound of formula (II), with the proviso that at least one R^1 or R^2 is an acetyl group.

[0052] In a more preferred embodiment, the composition comprises a sophorolipid defined by a mixture of compound of formula (I) and compound of formula (II),

wherein

25

R^1 and R^2 are an acetyl group, R^3 is a methyl group, R^4 is a $-\text{CH}_2-(\text{CH}_2)_5-\text{CH}=\text{CH}-(\text{CH}_2)_6-\text{CH}_2-$, R^5 is H and R^6 is OH in compound of formula (I), and wherein

R^1 and R^2 are an acetyl group, R^3 is a methyl group, R^4 is a $-\text{CH}_2-(\text{CH}_2)_5-\text{CH}=\text{CH}-(\text{CH}_2)_6-\text{CH}_2-$, and R^5 is a lactone ring formed with R^6 in compound of formula (II).

[0053] In a more preferred embodiment, the biosurfactant consists of a mixture of 60 wt.% to 62 wt.% sophorolipid of formula (I) and 38 wt.% to 40 wt.% of sophorolipid of formula (II).

30

[0054] Sophorolipids can be produced by yeast cells, for example *Torulopsis apicola* and *Torulopsis bombicola*. The fermentation process typically utilises sugars and alkanes as substrates. Appropriate fermentation methods are reviewed in, for example, Gobbert, et al., Sophorose lipid formation by resting cells of *Torulopsis bombicola*, Biotechnology Letters (1984) 6 (4), 225. Sophorolipids are commercially available, for example, as Rewoferm® SL (Evonik).

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[0055] The composition of the invention comprises usually between 1% and 25% by weight of sophorolipid, preferably between 2% and 15% by weight, more preferably between 3% and 10% by weight, more preferably between 4% and 7% by weight, and yet more preferably between 5% and 6% by weight on the total weight of the composition.

Enzymes

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[0056] The composition of the invention comprises at least one enzyme selected from the group consisting of protease, α -amylase, lipase, cellulase, and mannanase. In preferred embodiments, the composition comprises at least two, three, four, five, six, or seven enzymes from the group consisting of protease, α -amylase, lipase, cellulase, pectinase, oxidase, and mannanase.

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[0057] In a preferred embodiment the composition of the present invention comprises a combination of enzymes consisting of a protease, an α -amylase, and a lipase.

[0058] In another preferred embodiment the composition of the present invention comprises a combination of enzymes consisting of a protease, an α -amylase, and a cellulase.

[0059] In another preferred embodiment the composition of the present invention comprises a combination of enzymes consisting of a protease, an α -amylase, a lipase, and a cellulase.

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[0060] In another preferred embodiment, the composition of the present invention comprises a combination of enzymes consisting of a protease, an α -amylase, a lipase, and a mannanase.

[0061] In another preferred embodiment, the composition of the present invention comprises a combination of enzymes consisting of a protease, an α -amylase, a cellulase, and a mannanase.

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[0062] In another preferred embodiment the composition of the present invention comprises a combination of enzymes consisting of a protease, an α -amylase, a lipase, and a pectinase.

[0063] In another preferred embodiment the composition of the present invention comprises a combination of enzymes consisting of a protease, an α -amylase, a cellulase, and a pectinase.

[0064] In another preferred embodiment the composition of the present invention comprises a combination of enzymes

consisting of a protease, an α -amylase, a lipase, and an oxidase.

[0065] In another preferred embodiment the composition of the present invention comprises a combination of enzymes consisting of a protease, an α -amylase, a cellulase, and an oxidase.

[0066] In another preferred embodiment, the composition of the present invention comprises a combination of enzymes consisting of a protease, an α -amylase, a lipase, a cellulase, and a mannanase.

[0067] In the context of the invention, the expression "a protease", "an amylase", "a lipase", "a cellulase", "an oxidase", "a pectinase", and "a mannanase" extend to the combination of two or more proteases, α -amylases, lipases, cellulases, oxidases, pectinases, or, mannanases, respectively.

Protease

[0068] Proteases, or peptidases, constitute a group of enzymes capable of hydrolyzing the peptide bond of proteins. They belong to subclass EC 3.4.

[0069] The proteases are classified into exopeptidases or endopeptidases, according to their centre of action, so that the exopeptidases hydrolyse the peptide bond of the carboxy or amino terminal end of the polypeptide chain, while the endopeptidases cleave the internal peptide bonds of the polypeptide.

[0070] Proteases are also classified, according to the functional group present in their active site, into four groups: serine-proteases, cysteine-proteases, aspartic-proteases, and metalloproteases.

[0071] Likewise, depending on the pH at which they are active, they are classified into acidic, alkaline or neutral proteases.

[0072] Proteases can be obtained from plants, animals or microorganisms (bacteria, yeast and fungi).

[0073] In the context of the present invention, a protease of any origin can be employed.

[0074] Also included within the field of the present invention are mutant forms of the proteases, either by chemical modification or by genetic engineering.

[0075] Some proteases obtained from plants are, for example, papain, bromelain, and ficin. Among the proteases obtained from animals are, for example, protaminase, trypsin, chymotrypsin, pepsin and renin.

[0076] Proteases can also be obtained from bacteria such as *Bacillus licheniformis*, *Bacillus amyloliquefaciens*, *Bacillus firmus*, *Bacillus megaterium*, *Bacillus pumilis*, *Streptomyces fradiae*, *Streptomyces griseus*, *Streptomyces rectus*, *Bacillus subtilis*, *Bacillus cereus*, *Bacillus metagerium* or *Pseudomonas aeruginosa*, among others; as well as from fungi, such as *Aspergillus niger*, *Aspergillus sojae*, *Aspergillus oryzae*, *Aspergillus flavus*, *Pericularia oryzae*, *Endothia parasitica*, *Mucor miehei*, or *Mucor pusillus*.

[0077] In the context of the invention, a protease selected from those commercially available may be used, such as, for example, those marketed under the names Alcalase®, Savinase®, Primase®, Durazym®, Polarzyme®, Kannase®, Liquanase®, Ovozyme®, Neutrase®, Everlase®, Esperase®, Maxatase®, Maxacal®, Maxapem®, Polarzyme®, Properase®, Purafect®, Purafect® OXP, Properase®, Excellase® or Opticlean®.

[0078] In a preferred embodiment, the protease is a subtilisin. Subtilisins (EC 3.4.21.62) belong to the group of serine proteases and are produced mainly by bacteria of the *Bacillus* genus, such as *Bacillus sp.*, *Bacillus subtilis*, *Bacillus alcalophilus*, *Bacillus amyloliquefaciens*, *Bacillus clausii*, *Bacillus lentus*, *Bacillus licheniformis*, or *Bacillus stearothermophilus*, among others. Among subtilisins, for example, subtilisin A or subtilisin Carlberg, subtilisin BPN', subtilisin DY, subtilisin 309, subtilisin Y, subtilisin 168, or subtilisin PB92 may be mentioned. These proteases are commercially available like, for example, those marketed under the names Alcalase®, Everlase®, Savinase® or Polarzyme® by the company Novozymes A/S.

α -Amylase

[0079] α -amylases (EC 3.2.1.1) are enzymes that hydrolyze 1,4- α -D-glycosidic bonds in polysaccharides that contain three or more glucose units bound by 1,4- α bonds. α -amylases hydrolyze starch, as well as glycogen and oligosaccharides. They can be obtained from animals, plants or microorganisms. Any α -amylase of any origin is suitable for use within the field of the present invention.

