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(71) Applicant *(for AE, AG, AU, BB, BH, BN, BW, BZ, CA, CY, EG, GB, GD, GH, GM, IE, IL, KE, KN, LC, LK, LS, MT, MW, MY, NA, NG, NZ, OM, PG, QA, RW, SC, SD, SG, SL, SZ, TT, TZ, UG, VC, ZA, ZM, ZW only)*: **UNILEVER PLC** [GB/GB]; 100 Victoria Embankment, London Greater London EC4Y 0DY (GB).

(71) Applicant *(for all designated States except AE, AG, AU, BB, BH, BN, BW, BZ, CA, CY, EG, GB, GD, GH, GM, IE, IL, IN, KE, KN, LC, LK, LS, MT, MW, MY, NA, NG, NZ, OM, PG, QA, RW, SC, SD, SG, SL, SZ, TT, TZ, UG, US, VC, ZA, ZM, ZW)*: **UNILEVER N.V.** [NL/NL]; Weena 455, NL-3013 AL Rotterdam (NL).

(71) Applicant *(for IN only)*: **HINDUSTAN UNILEVER LIMITED** [IN/IN]; Unilever House, B.D. Sawant Marg Chakala Andheri (East), Mumbai 400 099, Maharashtra (IN).

(71) Applicant *(for US only)*: **CONOPCO, INC., d/b/a UNILEVER** [US/US]; 800 Sylvan Avenue, AG West, S. Wing, Englewood Cliffs, New Jersey 07632 (US).

(72) Inventors: **AHTCHI-ALI, Badreddine**; Conopco Inc., d/b/a UNILEVER, 40 Merritt Boulevard, Trumbull, Connecticut 06611 (US). **D'AGOSTINO, Eleanor, Margaret**; Unilever R&D Colworth, Sharnbrook, Bedford Bedfordshire MK44 1LQ (GB). **HEDGES, Nicholas, David**; Unilever R&D Colworth, Sharnbrook, Bedford Bedfordshire MK44 1LQ (GB). **MOADDEL, Teanoosh**; Conopco Inc., d/b/a UNILEVER, 40 Merritt Boulevard, Trumbull, Connecticut 06611 (US). **NANDI, Asish**; Unilever R&D Colworth, Sharnbrook, Bedford Bedfordshire MK44 1LQ (GB). **REYES, Jay**; Conopco Inc., d/b/a UNILEVER, 40 Merritt Boulevard, Trumbull, Connecticut 06611 (US). **WEI, Xiaoling**; Conopco Inc., d/b/a UNILEVER, 40 Merritt Boulevard, Trumbull, Connecticut 06611 (US).

(74) Agent: **TANSLEY, Sally, Elizabeth**; Unilever PLC, Unilever Patent Group, Colworth House, Sharnbrook, Bedford Bedfordshire MK44 1LQ (GB).

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(54) Title: PERSONAL CARE COMPOSITION

(57) Abstract: A personal care composition comprising a polymeric, cationic deposition aid and an oil-in-water emulsion comprising an oil phase and an oil-in-water emulsifier selected from one or more class II hydrophobins.

# PERSONAL CARE COMPOSITION

## Field of the Invention

The present invention relates a method of treating skin which provides enhanced delivery of oil phase components to the skin, scalp and hair.

## Background of the Invention

US2009136433 (BASF) discloses what appear to be prophetic compositions comprising cationic surfactant and hydrophobin. The hydrophobins are Class I fusion proteins and are said to be introduced into the compositions in order to deposit onto keratin or skin.

The present inventors have found that hydrophobins can be used to enhance delivery of oil phase components from personal care compositions to the body's surface, in particular the skin and hair. This effect is particularly beneficial in the presence of a cationic, polymeric deposition aid.

In addition, agents associated with the oil may be delivered more effectively.

## Summary of the Invention

The present invention provides a personal care composition comprising a polymeric, cationic deposition aid and an oil-in-water emulsion comprising an oil phase and an oil-in-water emulsifier selected from one or more class II hydrophobins.

A further aspect of the invention is the use of a class II hydrophobin to enhance the deposition effect of a deposition aid.

Description of the Invention

Preferably the invention relates to a composition obtainable by:

(i) preparing an oil-in-water emulsion comprising an oil phase and an oil-in-water emulsifier which is selected from one or more class II hydrophobins, and

ii) combining the oil-in–water emulsion with a base composition comprising a cationic, polymeric deposition aid.

Oil-in-water emulsion.

**Dispersed Oil Phase**

The oil phase may generally be formed from any physiologically acceptable lipophilic material having a liquid or semi-solid consistency at 25°C.

Lipophilic materials suitable for use as oil phase components in the invention include both natural and synthetically produced oils, more preferably the oil phase comprises fatty acid triglycerides, fatty acid monoglycerides or mixtures thereof.

