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(54) **Title**: SHAPING KERATIN FIBRES USING ARABINOSE AND ETHYLENE CARBONATE

(57) **Abstract**: A method for shaping keratin fibres including providing a crosslinking composition, wherein the crosslinking composition includes ethylene carbonate, arabinose, and a cosmetically acceptable carrier; applying the crosslinking composition to keratin fibres; and mechanically shaping the keratin fibres with an appliance at a temperature of from about 50C to about 250C.

SHAPING KERATIN FIBRES USING ARABINOSE AND ETHYLENE CARBONATE

FIELD OF THE INVENTION

A method for shaping keratin fibres including providing a crosslinking composition, wherein the crosslinking composition includes ethylene carbonate and arabinose, applying the crosslinking composition to the hair, and heating the hair.

BACKGROUND OF THE INVENTION

Consumers are constantly demanding products that meet their daily styling and conditioning needs without damaging the hair. The perceived and sometimes real impact of various treatments and the implements such as blow drying and flat iron can have detrimental effects on the acute and chronic nature of hair.

Permanent methods – or relaxers – usually comprise the steps of applying onto hair a composition comprising a high pH solution (or combination of components to generate high pH), leaving on for a protracted time and then applying a neutralizing composition. A relaxer is a treatment predominately used by people of African-descent to permanently straighten hair. The treatment relies on either the one-step sodium hydroxide (lye) or a two step (e.g. guanidine carbonate and calcium hydroxide) to achieve very high pH (pH 12-14).

Semi-permanent benefits can be achieved using redox chemistry such as thioglycolic acid (TGA) and hydrogen peroxide. Here, the curly hair is transformed into the straight hair because the disulfide bonds are broken by the reaction with TGA. The straighter style is locked in during the oxidation step with hydrogen peroxide.

Non-permanent methods usually comprise the step of heating the hair with a flat-iron or heating element. Methods using such devices in combination with chemically-modifying the internal hair fibres can obtain long-lasting effects e.g. over several months. The Brazilian Keratin Treatments (BKTs) enable the achievement of a straight hairstyle that lasts several months via a shampoo treatment. The key active in BKTs is formaldehyde. The most efficacious treatments (used mainly in salons) rely on high temperature – usually 232°C (450°F) – with formaldehyde. Hair treated with products with high concentration of formaldehyde such as Brazilian Blowout delivers semi- permanent straight hair. Over time and following shampooing, the hair reverts back to a curly configuration.

The known methods for straightening hair all have drawbacks. The permanent methods are typically time-consuming and may damage hair. In addition, such methods show little flexibility so that any need and/or wish for changing the hairstyle would require conducting again

a "permanent" wave onto hair, which is time-consuming and further damages the hair.

Along with the high potential skin irritation during application, relaxers tend to permanently change the hair by breaking the natural disulfide bonds in the hair. This leaves the hair weaker and more prone for further breakage. Over-processing can also increase hair damage and skin irritation. Consumer products using redox chemistry to achieve semi-permanent benefits, but overprocessing the hair and the strong sulphur smell are concerns of technologies based on reducing chemistry.

According to the US National Toxicology Program, formaldehyde is known to be a human carcinogen. Therefore, providing a semi-permanent style with carcinogen-free formulation is paramount. Given the safety concern of formaldehyde and the damaging effect of relaxers and reducing chemistry, there is a need for a safe alternative to durable straightening that does not break disulfide bonds.

None of the above methods allow achieving a hairstyle that may be retained and/or recovered after at least one shampoo treatment without severely damaging the hair or using a carcinogenic active. There is a need for the provision of a method for achieving a hairstyle that lasts at least five shampoo treatments so that the user would not need to re-shape hair after each shampoo but would still have the opportunity to change hairstyle after some time and without needing to use stringent or harsh hair treatment, such as the permanent technologies outlined above.

There is a need therefore for providing a method for achieving and semi-permanently retaining and/or recovering hairstyle using actives that do not break disulfide bonds (reducing agents) or that are considered carcinogenic. There is also the need for providing a method for obtaining a hairstyle exhibiting resistance to shampoo treatments. Particularly, there is a need for providing a method for retaining and/or recovering hairstyle after at least one shampoo treatment, particularly after five shampoo treatments, more particularly after ten shampoo treatments. In addition, there is a need for providing a method for achieving and retaining and/or recovering hairstyle, without damaging hair. Also, there is a need for providing more economic semi-permanent hair straightening or hair relaxing treatments.