[0080] In a preferred embodiment, the α -amylase is of microbial origin. Amylases can be obtained from bacteria such as, for example, *Acinetobacter spp.*, *Bacillus acidocaldarius* A-2, *Bacillus alcalophilus subsp. Halodurans*, *Bacillus amyloliquefaciens*, *Bacillus cereus*, *Bacillus coagulans*, *Bacillus licheniformis*, *Bacillus macerans*, *Bacillus subtilis*, *Halobacterium halobium*, among others; or from fungi such as *Aspergillus niger*, *Aspergillus oryzae*, *Fusarium oxysporum*, *Humicola insolens*, *Humicola lanuginosa*, *Mucor pusillus* or *Trichoderma viride*; or from yeasts, such as *Candida tropicalis* var. *japonica*, *Endomycopsis fibuligera*, *Lipomyces starkeyi*, *S. castellii*, *Pichia polymorpha* or *Sachwanniomycetes alluvius*.

[0081] Some commercially available α -amylases are, for example, Termamyl®, Duramyl®, Nalase®, Fungamyl®, Liquozyme®, Stainzyme®, Bioamylase®, Kemzym®, or Purastar®.

Lipase

[0082] Lipases, or triacylglycerol acylhydrolases (EC 3.1.1.3) are enzymes that are part of the family of hydrolases and that act on the ester-type bonds of triglycerides, hydrolyzing them into diglycerides, monoglycerides, fatty acids and glycerine.

[0083] Lipases can be obtained from animals, plants and microorganisms, mainly bacteria, fungi and yeasts. In the context of the present invention, a lipase from any origin can be employed, a good number of which are commercially available.

[0084] Among lipases of animal origin is, for example, the pancreatic lipase which can be obtained from the pig pancreas, and is available from various suppliers, for example, through the company Biocatalysts Ltd under the name Lipomod® 224P-L224P.

[0085] Lipases of bacterial origin are available, for example, from bacteria of the genera *Pseudomonas*, *Achromobacter*, *Alcaligenes*, *Burkholderia*, *Chromobacterium* or *Thermus*, which are marketed, for example, under the trade names Lumafast®, Lipomax®, Lipase ALC, Lipase ALG, Lipase PLC, Lipase PLG, Lipase QLG, Lipase SL, Lipase CV, Lipase PS "Amano", Lipase AK "Amano" or Lipase TL; of fungal origin as, for example, from fungi of the genera *Aspergillus*, *Penicillium*, *Mucor*, *Rhizomucor*, *Rhizopus*, *Thermomyces*, which are marketed, for example, under the trade names Lipase A "Amano" 6, Lypolyve AN, Lipase G "Amano" 50, Lipomod® 338P-L338P, Lipase M "Amano" 10, Piccnate®, Palatase®, Lipase F-AP15, Lipase L036P-L036P, Lipase F-DS, Lipomod® 627P-L627P, Lipopan® F, NovoLime, Greasex, NovoCor AD, Newlase F, Lipozyme® TL IM, Lipase UL, Lipolase®, Lipolase® Ultra, Lipo Prime®, Lipex®, Lipomod® 621P-L621 or Lipomod® 187P-L187P; or from yeasts as, for example, from yeasts of the genus *Candida*, which are marketed, for example, under the trade names Novozym® 435, Noopazyme®, Lipomod® 34P-L034P, Lypolyve CC, Lipase MY, Lipase AY "Amano" 30, Resinase®, Lipase AYS "Amano" or Lipase II. Preferably a lipase of fungal origin is used.

Cellulase

[0086] Cellulase is any of several enzymes produced chiefly by fungi, bacteria, and protozoans that break down the cellulose molecule into monosaccharides, such as β -glucose, or shorter polysaccharides and oligosaccharides.

[0087] Several different kinds of cellulases are known, which differ structurally and mechanistically. Synonyms, derivatives, and specific enzymes associated with the name "cellulase" include, for example, endo-1,4- β -D-glucanase (β -1,4-glucanase, β -1,4-endoglucan hydrolase, endoglucanase D, 1,4-(1,3,1,4)- β -D-glucan-4-glucanohydrolase), glycosyl hydrolase, alkali cellulase

[0088] In the context of the present invention, the cellulase has preferably endo-1,4- β -D-glucanase (EC 3.2.1.4) or glycosyl hydrolase activity (EC 3.2.1).

[0089] Cellulases showing different activity may be obtained commercially, for example, from the company Novozymes as Carezyme® 1000L or Celluclast® 1.5L.

Oxidase

[0090] In the context of the invention, the oxidase refers to an enzyme that catalyses an oxidation-reduction reaction. It includes, for example, glucose oxidase, monoamine oxidase, cytochrome P450 oxidase, NADPH oxidase, xanthine oxidase, and laccase. Oxidase is available through, for example, the company Novozymes.

Pectinase

[0091] In the context of the invention, the pectinase refers to an enzyme that breaks down pectin, a polysaccharide found in plant cell walls. It is commonly referred to as pectic enzymes, and includes pectolyase, pectozyme, and polygalacturonase. Pectinase is available through, for example, the company Novozymes.

Mannanase

[0092] In the context of the invention, the mannanase refers to mannohydrolase, which includes mannanhydroxylase, i.e., endomannanase, as well as mannoside mannohydrolase, i.e., exo-mannanase. The term also includes mannohydrolases including all possible specificities, such as α , β , 1,2, 1,3, 1,4, 1,6, L, D. This means that the mannanases that cleave any polysaccharide containing mannose in a bond involving at least one mannose sugar residue (α -mannosidase: E.C. 3.2.1.24; β -mannosidase: E.C. 3.2.1.25, etc.) are suitable for the purposes of the present invention. Mannanase is available through, for example, the companies DuPont and Novozymes.

[0093] In particular, when the enzyme combination comprises a mannanase, it is preferably a 1,4- β -mannosidase that

randomly hydrolyzes (1,4) bonds in mannans, galactomannans and glucomannans, such as, for example, Mannaway® from Novozymes company.

[0094] Commercially available enzymes are usually supplied in the form of aqueous solutions of various concentrations, so that the appropriate amounts of the commercial enzymes will be used in each case to provide the appropriate percentages of the enzyme combination, as well as the desired concentrations in the composition of the invention.

[0095] Alternatively, the content of enzymatic active matter can be expressed as activity units, according to the information usually contained in the technical sheets corresponding to the enzymatic products.

[0096] Thus, for example, for proteases, their enzymatic activity can be measured in units called KNPU (*Kilo Novo Protease Units*) defined in terms of the amount of protease capable of hydrolyzing a certain amount of dimethylcasein to peptides per minute, under certain conditions, as described, for example, in the international patent application WO-A-03/018734.

[0097] The enzymatic activity α -amylases can be measured using the KNU unit (*Kilo Novo alpha-Amylase Units*), defined as the amount of enzyme which hydrolyzes 5.26 g of starch per hour, according to certain conditions, as indicated, for example, in the US patent application US-A-2012/0122754.

[0098] The enzymatic activity of lipases is measured in units called LU (*Lipase Units*), or KLU (1 KLU = 1000 LU) defined according to the hydrolysis assay of tributyrin (glycerine tributyrate), so that 1 LU is the amount of enzyme that liberates 1 μ mol of butyric acid per minute, according to specified standard conditions, as described, for example, in the article Salis et al., Comparison among immobilised lipases on macroporous polypropylene toward biodiesel synthesis, J. Mol. Catal. B: Enzym., 2008, 54, 19-26 or in the international patent application WO-A-00/34450.