Specific examples of suitable oil phase components include naturally or synthetically derived liquid hydrocarbons such as liquid paraffin, squalane, squalene and mineral oil; fatty esters having 6 to 50 carbon atoms in a molecule such as glyceryl monooleate, glyceryl monolinoleate, glyceryl monoisostearate, cetyl isooctanoate, octyldodecyl myristate, isopropyl myristate, isopropyl palmitate, isocetyl stearate, octyldodecyl oleate, sorbitan monooleate, sorbitan monopalmitate, sucrose mono-, di-or tri-palmitate, glyceryl trioctanoate and glyceryl triisostearate; higher fatty acids having 6 to 50 carbon atoms in a molecule such as isostearic acid, oleic acid, hexanoic acid and heptanoic acid; aliphatic higher alcohols having 6 to 50 carbon atoms in a molecule, such as

isostearyl alcohol and oleyl alcohol; oils; triglyceride oils are particularly preferred especially those derived from plant sources such as castor oil, sunflower oil, olive oil, jojoba oil, rapeseed oil, soybean oil, palm kernel oil, babassu kernel oil and coconut oil.

The level of oil within the total composition is generally from 0.5 to 30 wt% of the total composition more preferably from 5 to 30 wt%; most preferably from 10 to 25 wt% by wt.

Mixtures of any of the above described materials may also be used, and may be preferred in some cases. For example liquid materials may be used as diluents or carriers for semi-solid materials in order to improve processability.

The oil phase may also include further skin care and/or hair care benefit agents dissolved, dispersed or entrapped therein. Preferably skin and hair care benefit agents are oil soluble.

The terms “skin care benefit agent” and “hair care benefit agents” in the context of the present invention generally means any material capable of providing a cosmetic or therapeutic benefit to the skin or hair.

Preferred skin care and/or hair care benefit agents are selected form the group consisting of antimicrobial, antifungal and anti-aging agents, sun protection actives, moisturisers, anti-inflammatory agents, skin lightening and skin tanning actives.

**Aqueous Continuous Phase**

The aqueous continuous phase (into which the oil phase is dispersed) generally comprises at least 10%, preferably at least 20% by weight water based on the total weight of the aqueous continuous phase.

**Hydrophobin**

The aqueous continuous phase comprises an oil-in-water emulsifier which is selected from one or more hydrophobins.

Hydrophobins are a well-defined class of proteins (Wessels, 1997, Adv. Microb. Physio. 38: 1-45; Wosten, 2001, Annu Rev. Microbiol. 55: 625-646) capable of self-assembly at a hydrophobic/hydrophilic interface, and having a conserved sequence:

$X_n$-C-$X_{5-9}$-C-C-$X_{11-39}$-C-$X_{8-23}$-C-$X_{5-9}$-C-C-$X_{6-18}$-C-$X_m$

(SEQ ID No. 1)

where X represents any amino acid, and n and m independently represent an integer. Typically, a hydrophobin has a length of up to 125 amino acids. The cysteine residues (C) in the conserved sequence are part of disulphide bridges. In the context of this invention, the term hydrophobin has a wider meaning to include functionally equivalent proteins still displaying the characteristic of self-assembly at a hydrophobic-hydrophilic interface resulting in a protein film, such as proteins comprising the sequence:

$X_n$-C-$X_{1-50}$-C-$X_{0-5}$-C-$X_{1-100}$-C-$X_{1-100}$-C-$X_{1-50}$-C-$X_{0-5}$-C-$X_{1-50}$-C-$X_m$

(SEQ ID No. 2)

or parts thereof still displaying the characteristic of self-assembly at a hydrophobic-hydrophilic interface resulting in a protein film. In accordance with the definition of this invention, self-assembly can be detected by adsorbing the protein to Teflon and using Circular Dichroism to establish the presence of a secondary structure (in general, α-helix) (De Vocht et al., 1998, Biophys. J. 74: 2059-68).

The formation of a film can be established by incubating a Teflon sheet in the protein solution followed by at least three washes with water or buffer (Wosten et al., 1994, Embo. J. 13: 5848-54). The protein film can be visualised by any suitable method, such as labelling with a fluorescent marker or by the use of fluorescent antibodies, as is well established in the art. m and n typically have values ranging from 0 to 2000, but more usually m and n in total are less than 100 or 200. The definition of hydrophobin in the context of this invention includes fusion proteins of a hydrophobin and another polypeptide as well as conjugates of hydrophobin and other molecules such as polysaccharides.

Hydrophobins identified to date are generally classed as either class I or class II. Both types have been identified in fungi as secreted proteins that self-assemble at hydrophobic-hydrophilic interfaces into amphipathic films.

Hydrophobin-like proteins have also been identified in filamentous bacteria, such as *Actinomycete* and *Streptomyces* sp. (WO01/74864; Talbot, 2003, Curr. Biol, 13: R696–R698). These bacterial proteins by contrast to fungal hydrophobins, may form only up to one disulphide bridge since they may have only two cysteine residues. Such proteins are an example of functional equivalents to hydrophobins

having the consensus sequences shown in SEQ ID Nos. 1 and 2, and are within the scope of this invention.