SUMMARY OF THE INVENTION

Described herein is a method for shaping keratin fibres comprising (a) providing a crosslinking composition, wherein the crosslinking composition comprises (i) ethylene carbonate; (ii) arabinose; and (iii) a cosmetically acceptable carrier; (b) applying the crosslinking

composition to keratin fibres; and (c) mechanically shaping the keratin fibres with an appliance at a temperature of from about 50°C to about 250°C.

Also described herein is a crosslinking composition for shaping keratin fibres comprising (a) ethylene carbonate; (b) arabinose; and (c) a cosmetically acceptable carrier; wherein arabinose and ethylene carbonate have a weight ratio of about 2:1, about 1:3, or about 1:6 arabinose:ethylene carbonate.

These and other features, aspects, and advantages of the present invention will become evident to those of ordinary skill in the art from a reading of the present disclosure.

DETAILED DESCRIPTION OF THE INVENTION

In this document, including in all embodiments of all aspects of the present invention, the following definitions apply unless specifically stated otherwise. All percentages are by weight of the total composition. All ratios are weight ratios. References to 'parts' e.g. a mixture of 1 part X and 3 parts Y, is a ratio by weight. "QS" or "QSP" means sufficient quantity for 100% or for 100g. +/- indicates the standard deviation. All ranges are inclusive and combinable. The number of significant digits conveys neither a limitation on the indicated amounts nor on the accuracy of the measurements. All numerical amounts are understood to be modified by the word "about". All measurements are understood to be made at 25°C and at ambient conditions, where "ambient conditions" means at 1 atmosphere (atm) of pressure and at 50% relative humidity. "Relative humidity" refers to the ratio (stated as a percent) of the moisture content of air compared to the saturated moisture level at the same temperature and pressure. Relative humidity can be measured with a hygrometer, in particular with a probe hygrometer from VWR® International. Herein: "min" means "minute" or "minutes"; "mol" means mole; "nanometers" is abbreviated "nm"; "g" following a number means "gram" or "grams". All weights as they pertain to listed ingredients are based on the active level and do not include carriers or by-products that may be included in commercially available materials. Herein, "comprising" means that other steps and other ingredients can be in addition. "Comprising" encompasses the terms "consisting of" and "consisting essentially of". The compositions, formulations, methods, uses, kits, and processes of the present invention can comprise, consist of, and consist essentially of the elements and limitations of the invention described herein, as well as any of the additional or optional ingredients, components, steps, or limitations described herein. Embodiments and aspects described herein may comprise or be combinable with elements, features or components of other embodiments and/or aspects despite not being expressly exemplified in combination, unless an incompatibility is stated. "In at least one embodiment" means that one or more embodiments,

optionally all embodiments or a large subset of embodiments, of the present invention has/have the subsequently described feature. Where amount ranges are given, these are to be understood as being the total amount of said ingredient in the composition, or where more than one species fall within the scope of the ingredient definition, the total amount of all ingredients fitting that definition, in the composition. For example, if the composition comprises from about 1% to about 5% fatty alcohol, then a composition comprising 2% stearyl alcohol and 1% cetyl alcohol, would fall within the scope.

"Molecular weight" or "M.Wt." or "MW" and grammatical equivalents mean the number average molecular weight.

"Viscosity" is measured at 25°C using a HAAKE Rotation Viscometer VT 550 with cooling/heating vessel and sensor systems according to DIN 53019 at a shear rate of 12.9 s^{-1}.

"Water-soluble" refers to any material that is sufficiently soluble in water to form a clear solution to the naked eye at a concentration of 0.1% by weight of the material in water at 25°C. The term "water-insoluble" refers to any material that is not "water-soluble".

"Substantially free from" or "substantially free of" means less than about 1%, or less than 0.8%, or less than 0.5%, or less than 0.3%, or about 0%, by total weight of the composition or formulation.

"Keratin fibres" means fibrous material composed of keratin. "Hair" means mammalian keratin fibres including scalp hair, facial hair, eyelashes, and body hair. It includes such hair still being attached to a living subject and also hair that has been removed therefrom such as hair swatches and hair on a doll/mannequin. In at least one embodiment, "hair" means human hair. "Hair shaft" or "hair fibre" means an individual hair strand and may be used interchangeably with the term "hair."