[0099] The enzymatic activity of cellulases can be measured in terms of filter paper units (FPU) per millilitre of original undiluted enzyme solution, as disclosed, for example, in Adney et al., Measurement of cellulase activities, National Renewable Energy Laboratory, 1996.

[0100] The enzymatic activity of oxidase, for example glucose oxidase, can be measured in terms of reaction with a fluorescent peroxidase substrate, as disclosed by the supplier (Sigma-Aldrich)

[0101] The enzymatic activity of pectinase can be measured in terms of polygalacturonase units per millilitre (PGU/ml).

[0102] The enzymatic activity of mannanases can be measured as mannanase MIUM units, defined according to an assay in which the amount of reducing sugars released from an appropriate substrate is determined, as described, for example, in the article Rättö et al, Enzymatic hydrolysis of isolated and fibre-bound galactoglucomannans from pine-wood and pine kraft pulp, Appl. Microbiol. Biotechnol., 1993, 40, 449-454. Usually the detergent composition of the invention comprises stabilizing agents such as, for example, glycerine, polyethylene glycol or propylene glycol, to improve the stability of the enzymes therein.

[0103] The content of each of the enzymes in the detergent composition of the invention does not usually exceed 2% by weight of enzymatic active matter on the total weight of the composition, being generally comprised between 0.0001% and 1.5% by weight, more preferably comprised between 0.001% and 1.0% by weight, yet more preferably comprised between 0.01% and 0.7% by weight, and yet more preferably comprised between 0.05% and 0.5% by weight on the total weight of the composition.

Soap

[0104] In a preferred embodiment, the composition of the invention comprises at least one soap, which is an alkali, ammonium or alkanolamine salt of a fatty acid with a saturated or unsaturated, hydroxylated or non-hydroxylated hydrocarbon chain having 8 to 18 carbon atoms. Preferably, the soap is a fatty acid having the carbon chain distribution of coconut oil or palm kernel oil, more preferably coconut oil, and more preferably a saturated hydrocarbon chain having 12 to 18 carbon atoms.

[0105] The content of the soap in the composition of the invention, if present, usually, is comprised between 0.5% to 10% by weight, preferably between 0.75% and 8% by weight, more preferably between 1% and 6% by weight, and more preferably between 1.5 and 5% by weight on the total weight of the composition.

Organic solvent

[0106] In a preferred embodiment, the composition of the invention further comprises at least one organic solvent selected from the group comprising ethanol, glycerine, propylene glycol, PEG, dipropylene glycol, 3-methoxy-3-methyl-1-butanol, a hydrocarbon/ester blend, isopropyl laurate, methyl ester from soybean oil, C₁-C₄ alkyl esters of lactic acid, D-limonene, and mixtures thereof. Those solvents are commercially available. In particular, a hydrocarbon/ester blend is available as Elevance Clean® 1000 and Elevance Clean® 1200 from the company Elevance. Isopropyl laurate is available, for example, as Estisol® 242 from the company Estichem; methyl ester from soybean oil is available, for example, as Steposol® SB-W from the company Stepan.

[0107] The organic solvent is a second solvent added in small amounts to improve the solvent power or the stabilizing

properties of the primary solvent, which is water in the composition of the invention.

[0108] In a preferred embodiment, the composition of the invention contains an organic solvent selected from the group of glycerine, propylene glycol, and mixtures thereof. In a more preferred embodiment, the organic solvent is glycerine.

[0109] In the context of the invention, in present, the organic solvent is present in an amount not exceeding 50% by weight of the amount of water present in the detergent composition, preferably not exceeding 25% by weight, more preferably not exceeding 10% by weight, and yet more preferably comprised between 5% and 10% by weight on the total weight of the composition.

Polymer

[0110] In a preferred embodiment, the composition of the invention further comprises at least one polymer selected from the group consisting of soil repellent polymer, anti-redeposition polymer, and dye-transfer inhibitor.

[0111] Soil repellent polymers are materials that are applied prior to exposure to soil. These polymers are substantive to the fabric and modify the surface to make it more resistant to oily soils. Soil repellent polymers are usually selected from acrylic acid polymers, fluoro chemicals, terephthalate-based products. Those polymers are commercially available from, for example, the company Clariant as Texcare® SRN 170.

[0112] Anti-redeposition polymers are chemicals that prevent soil once removed from a fabric, from re-depositing on the fabric during the wash cycle. Anti-redeposition agents are polymers that are added to the detergent formulation to suspend the soil and minimize redeposition on the garment. Those polymers are commercially available from, for example, the company Rohm & Haas as Acusol® 505N.

[0113] It is however true that the ability to act as a soil release polymer and the ability to act as an anti-redeposition agent are not mutually exclusive. Some polymers have both attributes.

[0114] Dye-transfer inhibitors are used in laundry detergent compositions to avoid recolouring of fabrics when fabrics of different shades are washed together, and there exists the danger that the dye of coloured fabrics if washed out into the washing water. Polyvinylpyrrolidon (PVP) homopolymers and copolymers thereof inhibit the transfer of dye to the fabric, as well vinylpyridine based polymers. Those polymers are commercially available from, for example, the company BASF as different Sokalan® HP grades, and from the company Ashland as Cromabond® types.

[0115] In a preferred embodiment, the composition comprises a combination of an anti-redeposition polymer and a dye-transfer inhibitor.

[0116] In a more preferred embodiment, the composition comprises a combination of a soil repellent polymer, an anti-redeposition polymer and a dye-transfer inhibitor.

[0117] The content of each of the polymers in the detergent composition of the invention does not usually exceed 5% by weight on the total weight of the composition, being generally comprised between 0.1% and 5% by weight, more preferably comprised between 0.2% and 4% by weight, yet more preferably comprised between 0.3% and 3% by weight, and yet more preferably comprised between 0.5% and 2% by weight on the total weight of the composition.

Additive

[0118] The composition of the invention further comprises, in a preferred embodiment, at least one at least one additive selected from the group consisting of sequestering agent, pH regulating system, hydrotrope, optical brightener, and antimicrobial active ingredient.

Sequestering agent

[0119] In a preferred embodiment, the detergent composition comprises at least one sequestering agent.

[0120] As is well known to the skilled in the art, sequestering agents, also known as chelating agents, are substances capable of forming soluble complexes with metal ions. Specifically, in the field of detergency, its presence allows improving the action of surfactants, by removing metal ions from the medium, mainly calcium and magnesium, thus decreasing the hardness of water and reducing the formation of insoluble salts.

[0121] Some of the sequestering agents suitable for use in the context of the present invention are, for example, polyphosphates, especially alkaline tripolyphosphates and pyrophosphates; phosphonates such as, for example, HEDP (1-hydroxyethane 1,1-diphosphonic acid), DTPMP (diethylenetriamine pentamethylenephosphonic acid), EDTMP (ethylene diamine tetramethylenephosphonic acid), ATMP (amino trimethylenephosphonic acid), or HDTMP (hexamethylenediamine tetramethylenephosphonic acid), or their alkaline salts; hydroxypolycarboxylates, such as citric, tartaric or gluconic acid; aminopolycarboxylates, such as EDTA (ethylenediaminetetraacetic acid), DTPA (diethylenetriaminepentaacetic acid), NTA (nitrilotriacetic acid), GLDA (glutamic acid, N,N-diacetic), MGDA (methylglycine diacetic acid), IDS (iminodisuccinic acid), EDDS (ethylenediamine-N,N'-disuccinic acid) or their alkaline salts; polycarboxylates:

itaconic acid or its alkali salts; or mixtures thereof.