The hydrophobins can be obtained by extraction from native sources, such as filamentous fungi, by any suitable process. For example, hydrophobins can be obtained by culturing filamentous fungi that secrete the hydrophobin into the growth medium or by extraction from fungal mycelia with 60% ethanol. It is particularly preferred to isolate hydrophobins from host organisms that naturally secrete hydrophobins. Preferred hosts are hyphomycetes (e.g. Trichoderma), basidiomycetes and ascomycetes. Particularly preferred hosts are food grade organisms, such as *Cryphonectria parasitica* which secretes a hydrophobin termed cryparin (MacCabe and Van Alfen, 1999, App. Environ. Microbiol 65: 5431-5435).

Alternatively, hydrophobins can be obtained by the use of recombinant technology. For example host cells, typically micro-organisms, may be modified to express hydrophobins and the hydrophobins can then be isolated and used in accordance with the present invention. Techniques for introducing nucleic acid constructs encoding hydrophobins into host cells are well known in the art. More than 34 genes coding for hydrophobins have been cloned, from over 16 fungal species (see for example WO96/41882 which gives the sequence of hydrophobins identified in *Agaricus bisporus;* and Wosten, 2001, Annu. Rev. Microbiol. 55: 625-646). Recombinant technology can also be used to modify hydrophobin sequences or synthesise novel hydrophobins having desired/improved properties.

Typically, an appropriate host cell or organism is transformed by a nucleic acid construct that encodes the desired hydrophobin. The nucleotide sequence coding for the polypeptide can be inserted into a suitable expression vector encoding the necessary elements for transcription and translation and in such a manner that they will be expressed under appropriate conditions (e.g. in proper orientation and

correct reading frame and with appropriate targeting and expression sequences). The methods required to construct these expression vectors are well known to those skilled in the art.

A number of expression systems may be used to express the polypeptide coding sequence. These include, but are not limited to, bacteria, fungi (including yeast), insect cell systems, plant cell culture systems and plants all transformed with the appropriate expression vectors. Preferred hosts are those that are considered food grade – 'generally regarded as safe' (GRAS).

Suitable fungal species, include yeasts such as (but not limited to) those of the genera *Saccharomyces, Kluyveromyces, Pichia, Hansenula, Candida, Schizo saccharomyces* and the like, and filamentous species such as (but not limited to) those of the genera *Aspergillus, Trichoderma, Mucor, Neurospora, Fusarium* and the like.

The sequences encoding the hydrophobins are preferably at least 80% identical at the amino acid level to a hydrophobin identified in nature, more preferably at least 95% or 100% identical. However, persons skilled in the art may make conservative substitutions or other amino acid changes that do not reduce the biological activity of the hydrophobin. For the purpose of the invention these hydrophobins possessing this high level of identity to a hydrophobin that naturally occurs are also embraced within the term "hydrophobins".

Hydrophobins can be purified from culture media or cellular extracts by, for example, the procedure described in WO01/57076 which involves adsorbing the hydrophobin present in a hydrophobin-containing solution to surface and then contacting the surface with a surfactant, such as Tween 20, to elute the hydrophobin from the surface. See also Collen et al., 2002, Biochim Biophys Acta. 1569: 139-50; Calonje et al., 2002, Can. J. Microbiol. 48: 1030-4; Askolin et

al., 2001, Appl Microbiol Biotechnol. 57: 124-30; and De Vries et al., 1999, Eur J Biochem. 262: 377-85.

Typically, the hydrophobin is in an isolated form, typically at least partially purified, such as at least 10% pure, based on weight of solids. By "isolated form", we mean that the hydrophobin is not added as part of a naturally-occurring organism, such as a mushroom, which naturally expresses hydrophobins. Instead, the hydrophobin will typically either have been extracted from a naturally-occurring source or obtained by recombinant expression in a host organism.

Hydrophobin proteins can be divided into two classes: Class I, which are largely insoluble in water, and Class II, which are readily soluble in water.

Hydrophobins for use with the present invention are Class II hydrophobins. Preferably the hydrophobins used are Class II hydrophobins such as HFBI, HFBII, HFBIII, or Cerato ulmin.

The hydrophobin can be from a single source or a plurality of sources e.g. a mixture of two or more different hydrophobins.

The amount of hydrophobin in the total composition is preferably at least 0.001 wt%, more preferably at least 0.005 wt% most preferably at least 0.01 wt%, and preferably no greater than 2 wt%, more preferably 1wt% or less.

Base Formulations

Deposition agents

Deposition agents can be used to aid deposition of oil; especially in the presence of surfactants. However after repeated washing and/or rinsing the oil is removed

from the surface of the skin and/or the hair. The present invention has the added advantage that deposition using a deposition aid is enhanced; furthermore once deposited the oil remains on the treated service even after repeated washing and rinsing.