"Cosmetically acceptable" means that the compositions, formulations or components described are suitable for use in contact with human keratinous tissue without undue toxicity, incompatibility, instability, allergic response, and the like. All compositions and formulations described herein which have the purpose of being directly applied to keratinous tissue are limited to those being cosmetically acceptable.

"Derivatives" includes but is not limited to, amide, ether, ester, amino, carboxyl, acetyl, acid, salt and/or alcohol derivatives of a given compound. In at least one embodiment, "derivatives thereof" means the amide, ether, ester, amino, carboxyl, acetyl, acid, salt and alcohol derivatives.

"Monomer" means a discrete, non-polymerised chemical moiety capable of undergoing polymerisation in the presence of an initiator or any suitable reaction that creates a

macromolecule e.g. such as polycondensation, polyaddition, anionic or cationic polymerization. “Unit” means a monomer that has already been polymerised i.e. is part of a polymer.

"Polymer" means a chemical formed from the polymerisation of two or more monomers. The term "polymer" shall include all materials made by the polymerisation of monomers as well as natural polymers. Polymers made from only one type of monomer are called homopolymers. Herein, a polymer comprises at least two monomers. Polymers made from two or more different types of monomers are called copolymers. The distribution of the different monomers can be random, alternating or block-wise (i.e. block copolymer). The term “polymer” used herein includes any type of polymer including homopolymers and copolymers.

“Kit” means a package comprising a plurality of components. “Kit” may be referred to as “kit-of-parts”. An example of a kit is, for example, a first composition and a separately packaged second composition and optionally application instructions.

The details of the different aspects of the invention are described hereinafter.

Description

Described herein is a method for shaping keratin fibres. The method allows the achievement of a semi-permanent hairstyle i.e. a durable hairstyle, and semi-permanent shaping of eyelashes. This semi-permanent hairstyle is retained after at least one shampoo treatment, particularly after five shampoo treatments, more particularly after 10 shampoo treatments. Besides the increased durability of the hairstyle, this method prevents clumping of hair and/or improves post-shampoo detangling of hair and feel. In addition, the inventors have found that this method increases the water- and humidity-resistance of the shape, increases the ease of style and/or increases the manageability of the shape after shampooing.

Without wishing to be bound by any theory, it is believed that the above benefits are due to the steps conducted, their sequence, as well as the specific components used including the active agent. It is believed that the selected active agent diffuses into the shaft of the keratin fibre, reacts with amino groups in the keratin polypeptide and crosslinks these functional groups in the keratin protein structure, providing sufficient crosslinks to overcome the innate restoring force of the keratin fibre structure. This results in a durable shaping of keratin fibres, for example a durable hairstyle or durable eyelash shape.

The details of the different aspects of the invention are described hereinafter.

Crosslinking composition

The crosslinking composition comprises a first and a second active agent. The active agents are useful for reacting with and providing crosslinks in keratin, wherein the first active agent is arabinose, and the second active agent is ethylene carbonate.

Sugars such as arabinose are useful because they are naturally-derived, which is preferred by consumers versus synthetic compounds. This is not only for perceived health and lack of sensitisation reasons, but also for sustainability and environmental reasons – sugars break down naturally and quickly and do not require special disposal methods. Furthermore, sugars are also easy to source and relatively inexpensive.

Without wishing to be bound by theory, the second active agent may be useful for reacting with and providing further crosslinks in keratin. The hair comprises polypeptides of keratin having functional groups -COOH, OH, and NH_2, and SH. Different active agents can react preferentially with each functional group. For instance, arabinose preferentially reacts with amino groups whereas ethylene carbonate reacts preferentially with -COOH.

The second active agent is liquid at 25°C. Second active agents being liquid at this temperature have the advantage of providing improved hair feel versus second active agents that are solid at this temperature.

The arabinose and ethylene carbonate are present in the crosslinking composition at a weight ratio of from about 7:4 to about 9:4, alternatively about 2:1, alternatively from about 3:12 to about 5:12, alternatively about 1:3, alternatively from about 1:12 to about 3:12, and alternatively about 1:6 arabinose:ethylene. The crosslinking composition may comprise from about 0.1% to about 40%, or from about 0.5% to about 20%, or from about 1% to about 15%, or from about 7% to about 20%, or from about 8% to about 19%, or from about 10% to about 18% arabinose and ethylene carbonate combined, by weight of the crosslinking composition.