[0122] Preferably, the sequestering agent is selected from the group consisting of citric acid, tartaric acid, gluconic acid, phosphonates, aminocarboxylates, polycarboxylates, their sodium salts; and mixtures thereof; more preferably the sequestering agent is selected from the group consisting of citric acid, phosphonates, and mixtures thereof.

[0123] The content of sequestering agent in the composition of the invention does not usually exceed 10% by weight on the total weight of the composition, preferably the content is comprised between 0.1% and 7.5% by weight, more preferably between 0.2% and 5% by weight, and yet more preferably between 0.5% and 2.5% by weight on the total weight of the composition.

pH regulating agent

[0124] The composition generally contains a pH regulating agent, for example, of basic nature, such as alkaline hydroxides; ammonia; mono-, di- or tri-alkylamines; mono-, di-, or tri-alkanolamines; or of acid nature, such as mineral acids as, for example, hydrochloric acid or sulfuric acid, or carboxylic acids such as, for example, acetic acid, lactic acid, tartaric acid, or citric acid; or mixtures thereof. Preferably, the pH regulating agent comprises a mixture of at least one alkanolamine and a carboxylic acid, more preferably a mixture of at least one alkanolamine and citric acid, and still more preferably a mixture of at least one alkanolamine selected from monoethanolamine, triethanolamine, and mixtures thereof, and citric acid. In a particularly preferred embodiment, the pH regulating agent comprises a mixture of monoethanolamine and citric acid, and in another particularly preferred embodiment, the pH regulating agent comprises a mixture of monoethanolamine, triethanolamine and citric acid.

[0125] Generally, the composition of the invention contains pH regulating agents for adjusting the pH value in a range comprised between 7 and 10, preferably between 8 and 9.

[0126] The content of pH regulating agent in the composition of the invention does not usually exceed 10% by weight on the total weight of the composition, preferably the content is comprised between 0.1% and 7.5% by weight, more preferably between 0.2% and 5% by weight, and yet more preferably between 0.5% and 2.5% by weight on the total weight of the composition.

Hydrotrope

[0127] Additionally, the composition may contain a hydrotropic agent.

[0128] Hydrotropes, as is well known to the skilled in the art, are products that increase the solubility and miscibility of organic salts in water, and provide greater homogeneity to the products in solution. Some hydrotropes suitable for use in the detergent composition of the present invention are, for example, toluenesulfonates, xylenesulfonates, cumenesulfonates, and methylnaphthalenesulfonates, in the form of their monoethanolammonium, diethanolammonium, and triethanolammonium salts, or as alkaline salts, preferably, sodium or potassium salts; or it is a short-chain alkyl sulfate, such as, for example, *n*-octyl sulfate, 2-ethylhexyl sulfate, or its alkaline salts, preferably sodium or potassium salts.

[0129] The content of hydrotrope in the composition of the invention does not usually exceed 10% by weight on the total weight of the composition, preferably the content is comprised between 0.1% and 7.5% by weight, more preferably between 0.2% and 5% by weight, and yet more preferably between 0.5% and 2.5% by weight on the total weight of the composition.

Optical brightener

[0130] The composition may contain an optical brightener. The optical brightener is preferably selected from hydrophobic brighteners, stilbene brighteners, biphenyl type brighteners, or a mixture thereof. Suitable brighteners include: di-styryl biphenyl compounds, e.g. Tinopal® CBS-X, di-amino stilbene di-sulfonic acid compounds, e.g. Tinopal® DMS pure Xtra and Blankophor® HRH, and Pyrazoline compounds, e.g. Blankophor®SN, and coumarin compounds, e.g. Tinopal®SWN.

[0131] The content of optical brightener is usually comprised between 0.05% and 2% by weight, preferably between 0.1% and 1.5%, yet more preferably between 0.2% and 1% by weight on the total weight of the composition.

Anti-bacterial active

[0132] Anti-bacterial active agent can be present in the composition of the invention.

[0133] The anti-bacterial actives may be selected from the group comprising benzalkonium chloride, benzethonium chloride, sodium benzoate, 5-bromo-5-nitro-1,3 dioxane, 2-bromo-2-nitropropane-1,3-diol, alkyl trimethyl ammonium bromide, *N*-(hydroxymethyl)-*N*-(1,3-dihydroxymethyl-2,5-dioxo-4-imidaxolidinyl)-*N'*-(hydroxy methyl) urea, 1,3-dimethyl-5,5-dimethylhydantoin, phenoxyethanol, lactic acid, sorbic acid, sorbate, formaldehyde, butyl paraben, ethyl paraben,

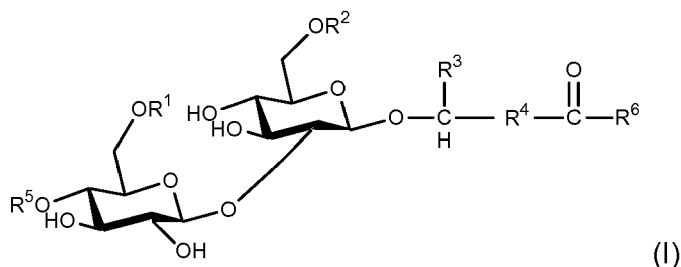
methyl paraben, propyl paraben, 2-phenoxyethanol, isothiazolinones (such as benzisothiazolinone, methylisothiazolinone, 5-chloro-2-methyl-4-isothiazol-3-one; 2-methyl-4-isothiazol-3-one), 1,2-dibromo-2,4-dicyanobutane, essential oils, natural extracts, and mixtures thereof. Preferably it is selected from isothiazolinones, essential oils and natural extracts. In a preferred embodiment it is selected from isothiazolinones. In another preferred embodiment it is selected from a natural extract. In another preferred embodiment it is selected from an essential oil.

[0134] The content of preservative is usually comprised between 0.01% by weight to 3% by weight on the total weight of the composition.

[0135] Additionally, the composition of the invention may contain other components such as corrosion inhibitor, anti-oxidant, opacifier, fragrance, dyestuff, and mixtures thereof.

[0136] In a preferred embodiment, the liquid laundry detergent composition comprises:

- a) at least one anionic surfactant selected from the group consisting of alkali, ammonium and alkanolamine salts of alkyl ether sulphate, alkyl sulphate and alkylbenzene sulphate,
- b) at least one soap having saturated or unsaturated, hydroxylated or non-hydroxylated hydrocarbon chain having 8 to 18 carbon atoms,
- c) at least one non-ionic surfactant selected from the group consisting of ethoxylated fatty alcohol C₁₂₋₁₈, amine oxide, alkyl polyglycoside, fatty acid methylglucamide, alkyl xyloside, and glycerine polyalkoxylated fatty ester,
- d) a biosurfactant comprising a sophorolipid according to general formula (I)



wherein:

R¹ and R² are individually H or an acetyl group;

R³ is a saturated or unsaturated, hydroxylated or non-hydroxylated hydrocarbon group having 1 to 9 carbon atoms;

R⁴ is a saturated or unsaturated, hydroxylated or non-hydroxylated hydrocarbon group having 1 to 19 carbon atoms, with the proviso that the total number of carbon atoms in the groups R³ and R⁴ does not exceed 20;

R⁵ is H or a lactone ring formed with R⁶; and

R⁶ is OH or a lactone ring formed with R⁵.

e) a combination of enzymes selected from the group consisting of protease, α -amylase, lipase, cellulase, pectinase, oxidase, and mannanase,

f) at least one soap as an alkali, ammonium or alkanolamine salt having saturated or unsaturated, hydroxylated or non-hydroxylated hydrocarbon chain having 8 to 18 carbon atoms, and

g) water.