Suitable cationic deposition agents include the cationic cellulose ethers described in US Patent Nos. 3 816 616 and 4 272 515 and which are available commercially from Union Carbide Corporation as Polymer JR. Polymer JR has the CTFA designation Polyquaternium 10. Other suitable materials are the cationic polygalactomannan gum deriviatives described in US Patent No. 4 298 494 which are commercially available under the trade mark Jaguar from Rhodia. An example of a suitable material has the CTFA designation guar hydroxypropyltrimonium chloride and is available under the name Jaguar C13S. Other suitable materials include that known as Jaguar C17 and Jaguar C16 which is hydroxypropylated cationic guar derivative containing hydroxypropyl substituent groups as well as cationic quaternary ammonium groups.

Other deposition agents useful in the compositions of the present invention include cationic polyamide polymers such as the low molecular weight adipic acid/diethylene-triamine polyamide and the copolymers of vinylpyrrolidone and dimethylaminoethyl methacrylate quaternised with dimethyl sulphate (Gafquat 755, GAF Corporation) described in US Patent No. 4 080 310; the graft cationic copolymer containing N-vinylpyrrolidone, dimethylamonoethyl methacrylate and polyethylene glycol described in US Patent No. 048 301; the mineral acid salts of the amono-alkyl esters of homo- and copolymers of unsaturated carboxylic acids having from 3 to 5 carbon atoms described in US Patent No. 4 009 256; and the polymers of etherified starch described in US Patent No. 3 186 911.

The high molecular weight polymers sold under the trade mark Merquat by Merck and Co. Inc., are also suitable for use as deposition agents in the present

composition. Representative ones are Merquat 100, a highly charged cationic dimethyldiallylammonium chloride homopolymer, and Merquat 550, a highly charged cationic copolymer prepared with dimethyldiallylammonium chloride and acrylamide. These materials are designated in the CFTA dictionary as Quaternium-40 and Quaternium-41, respectively.

The level of deposition aid is preferably from 0.05 to 10 wt% of the total composition more preferably from 0.1 to 5 wt% of the total composition.

It is preferred if the ratio of hydrophobin to deposition aid is from 2:1 to 1:20, more preferably from 1:1 to 1:10 most preferably from 1:2 to 1:5

**Surfactant**

In one aspect of the invention, particularly if the compositions are shampoo or personal wash compositions, composition of the invention preferably comprise a cleansing surfactants.

For compositions which are mild to the skin and hair the surfactant system preferably comprise a fatty acyl isethionate. Fatty acyl isethionate are preferably present at a level of from 1 to 15 wt.% of the total composition, more preferably from 2 to 10 wt.%, most preferably from 2.5 to 7.5 wt.%.

Preferably the fatty acyl isethionate are of chain length greater than or equal to $C_{16}$; and greater than 50 wt.%, preferably greater than 60 wt.% of the free fatty acid/soap is of chain length $C_{16}$ to $C_{20}$.

Examples of commercial fatty acyl isethionate products that are particularly useful in the subject invention are DEFI flakes and Dove® cleansing bar noodles produced by Unilever. DEFI (Direct Esterification of Fatty Isethionate) flakes

typically contain about 68 to 80 wt. % of sodium fatty acyl isethionate and 15 to 30 wt. % free fatty acid. More than 25 wt. % and no more than 35% of fatty acyl group of the resulting fatty acyl isethionate have 16 to 18 carbon atoms. Dove® cleansing bar noodles are mixtures of DEFI flakes described above and long chain (mainly $C_{16}$ and $C_{18}$) fatty acid and fatty soap which contain about 40 to 55 wt. % of fatty acyl isethionate and 30 to 40 wt. % of fatty acid and fatty soap. These preferred fatty acyl isethionate surfactant products are extremely mild and have very good emollient benefits to the skin.

Surfactants may be anionic surfactants, preferably an alkyl sulphate and/or ethoxylated alkyl sulphate anionic surfactant. Such anionic surfactants are preferably present at a level from 0 to 5 wt.% of the total composition, more preferably from 0 to 2 wt.%, most preferably from 0 to 1 wt.%.

In some instances preferred alkyl sulfates are $C_{8-18}$ alky sulfates, more preferably $C_{12-18}$ alkyl sulfates, preferably in the form of a salt with a solubilising cation such as sodium, potassium, ammonium or substituted ammonium. Examples are sodium lauryl sulfate (SLS) or sodium dodecyl sulfate (SDS).

Preferred alkyl ether sulfates are those having the formula: $RO(CH_2CH_2O)_nSO_3M$; wherein R is an alkyl or alkenyl having from 8 to 18 (preferably 12 to 18) carbon atoms; n is a number having an average value of greater than at least 0.5, preferably between 1 and 3, more preferably between 2 and 3; and M is a solubilising cation such as sodium, potassium, ammonium or substituted ammonium. Preferred ethoxylated alkyl sulfate anionic surfactant is sodium lauryl ether sulfate (SLES) having an average degree of ethoxylation of from 0.5 to 3, preferably 1 to 3.