In an embodiment, the crosslinking composition comprises from about 7% to about 20%, or from about 8% to about 19%, or from about 10% to about 18% arabinose:ethylene carbonate. In at least one embodiment, the crosslinking composition comprises from about 12% to about 18% arabinose:ethylene carbonate, by weight of the crosslinking.

In an embodiment, the crosslinking composirion may comprise from about 0.1% to about 20%, alternatively from about 1% to about 13%, alternatively from about 4% to about 6%, alternatively from about 9% to about 11% arabinose, and alternatively from about 1.5% to about 3.5% arabinose, by weight of the crosslinking composition.

In an embodiment, the crosslinking composirion may comprise from about 0.1% to about 20%, alternatively from about 2% to about 18%, alternatively from about 4% to about 6%, and alternatively from about 14% to about 16% ethylene carbonate, by weight of the crosslinking composition.

In at least one embodiment, the crosslinking composition comprises a cosmetically acceptable carrier. In at least one embodiment, the cosmetically acceptable carrier is any carrier

suitable for formulating the active agent into a crosslinking composition being suitable for application onto hair. In at least one embodiment, the cosmetically acceptable carrier is selected from either an aqueous medium or an aqueous-alcoholic medium. In at least one embodiment, when the carrier is an aqueous-alcoholic carrier, this carrier comprises water and an alcohol. In at least one embodiment, the alcohol is selected from the group consisting of: ethanol, isopropanol, propanol, and mixtures thereof. In at least one embodiment, when the carrier is an aqueous carrier, this carrier consists essentially of water and is substantially free of alcohol. In at least one embodiment, the crosslinking composition comprises a safe and effective amount of cosmetically acceptable carrier. In at least one embodiment, the crosslinking composition comprises from about 0.1% to about 99%, or from about 1% to about 98%, or from about 10% to about 97%, or from about 30% to about 95% water, by weight of the crosslinking composition.

Other ingredients may be present in the crosslinking composition. In at least one embodiment, the crosslinking composition comprises antioxidant. Antioxidant is useful in view of providing longer-term stability for the crosslinking composition. In at least one embodiment, the crosslinking composition comprises a safe and effective amount of an antioxidant. In at least one embodiment, the crosslinking composition comprises from about 0.001% to about 5%, or from about 0.5% to about 1.0% antioxidant. In at least one embodiment, the antioxidant is selected from the group consisting of: ascorbic acid (vitamin C), ascorbyl esters of fatty acids, ascorbic acid derivatives (e.g., magnesium ascorbyl phosphate, sodium ascorbyl phosphate, ascorbyl sorbate), tocopherol (vitamin E), tocopherol sorbate, tocopherol acetate, other esters of tocopherol, butylated hydroxy benzoic acids and their salts, peroxides including hydrogen peroxide, perborate, thioglycolates, persulfate salts, 6-hydroxy-2,5,7,8-tetramethylchroman-2-carboxylic acid (commercially available under the tradename Trolox™), gallic acid and its alkyl esters, especially propyl gallate, uric acid and its salts and alkyl esters, ferulic acid and its salts and esters, sorbic acid and its salts, lipoic acid, amines (e.g., N,N-diethylhydroxylamine, amino-guanidine), sulfhydryl compounds (e.g., glutathione), dihydroxy fumaric acid and its salts, lycine pidolate, arginine pilolate, nordihydroguaiaretic acid, bioflavonoids, curcumin, lysine, 1-methionine, proline, superoxide dismutase, silymarin, tea extracts, grape skin and/or grape seed extracts, melanin, rosemary extracts, and mixtures thereof. In at least one embodiment, the antioxidant is tocopherol sorbate or an ester of tocopherol. For example, the use of tocopherol sorbate in topical compositions and applicable to the present invention is described in U.S. Pat. No. 4,847,071, issued on Jul. 11, 1989 to Donald L. Bissett, Rodney D. Bush and Ranjit Chatterjee. In at least one embodiment, the antioxidant is sodium benzoate. In at least one embodiment, the antioxidant is ferulic acid. Ferulic acid has the benefit of enhancing the

oxidative stability of the formulation. In at least one embodiment, the crosslinking composition comprises a safe and effective amount of ferulic acid. In at least one embodiment, the crosslinking composition comprises from about 0.001% to about 5%, or from about 0.5% to about 1.0% ferulic acid.