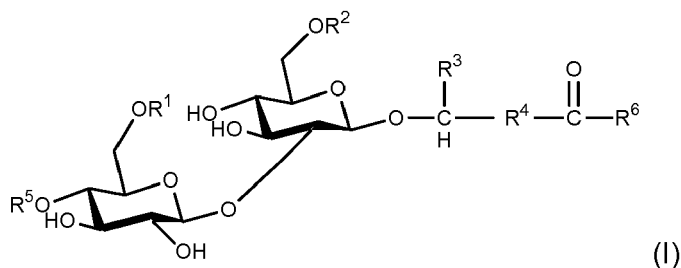
[0137] In a preferred embodiment, the composition comprises:

a) at least one anionic surfactant selected from the group consisting of alkali, ammonium and alkanolamine salts of alkyl ether sulphate, alkyl sulphate and alkylbenzene sulphate,

b) at least one soap having saturated or unsaturated, hydroxylated or non-hydroxylated hydrocarbon chain having 8 to 18 carbon atoms,

c) at least one non-ionic surfactant selected from the group consisting of ethoxylated fatty alcohol C₁₂₋₁₈, amine oxide, alkyl polyglycoside, fatty acid methylglucamide, alkyl xyloside, and glycerine polyalkoxylated fatty ester,

d) a biosurfactant comprising a sophorolipid according to general formula (I)



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wherein:

R¹ and R² are individually H or an acetyl group;

R³ is a saturated or unsaturated, hydroxylated or non-hydroxylated hydrocarbon group having 1 to 9 carbon atoms;

R⁴ is a saturated or unsaturated, hydroxylated or non-hydroxylated hydrocarbon group having 1 to 19 carbon atoms, with the proviso that the total number of carbon atoms in the groups R³ and R⁴ does not exceed 20;

R⁵ is H or a lactone ring formed with R⁶; and

R⁶ is OH or a lactone ring formed with R⁵.

e) a combination of enzymes selected from the group consisting of protease, α -amylase, lipase, cellulase, pectinase, oxidase, and mannanase,

f) at least one soap as an alkali, ammonium or alkanolamine salt having saturated or unsaturated, hydroxylated or non-hydroxylated hydrocarbon chain having 8 to 18 carbon atoms,

g) at least one polymer selected from the group consisting of soil repellent polymer, anti-redeposition polymer, and dye-transfer inhibitor, and

h) water.

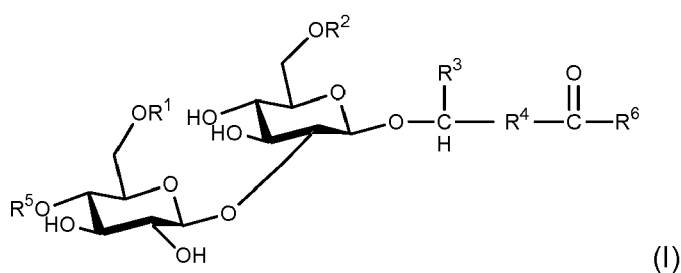
[0138] In a preferred embodiment, the composition comprises:

a) at least one anionic surfactant selected from the group consisting of alkali, ammonium and alkanolamine salts of alkyl ether sulphate, alkyl sulphate and alkylbenzene sulphonate,

b) at least one soap having saturated or unsaturated, hydroxylated or non-hydroxylated hydrocarbon chain having 8 to 18 carbon atoms,

c) at least one non-ionic surfactant selected from the group consisting of ethoxylated fatty alcohol C₁₂₋₁₈, amine oxide, alkyl polyglycoside, fatty acid methylglucamide, alkyl xyloside, and glycerine polyalkoxylated fatty ester,

d) a biosurfactant comprising a sophorolipid according to general formula (I)



wherein:

R¹ and R² are individually H or an acetyl group;

R³ is a saturated or unsaturated, hydroxylated or non-hydroxylated hydrocarbon group having 1 to 9 carbon atoms;

R⁴ is a saturated or unsaturated, hydroxylated or non-hydroxylated hydrocarbon group having 1 to 19 carbon atoms, with the proviso that the total number of carbon atoms in the groups R³ and R⁴ does not exceed 20;

R⁵ is H or a lactone ring formed with R⁶; and

R⁶ is OH or a lactone ring formed with R⁵.

- e) a combination of enzymes selected from the group consisting of protease, α -amylase, lipase, cellulase, pectinase, oxidase, and mannanase,
 f) at least one soap as an alkali, ammonium or alkanolamine salt having saturated or unsaturated, hydroxylated or non-hydroxylated hydrocarbon chain having 8 to 18 carbon atoms,
 5 g) at least one polymer selected from the group consisting of soil repellent polymer, anti-redeposition polymer, and dye-transfer inhibitor,
 h) at least one organic solvent selected from the group comprising ethanol, glycerine, propylene glycol, PEG, dipropylene glycol, 3-methoxy-3-methyl-1-butanol, a hydrocarbon/ester blend, isopropyl laurate, methyl ester from soybean oil, C₁-C₄ alkyl esters of lactic acid, D-limonene, and mixtures thereof, and
 10 i) water.

Use of the composition

[0139] Another aspect of the present invention is the use of the composition of the invention in laundry washing.

15 **[0140]** The presence of sophorolipids in the composition provides an improvement in the performance of removal of enzymatic and bleachable stains, as shown in the examples.

[0141] The presence of a biosurfactant selected from the group of sophorolipids surprisingly, shows at least one of the following improvements: enhancement of the stability of enzymes, in particular the stability of any one of amylases, lipases, cellulases or mannanases, enhancement of the performance of enzymes, in particular the performance of any
 20 one of amylases, lipases, cellulases or mannanases, the content of organic solvents is significantly reduced, control of the rheological behaviour, enhancement of fragrance, synergistic removal of fatty soil in combination with anionic and/or non-ionic surfactants, enhancement of the performance of the optical brightener agent, enhanced bactericidal effect in combination with bactericidal actives of natural origin, in particular, essential oils or natural extracts.

[0142] In a preferred embodiment, the composition of the invention, comprising a biosurfactant selected from the group of sophorolipids, provides enhancement of the stability of enzymes, in particular the stability of any one of amylases,
 25 lipases, cellulases, pectinases, oxidases, and mannanases.

[0143] In another preferred embodiment, the composition of the invention, comprising a biosurfactant selected from the group of sophorolipids, provides the enhancement of the performance of enzymes, in particular the performance of
 30 any one of amylases, lipases, cellulases, pectinases, oxidases or mannanases.

[0144] In another preferred embodiment, the composition of the invention, comprising a biosurfactant selected from the group of sophorolipids, provides a reduction of the content of organic solvents in the composition.

[0145] In another preferred embodiment, the composition of the invention, comprising a biosurfactant selected from the group of sophorolipids, provides control of the rheological behaviour of the composition.

[0146] In another preferred embodiment, the composition of the invention, comprising a biosurfactant selected from the group of sophorolipids, provides enhancement of fragrance perception.
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[0147] In another preferred embodiment, the composition of the invention, comprising a biosurfactant selected from the group of sophorolipids, provides a synergistic removal of fatty soil in combination with anionic and/or non-ionic surfactants.