The anionic surfactant may be, for example, aliphatic sulfonates, such as a primary alkane (e.g., $C_8$-$C_{22}$) sulfonates, primary alkane (e.g., $C_8$-$C_{22}$) disulfonate,

$C_8$-$C_{22}$ alkene sulfonate, $C_8$-$C_{22}$ hydroxyalkane sulfonate or alkyl glyceryl ether sulfonate (AGS); or an aromatic sulfonate such as alkyl benzene sulfonate.

In a particularly preferred embodiment the anionic may also be alkyl sulfosuccinates (including mono- and dialkyl, e.g., $C_6$-$C_{22}$ sulfosuccinates); fatty acyl taurates, fatty acyl amino acids other than lauroyl and cocoyl glycinate or sarcosinate, alkyl sulfoacetates, $C_8$-$C_{22}$ alkyl phosphates, alkyl phosphate esters and alkoxyl alkyl phosphate esters, acyl lactates, $C_8$-$C_{22}$ monoalkyl succinates and maleates, and fatty acyl isethionates. When present the levels of these surfactants are preferably from 1 to w5 wt% of the total composition.

Another suitable class of anionics is carboxylates such as follows:

$$R\text{-}(CH_2CH_2O)nCO_2M$$

wherein R is $C_8$ to $C_{20}$ alkyl; n is 0 to 10; and M is as defined above.

Another carboxylate which can be used is amido alkyl polypeptide carboxylates such as, for example, Monteine LCQ® by Seppic.

Another preferred surfactant type is the alkanoyl surfactant especially those combined with sarcosine to form alkanoyl sarcosinate (e.g., lauroyl sarcosinate). In a preferred embodiment mixture of alkanoyl glycinate and alkanoyl sarcosinate may be used.

For mild skin cleansing composition, the compositions preferably have 3% or less, preferably 2% or less, more preferably 1% or less of any alkyl sulfate anionic including alkyl sulfates such as sodium dodecyl sulfates or alkoxylated sulfates such as lauryl ether sulfate. In a preferred embodiment, the compositions will have 0.2% or less anionic surfactant and, in particular 0.2% or less alkyl sulfate.

Further, in another preferred skin cleansing embodiment, the composition of the invention will comprise from 5 to 70 wt% of isethionate product; 20 to 85wt% of alkanoyl ; 20 to 80wt% of amphoteric and/or zwitterionic surfactant and 3% or less anionic and nonionic together.

Compositions of the invention may comprise a nonionic surfactant. The nonionic surfactants which may be used include in particular the reaction products of compounds having a hydrophobic group and a reactive hydrogen atom, for example aliphatic alcohols, acids, amides or alkyl phenols with alkylene oxides, especially ethylene oxide either alone or with propylene oxide. Specific nonionic detergent compounds are alkyl ($C_6$-$C_{22}$) phenols-ethylene oxide condensates, the condensation products of aliphatic ($C_8$-$C_{18}$) primary or secondary linear or branched alcohols with ethylene oxide, and products made by condensation of ethylene oxide with the reaction products of propylene oxide and ethylenediamine. Other so-called nonionic detergent compounds include long chain tertiary amine oxides, long chain tertiary phosphine oxides and dialkyl sulphoxides.

The nonionic may also be a sugar amide, such as a polysaccharide amide. Specifically, the surfactant may be one of the lactobionamides described in U.S. Patent No. 5,389,279 to Au et al. which is hereby incorporated by reference or it may be one of the sugar amides described in Patent No. 5,009,814 to Kelkenberg, hereby incorporated into the subject application by reference.

Preferred alkyl polysaccharides are alkylpolyglycosides of the formula:

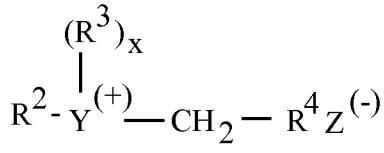
$$R^2O(C_nH_{2n}O)_t(\text{glycosyl})_x$$

wherein $R^2$ is selected from the group consisting of alkyl, alkylphenyl, hydroxyalkyl, hydroxyalkylphenyl, and mixtures thereof in which alkyl groups contain from about 10 to about 18, preferably from about 12 to about 14, carbon

atoms; n is 0 to 3, preferably 2; t is form 0 to about 10, preferably 0; and x is from 1.3 to about 10, preferably from 1.3 to about 2.7. The glycosyl is preferably derived from glucose.

The zwitterionic and amphoteric surfactants which are used in preferred embodiments of the invention are as noted below.