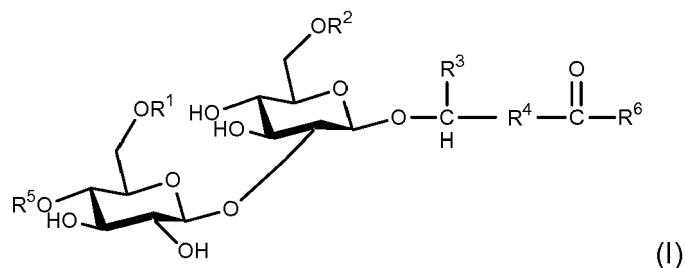
[0148] In another preferred embodiment, the composition of the invention, comprising a biosurfactant selected from the group of sophorolipids, provides enhancement of the performance of the optical brightener agent.
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[0149] In another preferred embodiment, the composition of the invention, comprising a biosurfactant selected from the group of sophorolipids, provides an enhanced bactericidal effect in combination with bactericidal actives of natural origin, in particular, essential oils or natural extracts.

[0150] The present invention comprises the following embodiments:
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1.- Liquid laundry detergent composition, characterized in that it comprises:

- a) at least one anionic surfactant selected from the group consisting of alkali, ammonium and alkanolamine salts of alkyl ether sulphate, alkyl sulphate and alkylbenzene sulphonate,
 50 b) at least one soap having saturated or unsaturated, hydroxylated or non-hydroxylated hydrocarbon chain having 8 to 18 carbon atoms,
 c) at least one non-ionic surfactant selected from the group consisting of ethoxylated fatty alcohol C₁₂₋₁₈, amine oxide, alkyl polyglycoside, fatty acid methylglucamide, alkyl xyloside, and glycerine polyalkoxylated fatty ester,
 55 d) a biosurfactant comprising a sophorolipid according to general formula (I)



wherein:

R¹ and R² are individually H or an acetyl group;

R³ is a saturated or unsaturated, hydroxylated or non-hydroxylated hydrocarbon group having 1 to 9 carbon atoms;

R⁴ is a saturated or unsaturated, hydroxylated or non-hydroxylated hydrocarbon group having 1 to 19 carbon atoms, with the proviso that the total number of carbon atoms in the groups R³ and R⁴ does not exceed 20;

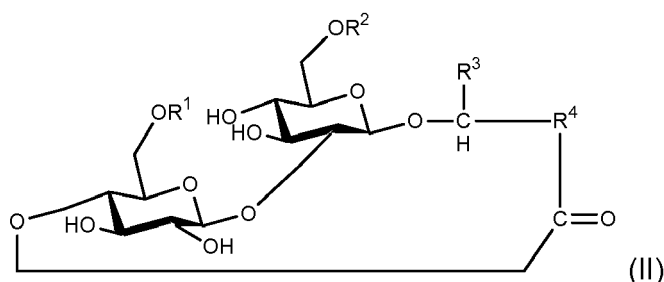
R⁵ is H or a lactone ring formed with R⁶; and

R⁶ is OH or a lactone ring formed with R⁵.

e) at least one enzyme selected from the group consisting of protease, α -amylase, lipase, cellulase, pectinase, oxidase, and mannanase, and

f) water.

2.- Liquid laundry detergent composition according to embodiment 1, characterized in that the sophorolipid includes a lactone ring formed between R⁵ and R⁶ as shown by general formula (II):



wherein R¹, R², R³ and R⁴ are as defined above, with the proviso that at least one of R¹ and R² is an acetyl group.

3.- Liquid laundry detergent composition according to embodiment 1 or 2, characterized in that the alkyl ether sulphate has a carbon chain of between 10 and 20 carbon atoms and comprises between 0.5 and 10 moles of ethylene oxide.

4.- Liquid laundry detergent composition according to embodiments 1 or 2, characterized in that the alkyl sulphate has a carbon chain of between 10 and 20 carbon atoms.

5.- Liquid laundry detergent composition according to embodiments 1 or 2, characterized in that the alkyl group in the alkylbenzene sulfonate contains a carbon chain of between 8 and 16 carbon atoms.

6.- Liquid laundry detergent composition according to embodiment 1, characterized in that it comprises a mixture of an alkyl ether sulphate and alkylbenzene sulphonate in the form of alkali, ammonium or alkanolamine salts.

7.- Liquid laundry detergent composition according to embodiment 6, characterized in that it comprises a mixture of a sodium lauryl sulphate with 2 moles of ethylene oxide and dodecylbenzene sulfonate sodium salt.

8.- Liquid laundry detergent composition according to embodiment 1, characterized in that it comprises a mixture

of alkyl ether sulphate and alkyl sulphate in the form of alkali, ammonium or alkanolamine salts

9.- Liquid laundry detergent composition according to embodiment 8, characterized in that it comprises a mixture of a sodium lauryl sulphate with 2 moles of ethylene oxide and lauryl sulphate sodium salt.

10.- Liquid laundry detergent composition according to any one of embodiments 1 to 9, characterized in that the content of anionic surfactant is comprised between 1% and 25% by weight on the total weight of the composition.

11.- Liquid laundry detergent composition according to any one of embodiments 1 to 10, characterized in that the non-ionic surfactant is an ethoxylated fatty alcohol C₁₂₋₁₈, wherein the moles of ethylene oxide are comprised between 2 and 12.

12.- Liquid laundry detergent composition according to any one of embodiments 1 to 11, characterized in that the content of non-ionic surfactant is comprised between 1 % and 25% by weight on the total weight of the composition.

13.- Liquid laundry detergent composition according to any one of embodiments 1 to 12, characterized in that the biosurfactant consists of a sophorolipid of formula (I) or formula (II).

14.- Liquid laundry detergent composition according to any one of embodiments 1 to 13, characterized in that the biosurfactant is defined by a mixture of compound of formula (I) and compound of formula (II),
wherein

R¹ and R² are individually H or an acetyl group, R³ is a methyl group, R⁴ is a -CH₂-(CH₂)₅-CH=CH-(CH₂)₆-CH₂-, R⁵ is H and R⁶ is OH in compound of formula (I), and wherein

R¹ and R² are individually H or an acetyl group, R³ is a methyl group, R⁴ is a -CH₂-(CH₂)₅-CH=CH-(CH₂)₆-CH₂-, and R⁵ is a lactone ring formed with R⁶ in compound of formula (II), with the proviso that at least one R¹ or R² is an acetyl group.

15.- Liquid laundry detergent composition according to any one of embodiments 1 to 13, characterized in that the biosurfactant is defined by a mixture of compound of formula (I) and compound of formula (II),
wherein

R¹ and R² are an acetyl group, R³ is a methyl group, R⁴ is a -CH₂-(CH₂)₅-CH=CH-(CH₂)₆-CH₂-, R⁵ is H and R⁶ is OH in compound of formula (I), and

wherein
R¹ and R² are an acetyl group, R³ is a methyl group, R⁴ is a -CH₂-(CH₂)₅-CH=CH-(CH₂)₆-CH₂-, and R⁵ is a lactone ring formed with R⁶ in compound of formula (II).

16.- Liquid laundry detergent composition according to any one of embodiments 1 to 15, characterized in that the biosurfactant consists of a mixture of 60 wt.% to 62 wt.% sophorolipid of formula (I) and 38 wt.% to 40 wt.% of sophorolipid of formula (II).

17.- Liquid laundry detergent composition according to any one of embodiments 1 to 16, characterized in that the content of sophorolipid is comprised between 1% and 25% by weight on the total weight of the composition.

18.- Liquid laundry detergent composition according to any one of embodiments 1 to 17, characterized in that the composition comprises a combination of enzymes consisting of a protease, an α -amylase, and a lipase.

19.- Liquid laundry detergent composition according to any one of embodiments 1 to 17, characterized in that the composition comprises a combination of enzymes consisting of a protease, an α -amylase, and a cellulase.

20.- Liquid laundry detergent composition according to any one of embodiments 1 to 17, characterized in that the composition comprises a combination of enzymes consisting of a protease, an α -amylase, a lipase, and a cellulase.