Zwitterionic surfactants are exemplified by those which can be broadly described as derivatives of aliphatic quaternary ammonium, phosphonium, and sulfonium compounds, in which the aliphatic radicals can be straight or branched chain, and wherein one of the aliphatic substituents contains from about 8 to about 18 carbon atoms and one contains an anionic group, e.g., carboxy, sulfonate, sulfate, phosphate, or phosphonate. A general formula for these compounds is:



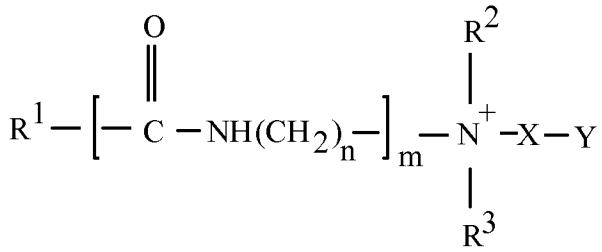
wherein $R^2$ contains an alkyl, alkanoyl, or hydroxyl alkyl radical of from about 8 to about 18 carbon atoms, from 0 to about 10 ethylene oxide moieties and from 0 to about 1 glyceryl moiety; Y is selected from the group consisting of nitrogen, phosphorus, and sulfur atoms; $R^3$ is an alkyl or monohydroxyalkyl group containing about 1 to about 3 carbon atoms; X is 1 when Y is a sulfur atom, and 2 when Y is a nitrogen or phosphorus atom; $R^4$ is an alkylene or hydroxyalkylene of from about 1 to about 4 carbon atoms and Z is a radical selected from the group consisting of carboxylate, sulfonate, sulfate, phosphonate, and phosphate groups.

Examples of such surfactants include:

4-[N,N-di(2-hydroxyethyl)-N-octadecylammonio]-butane-1-carboxylate;

5-[S-3-hydroxypropyl-S-hexadecylsulfonio]-3-hydroxypentane-1-sulfate;
3-[P,P-diethyl-P-3,6,9-trioxatetradexocylphosphonio]-2-hydroxypropane-1-phosphate;

Amphoteric surfactants which may be used in this invention include at least one acid group. This may be a carboxylic or a sulphonic acid group. They include quaternary nitrogen and therefore are quaternary amido acids. They should generally include an alkyl or alkanoyl group of 7 to 18 carbon atoms. They will usually comply with an overall structural formula:



where $R^1$ is alkyl or alkanoyl of 7 to 18 carbon atoms; $R^2$ and $R^3$ are each independently alkyl, hydroxyalkyl or carboxyalkyl of 1 to 3 carbon atoms; n is 2 to 4; m is 0 to 1; X is alkylene of 1 to 3 carbon atoms optionally substituted with hydroxyl, and Y is $–CO_2-$ or $–SO_3-$.

Alkylamphoacetates and dialkylamphoacetates are also intended to be covered among possible amphoteric compounds which may be used.

Examples of suitable amphoteric surfactants are alkyl betaines; amidoalkyl betaines; amphocarboxylate derivatives such as (mono or di) alkylamphoacetate; and amidoalkyl sultaines.

Cocamidopropyl betaine, lauramidopropyl betaine, lauryl betaine, coco-betaine, lauroamphoacetate, cocoamphoacetate, cocoamphopropionate, lauryl

hydroxysultaine and cocamidopropyl hydroxysultaine surfactants are particularly useful and preferred for this application.

A preferred surfactant system of the invention comprises isethionate product, mixtures of alkanoyl glycinate and alkanoyl sarcosinate and amphoteric surfactant such as betaine. Further, such may be combined with free fatty acids, e.g., $C_8$ – $C_{24}$ straight chain free fatty acid such as, for example, lauric acid.

Suspending Agent/ Thickening Agent

Preferably the aqueous composition of the invention further comprises a suspending agent. Suitable suspending agents are selected from polyacrylic acids, cross-linked polymers of acrylic acid, copolymers of acrylic acid with hydrophobic monomer, copolymers of carboxylic acid-containing monomers and acrylic esters, cross-linked copolymers of acrylic acid and acrylate esters, heteropolysaccharide gums and crystalline long chain acyl derivatives. The long chain acyl derivative is desirably selected from ethylene glycol stearate, alkanolamides of fatty acids having from 16 to 22 carbon atoms and mixtures thereof. Ethylene glycol distearate and polyethylene glycol 3 distearate are preferred long chain acyl derivatives, since these impart pearlescence to the composition. Polyacrylic acid is available commercially as Carbopol 420, Carbopol 488 or Carbopol 493. Polymers of acrylic acid cross-linked with a polyfunctional agent may also be used; they are available commercially as Carbopol 910, Carbopol 934, Carbopol 941 and Carbopol 980. An example of a suitable copolymer of a carboxylic acid containing monomer and acrylic acid esters is Carbopol 1342. All Carbopol (trademark) materials are available from Lubrizol Corp.

Suitable cross-linked polymers of acrylic acid and acrylate esters are Pemulen TR1 or Pemulen TR2. A suitable heteropolysaccharide gum is xanthan gum, for example that available as Kelzan mu.