21.- Liquid laundry detergent composition according to any one of embodiments 1 to 17, characterized in that the composition comprises a combination of enzymes consisting of a protease, an α -amylase, a lipase, and a mannanase.

22.- Liquid laundry detergent composition according to any one of embodiments 1 to 17, characterized in that the composition comprises a combination of enzymes consisting of a protease, an α -amylase, a cellulase, and a man-

nanase.

23.- Liquid laundry detergent composition according to any one of embodiments 1 to 17, characterized in that the composition comprises a combination of enzymes consisting of a protease, an α -amylase, a lipase, and a pectinase.

24.- Liquid laundry detergent composition according to any one of embodiments 1 to 17, characterized in that the composition comprises a combination of enzymes consisting of a protease, an α -amylase, a cellulase, and a pectinase.

25.- Liquid laundry detergent composition according to any one of embodiments 1 to 17, characterized in that the composition comprises a combination of enzymes consisting of a protease, an α -amylase, a lipase, and an oxidase.

26.- Liquid laundry detergent composition according to any one of embodiments 1 to 17, characterized in that the composition comprises a combination of enzymes consisting of a protease, an α -amylase, a cellulase, and an oxidase.

27.- Liquid laundry detergent composition according to any one of embodiments 1 to 17, characterized in that the composition comprises a combination of enzymes consisting of a protease, an α -amylase, a lipase, a cellulase, and a mannanase.

28.- Liquid laundry detergent composition according to any one of embodiments 1 to 27, characterized in that the content of each of the enzymes is comprised between 0.0001% and 1.5% by weight on the total weight of the composition.

29.- Liquid laundry detergent composition according to any one of embodiments 1 to 28, characterized in that it comprises at least one soap as an alkali, ammonium or alkanolamine salt having saturated or unsaturated, hydroxylated or non-hydroxylated hydrocarbon chain having 8 to 18 carbon atoms.

30.- Liquid laundry detergent composition according to embodiment 29, characterized in that the fatty acid of the soap has a carbon chain distribution of coconut oil or palm kernel oil.

31.- Liquid laundry detergent composition according to embodiments 29 or 30, characterized in that the content of the soap is comprised between 0.5% to 10% by weight, preferably between 1% and 8% by weight on the total weight of the composition.

32.- Liquid laundry detergent composition according to any one of embodiments 1 to 31, characterized in that it further comprises at least one organic solvent selected from the group comprising ethanol, glycerine, propylene glycol, PEG, dipropylene glycol, 3-methoxy-3-methyl-1-butanol, a hydrocarbon/ester blend, isopropyl laurate, methyl ester from soybean oil, C₁-C₄ alkyl esters of lactic acid, D-limonene, and mixtures thereof.

33.- Liquid laundry detergent composition according to embodiment 32, characterized in that it comprises an organic solvent selected from the group of glycerine, propylene glycol, and mixtures thereof.

34.- Liquid laundry detergent composition according to embodiments 32 or 33, characterized in that the content of the organic solvent does not exceed the 10% by weight on the total weight of the composition.

35.- Liquid laundry detergent composition according to any one of embodiments 1 to 34, characterized in that it further comprises at least one polymer selected from the group consisting of soil repellent polymer, anti-redeposition polymer, and dye-transfer inhibitor.

36.- Liquid laundry detergent composition according to embodiment 35, characterized in that it comprises a combination of an anti-redeposition polymer and a dye-transfer inhibitor.

37.- Liquid laundry detergent composition according to embodiment 35, characterized in that it comprises a combination of a soil repellent polymer, an anti-redeposition polymer and a dye-transfer inhibitor.

38.- Liquid laundry detergent composition according to any of embodiments 35 to 37, characterized in that the content of each of the polymers is comprised between 0.1% and 5% by weight on the total weight of the composition.

EP 3 686 265 A1

39.- Liquid laundry detergent composition according to any one of embodiments 1 to 38, characterized in that it further comprises at least one at least one additive selected from the group consisting of sequestering agent, pH regulating system, hydrotrope, optical brightener, and antimicrobial active ingredient.

5 40.- Liquid laundry detergent composition according to any one of embodiments 1 to 39, characterized in that it further comprises corrosion inhibitor, antioxidant, opacifier, fragrance, dyestuff, and mixtures thereof.

41.- Use of the composition according to any one of embodiments 1 to 40 in laundry washing.

10 **[0151]** In the following examples, particular embodiments of the composition of the invention are shown.

Examples 1-7: Liquid laundry composition

15 **[0152]** Different formulations corresponding to the liquid laundry composition of the invention were prepared using the amounts detailed in Table I, expressed as % of product as it is:

TABLE I

Component	Example						
	1	2	3	4	5	6	7
LAS Na salt	12.5	10.0	12.5	15.0	-	-	-
LES Na salt	4.0	10.0	7.5	5.0	20.0	15.0	10.0
C ₁₂₋₁₈ 7 EO	7.5	5.0	5.0	5.0	2.0	7.0	5.0
Sophorolipid ¹	4.5	2.0	2.0	2.0	5.0	5.0	5.0
C ₁₂₋₁₈ soap Na salt	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Protease ²	0.3	0.3	0.3	0.3	0.3	0.3	0.3
α-amylase ²	0.2	0.2	0.2	0.2	0.2	0.2	0.2
lipase ²	0.1	0.1	0.1	0.1	0.1	0.1	0.1
cellulase ²	0.1	0.1	0.1	0.1	0.1	0.1	0.1
mannanase ²	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Soil repellent polymer ²	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Anti-redeposition polymer ²	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Dye-transfer inhibitor ²	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Glycerine	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Propylene glycol	3.0	3.0	3.0	-	-	-	-
Ethanol	-	-	-	5.0	5.0	5.0	5.0
Opacifier ²	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Optical brightener ²	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Hydrotrope ²	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Citric acid	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Phosphonate ²	0.2	0.2	0.2	0.2	-	-	-
Caustic soda	1-5	1-5	1-5	1-5	1-5	1-5	1-5
Preservative ²	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Water	q.s. 100						
q.s. = <i>quantum satis</i> (sufficient quantity)							
1: Rewoferm® SL							
2: Product <i>tel quel</i>							

EP 3 686 265 A1

[0153] The detergent formulations were prepared by mixing the components and adjusted to a pH comprised between 8 and 9.

[0154] The formulations were tested according to ASTM D 1173 standard to determine their foaming power.

[0155] These formulations were subjected to a stability test at 5° C, 20° C and 40° C for 8 weeks, and they maintained substantially stable the appearance and pH value.

[0156] The compositions were also subjected to stability studies to verify that they showed stable enzymatic activity after a prolonged period of time. To this end, the initial activity of the enzymes and their activity after three weeks at 20° C were measured and it was found that the enzymatic activity was acceptable.

Examples 8 - 11: Liquid laundry compositions

[0157] Different formulations containing different amounts of anionic surfactant (LES, C₁₂₋₁₄ 2 EO), no-ionic surfactant (C₁₂₋₁₈ 7 EO) and sophorolipid were prepared according to a mixture design as shown in Table II. The formulation was completed with a base composition having a pH value of 9.3 at 10% dilution.