The aqueous continuous phase may if necessary include a thickener in order to reduce creaming or coalescence of the particles of the dispersed oil phase. Examples of suitable thickeners include organic polyols having 3 or more hydroxyl groups in the molecule (hereinafter termed “organic polyols”). Examples of such materials include glycerol, sorbitol, xylitol, mannitol, lactitol, maltitol, erythritol, and hydrogenated partially hydrolyzed polysaccharides. The most preferred organic polyol is glycerol. Mixtures of any of the above described materials may also be used.

Mixtures of any of the above suspending agents/thickeners may be used. Preferred is a mixture of cross-linked polymer of acrylic acid and crystalline long chain acyl derivative.

Suspending agents and/or thickening agents if included, will generally be present in the composition of the invention at levels of from 0.1 to 10%, preferably from 0.5 to 6%, more preferably from 0.9 to 4% by total weight of suspending agent based on the total weight of the composition.

Further Ingredients

Adjunct humectants may be employed in the end use compositions of the present invention. These are generally polyhydric alcohol-type materials. Typical polyhydric alcohols include glycerol, propylene glycol, dipropylene glycol, polypropylene glycol, polyethylene glycol, sorbitol, hydroxypropyl sorbitol, hexylene glycol, 1,3-butylene glycol, isoprene glycol, 1,2,6-hexanetriol, ethoxylated glycerol, propoxylated glycerol and mixtures thereof. If used, the

amount of adjunct humectant may range anywhere from 0.5 to 40%, preferably between 1 and 30 % by weight of the end use composition.

A composition of the invention may contain other ingredients for enhancing performance and/or consumer acceptability. Such ingredients include fragrance, colouring agents, dyes and pigments, pH adjusting agents, pearlescers or opacifiers, viscosity modifiers, preservatives, and natural hair/skin nutrients such as botanicals, fruit extracts, sugar derivatives and amino acids, silicones, chelating agents such as EDTA, antioxidants such as vitamin E acetate, antimicrobials and sunscreens. Each of these ingredients will be present in an amount effective to accomplish its purpose. Generally these optional ingredients are included individually at a level of up to about 5% by weight of the total composition, more preferably at a level of up to 2%, most preferably up to 1%, by weight of the total composition.

Product Format

Preferably the compositions of the invention are wash off compositions, in that they are used to clean the skin or hair and are then immediately (within 5 minutes) removed by rinsing with water.

Method of preparation

A typical process used to form the oil-in-water emulsion described above comprises the following steps:

mixing one or more hydrophobins with water and optionally a thickener such as glycerol to form an aqueous phase;

mixing one or more oil phase components (as described above) in a separate vessel to form an oil phase;

adding the oil phase to the aqueous phase, agitating to form a mixture and subjecting the resultant mixture to a mechanical emulsification treatment, thereby forming an oil-in-water emulsion in which the emulsified particles of oil phase are emulsified with the one or more hydrophobins.

The mechanical emulsification treatment may suitably be carried out using high shear mixing or homogenizing equipment known to those skilled in the art, such as a Silverson® mixer or a Microfluidizer®.

Heating may be employed if necessary to aid processing during any or all of the process steps described above.

The oil-in-water emulsion is then added to a base composition followed by mixing in a conventional manner.

The invention is further illustrated with reference to the following, non-limiting Examples.

## EXAMPLES

## Personal Wash Composition

### Base Formulation

| Ingredient | Base formulation |
|---|---|
| Glycerin | 30.000 |
| Guar gum | 0.600 |
| Sodium Cocoyl Glycinate | 18.000 |
| Sodium Lauroyl Sarcosinate | 1.7 |
| Cocamidopropyl Betaine | 17.100 |
| Dove 40% Premix (Hammond) | 5.000 |
| Lauric Acid | 1.600 |
| Starch B990 | 7.000 |
| Water and minors | To 100 |

**Example 1:** 12% soya bean oil in base formulation

**Example 2** 12% soya bean oil in base formulation and 0.2% hydrophobin (HFBII, class II hydrophobin from *trichoerderma reesei* ex Danisco).

**Example 3:** 12 % soya bean oil in base formulation with 0.5% Jaguar C-17.

**Example 4** 12% soya bean oil in base formulation with 0.5% Jaguar C-17 and and 0.2% hydrophobin (HFBII, class II hydrophobin from *trichoerderma reesei* ex Danisco).

The hydrophobin was used to form a pre-emulsion with the soya bean oil prior to combining with the other ingredients, Soybean oil, water and hydrophobin were

heated to 75°C with mixing to form an emulsion. The mixture was added to a vessel containing Dove body wash and homogenized (speed: 3600RPM; mix for 1TP or equivalent).

**Deposition protocol** and 0.2% hydrophobin (HFBII, class II hydrophobin from *trichoerderma reesei* ex Danisco.

**For Examples**

**Porcine skin pre-treatment.**

Pig back skin (waste product from meat processing) was cut in to 10cm x 10 cm pieces. The skin was washed with a 70:30 ethanol/water mixture. The skin was rubbed 3-4 timed with ethanol/water and then rinsed with tap water (at 37°C and at a flow rate of approximately 43 ml/sec). The pre-washed skin was then washed with Dove white beauty bar soap for 2 minutes, rinsed with water and patted try with a towel. The washed skin was then cut into 5cm x 5 cm pieces.