TABLE II

Example	Anionic (%)	Non-ionic (%)	Sophorolipid (%)
8	18	4.5	4.5
Comparative 1	13.5	13.5	0
9	9	9	9
Comparative 2	0	13.5	13.5
Comparative 3	0	27	0
Comparative 4	27	0	0
10	4.5	18	4.5
Comparative 5	13.5	0	13.5
11	4.5	4.5	18
Comparative 6	0	0	27

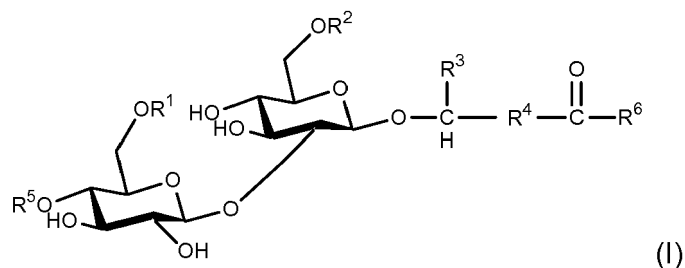
[0158] Formulations were tested using a MIELE Professional - PW 6055 Plus washing machine, in a white/colour program, without pre-washing, at 40° C, and using water with a hardness of 25° HF. It was used a dose of 62.5 g of detergent. The washing machine was filled with 3 kg of clothes 100% cotton, and 32 g of soiled clothes were introduced in each washing. Washings were replicated twice.

[0159] It was observed that a presence of about 4.5% by weight of sophorolipid improved the washing performance of bleachable and enzymatic stains for laundry detergent compositions comprising LES and non-ionic surfactant.

Claims

1. Liquid laundry detergent composition, **characterized in that** it comprises:

- at least one anionic surfactant selected from the group consisting of alkali, ammonium and alkanolamine salts of alkyl ether sulphate, alkyl sulphate and alkylbenzene sulphonate,
- at least one soap having saturated or unsaturated, hydroxylated or non-hydroxylated hydrocarbon chain having 8 to 18 carbon atoms,
- at least one non-ionic surfactant selected from the group consisting of ethoxylated fatty alcohol C₁₂₋₁₈, amine oxide, alkyl polyglycoside, fatty acid methylglucamide, alkyl xyloside, and glycerine polyalkoxylated fatty ester,
- a biosurfactant comprising a sophorolipid according to general formula (I)



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wherein:

R¹ and R² are individually H or an acetyl group;

R³ is a saturated or unsaturated, hydroxylated or non-hydroxylated hydrocarbon group having 1 to 9 carbon atoms;

R⁴ is a saturated or unsaturated, hydroxylated or non-hydroxylated hydrocarbon group having 1 to 19 carbon atoms, with the proviso that the total number of carbon atoms in the groups R³ and R⁴ does not exceed 20;

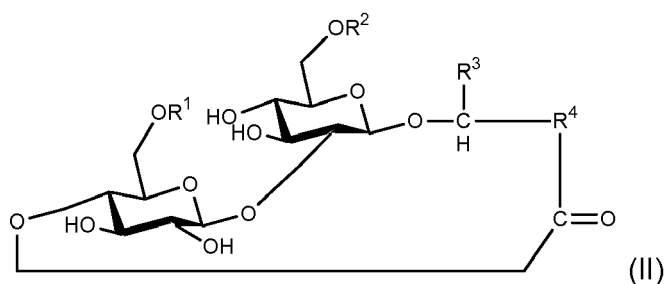
R⁵ is H or a lactone ring formed with R⁶; and

R⁶ is OH or a lactone ring formed with R⁵,

e) at least one enzyme selected from the group consisting of protease, α -amylase, lipase, cellulase, pectinase, oxidase, and mannanase, and

f) water.

2. Liquid laundry detergent composition according to claim 1, **characterized in that** the sophorolipid includes a lactone ring formed between R⁵ and R⁶ as shown by general formula (II):



wherein R¹, R², R³ and R⁴ are as defined above, with the proviso that at least one of R¹ and R² is an acetyl group.

3. Liquid laundry detergent composition according to claim 1, **characterized in that** it comprises a mixture of an alkyl ether sulphate and alkylbenzene sulphonate in the form of alkali, ammonium or alkanolamine salts.
4. Liquid laundry detergent composition according to claim 1, **characterized in that** it comprises a mixture of alkyl ether sulphate and alkyl sulphate in the form of alkali, ammonium or alkanolamine salts
5. Liquid laundry detergent composition according to any one of claims 1 to 4, **characterized in that** the biosurfactant consists of a sophorolipid of formula (I) or formula (II).
6. Liquid laundry detergent composition according to any one of claims 1 to 5, **characterized in that** the biosurfactant is defined by a mixture of compound of formula (I) and compound of formula (II),
wherein
R¹ and R² are individually H or an acetyl group, R³ is a methyl group, R⁴ is a -CH₂-(CH₂)₅-CH=CH-(CH₂)₆-CH₂-,
R⁵ is H and R⁶ is OH in compound of formula (I), and
wherein
R¹ and R² are individually H or an acetyl group, R³ is a methyl group, R⁴ is a -CH₂-(CH₂)₅-CH=CH-(CH₂)₆-CH₂-,
and R⁵ is a lactone ring formed with R⁶ in compound of formula (II), with the proviso that at least one R¹ or R² is an

acetyl group.

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7. Liquid laundry detergent composition according to any one of claims 1 to 5, **characterized in that** the biosurfactant is defined by a mixture of compound of formula (I) and compound of formula (II),
wherein
R¹ and R² are an acetyl group, R³ is a methyl group, R⁴ is a -CH₂-(CH₂)₅-CH=CH-(CH₂)₆-CH₂-, R⁵ is H and R⁶ is OH in compound of formula (I), and
wherein
10 R¹ and R² are an acetyl group, R³ is a methyl group, R⁴ is a -CH₂-(CH₂)₅-CH=CH-(CH₂)₆-CH₂-, and R⁵ is a lactone ring formed with R⁶ in compound of formula (II).
8. Liquid laundry detergent composition according to any one of claims 1 to 7, **characterized in that** the composition comprises a combination of enzymes consisting of a protease, an α -amylase, and a lipase.
- 15 9. Liquid laundry detergent composition according to any one of claims 1 to 7, **characterized in that** the composition comprises a combination of enzymes consisting of a protease, an α -amylase, a lipase, and a cellulase.
10. Liquid laundry detergent composition according to any one of claims 1 to 9, **characterized in that** it comprises at least one soap as an alkali, ammonium or alkanolamine salt having saturated or unsaturated, hydroxylated or non-
20 hydroxylated hydrocarbon chain having 8 to 18 carbon atoms.
11. Liquid laundry detergent composition according to any one of claims 1 to 10, **characterized in that** it further comprises at least one organic solvent selected from the group comprising ethanol, glycerine, propylene glycol, PEG, dipropylene glycol, 3-methoxy-3-methyl-1-butanol, a hydrocarbon/ester blend, isopropyl laurate, methyl ester from soybean oil, C₁-C₄ alkyl esters of lactic acid, D-limonene, and mixtures thereof.
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12. Liquid laundry detergent composition according to any one of claims 1 to 11, **characterized in that** it further comprises at least one polymer selected from the group consisting of soil repellent polymer, anti-redeposition polymer, and dye-transfer inhibitor.
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13. Liquid laundry detergent composition according to claim 12, **characterized in that** it comprises a combination of a soil repellent polymer, an anti-redeposition polymer and a dye-transfer inhibitor.
- 35 14. Liquid laundry detergent composition according to any one of embodiments 1 to 13, **characterized in that** it further comprises at least one at least one additive selected from the group consisting of sequestering agent, pH regulating system, hydrotrope, optical brightener, and antimicrobial active ingredient.
15. Use of the composition according to any one of claims 1 to 14 in laundry washing.
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EUROPEAN SEARCH REPORT

Application Number
EP 19 38 2046

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