**Product application**

The prewashed and dried pig samples were pre wetted with water. The body wash formulation was lathered on a towel (0.2 $cm^3$ product) and applied to a circular test site (3 cm in diameter) using a circular motion for ten seconds. The lather was left on the skin site for ninety seconds, before being rinsed for fifteen seconds under running water ( the water temperature was 37°C and the flow rate approximately 43$cm^3$/sec). The test site was patted dry with a soft, disposable paper towel. After 3 minutes the entire wash procedure was repeated for a second time to complete one full wash session.

**Amount of oil deposited**

After the application and wash protocols were completed the amount of oil deposited onto each skin samples was measured using a liquid chromatography-mass spectrometry (LC-MS) method.

Table 1 shows the amounts of oil deposited from Examples 1, 2, 3 and 4. Clearly most oil has been deposited from the bodywash formulation containing hydropbobin and the deposition aid.

Table1

| Formulation | Amount of oil deposited (µg of oil/$cm^2$ of skin) |
|---|---|
| Example 1 | 0 |
| Example 2 | 0 |
| Example 3 | 17.42 |
| Example 4 | 30.64 |

Example 4 deposited more oil than Examples 1, 2 or 3

Method for deposition of DEFI Glycinate prototypes on hair

Spanish dark brown virgin hair switches supplied by International Hair Importers & products were used for these experiments. The hair switches were 5cm long and weighed 0.25g.

The hair switches were washed before use in the following way. The hair switches were soaked in 1% SDS solution for 1 hour. After which a drop of 10% SDS solution was placed on the hair & rubbed for 1 minute. The hair switch was rinsed under running tap water for 2 minutes. The washed hair switches were pat dried and left to dry at room temperature till used.

The washed hair switch was made wet under running tap water. The DEFI glycinate sample was stained with a 0.1% solution of Nile Blue (in water) by adding 1 part Nile Blue solution to 9 parts emulsion (and mixing gently). The Nile Blue used was Nile Blue hydrogen sulphate from Gurr microscopy materials, BDH Chemicals Ltd. 50µl (200µl/g hair) of the sample stained with Nile blue was applied over the hair switch. The sample was rubbed onto the hair switch for 2 minutes.

Deposition on application on the hair switch and a few strands of cut hair was assessed using a Leica DM IRBE confocal microscope with a Leica TCS SP blue laser and with a Leica Z16 APOA stereo macroscope. The hair switch was then rinsed under running tap water for 1 minute. Deposition on rinsing was then re-examined on the hair switch and a few strands of cut hair.

**Results**

Hair treated with Example 4 exhibited more evenly distributed oil along the hair shaft compared with Example 3. Additionally more oil was retained on the hair shaft after washing for Example 4 compared with Example 3.

## CLAIMS

1. A personal care composition comprising a polymeric, cationic deposition aid and an oil-in-water emulsion comprising an oil phase and an oil-in-water emulsifier selected from one or more class II hydrophobins.

2. A personal care composition according to claim 1 obtainable by:
(i) preparing an oil-in-water emulsion comprising an oil phase and an oil-in-water emulsifier selected from one or more class II hydrophobins; and
(ii) combining the oil-in–water emulsion with a base composition comprising a polymeric, cationic deposition aid.

3. A personal care composition according to claim 1 in which the level of hydrophobin is from 0.005 wt% to 2 wt% of the total composition.

4. A personal care composition according to any preceding claim in which the level of deposition aid is from 0.1 to 5 wt% of the total composition.

5. A personal care composition according to any preceding claim in which oil within the oil phase is present from 1 to 20 wt% of the total composition.

6. A personal care composition according to any preceding claim in which the weight ratio of hydrophobin to deposition aid is from 1:1 to 1:10.

7. A personal care composition according to any preceding claim, in which the Class II hydrophobin is HFBI, HFBII, or a mixture thereof.

8. A personal care composition according to any preceding claim, in which the oil is a hydrocarbon based oil.

9. A personal care composition according to any preceding claim in which the oil phase comprises fatty acid triglycerides, fatty acid monoglycerides or mixtures thereof.

10. A personal care composition according to any preceding claim in which the oil phase may also further comprises skin care and/or hair care benefit agents dissolved, dispersed or entrapped therein.

11. A personal care composition according to any preceding claim, in which the base formulation comprises a continuous phase comprising an anionic surfactant.

12. A personal care composition according to any preceding claim, in which the base formulation further comprises fatty acyl isethionate.

13. A method of treating skin comprising the step of applying to the skin a composition described in any preceding claim.

14. A method of treating hair comprising the step of applying to the hair a composition described in any one of claims 1 to 12.

15. Use of a class II hydrophobin to enhance the water resistance of a composition described in any of the previous claims.