In at least one embodiment, the crosslinking composition comprises a chelator or chelating agent. As used herein, "chelator" or "chelating agent" means an active agent capable of removing a metal ion from a system by forming a complex so that the metal ion cannot readily participate in or catalyze chemical reactions. The inclusion of a chelating agent is especially useful for providing protection against UV radiation which can contribute to excessive scaling or skin texture changes and against other environmental agents which can cause skin damage, in order to decrease the local iron load, which generates, as indicated above, a pro-oxidant situation and pigmentation. A chelating agent is useful in view of providing longer-term stability for the crosslinking composition. In at least one embodiment, the crosslinking composition comprises a safe and effective amount of a chelator or chelating agent. In at least one embodiment, the crosslinking composition comprises a chelating agent, and wherein the chelating agent is selected from the group consisting of: N-hydroxysuccinimide, EDTA, NTA, deferoxamine, hydroxamic acids and their salts, phytic acid, phytate, gluconic acid and its salts, transferrine, lactoferrin, and mixtures thereof. In at least one embodiment, the crosslinking composition comprises a safe and effective amount of chelating agent. In at least one embodiment, the crosslinking composition comprises from about 0.001% to about 10%, or from about 0.01% to about 5%, or from about 0.1% to about 5%, or from about 0.5% to about 1.0% chelating agent. Exemplary chelators that are useful herein are disclosed in U.S. Pat. No. 5,487,884, issued Jan. 30, 1996 to Bissett *et al.*; International Publication No. 91/16035, Bush *et al.*, published Oct. 31, 1995; and International Publication No. 91/16034, Bush *et al.*, published Oct. 31, 1995. In at least one embodiment, the chelating agent is selected from the group consisting of: N-hydroxysuccinimide deferoxamine, lactoferrin, hydroxamic acids, gluconic acid, phytic acid, derivatives thereof, and mixtures thereof.

In at least one embodiment, the crosslinking composition is in a form suitable for application onto hair. In at least one embodiment, the crosslinking composition is in the form of an emulsion, a solution, or a dispersion. In at least one embodiment, the crosslinking composition comprises a surfactant. The surfactant can be useful in providing an emulsion. In at least one embodiment, when being in the form of an emulsion, said emulsion may be a water-in-oil emulsion, an oil-in-water emulsion, or a multiple emulsion. An emulsion has the benefit of providing an easy-to-apply composition for the consumer to apply to the hair and has aesthetic

advantages. The crosslinking composition may be a leave-in composition or a rinse-off composition. The crosslinking composition may be in a form selected from: a shampoo; a hair conditioning composition; a hairstyling composition; or combinations thereof. When being a hairstyling composition, said composition may be a gel composition; a spray gel composition, optionally dispensed using a mechanical spray device and/or at least one propellant; a non-aerosol hairspray, optionally dispensed using a suitable mechanically operated spraying device; a foamable composition, optionally dispensed using devices for foaming; hair wax composition; hair lotion composition; hair cream composition; or combinations thereof. In at least one embodiment, the crosslinking composition is a mascara composition.

The crosslinking composition may further comprise at least one cosmetic agent selected from hairstyling polymers, conditioning agents, hair cleansing agents, or mixtures thereof. In at least one embodiment, the crosslinking composition comprises a hairstyling polymer. In at least one embodiment, the hairstyling polymer is selected from the group consisting of: non-ionic hairstyling polymer, anionic hairstyling polymer, zwitterionic and/or amphoretic hairstyling polymer, cationic hair styling polymer, or mixtures thereof. Suitable hairstyling polymers may be found in the CTFA International Cosmetics Ingredient Dictionary and Handbook, "Hair Fixatives", 12th edition (2008). Suitable hairstyling polymers are, for example, those materials disclosed from page 12, line 5 to page 19, line 1 of the European patent application 08151246.9 filed on 11 February 2008, which is incorporated herein by reference.

In at least one embodiment, the crosslinking composition comprises from about 0.01% to about 10% by weight, or from about 0.1% to about 8%, or from about 0.1% to about 5% hairstyling polymer.

In at least one embodiment, the crosslinking composition comprises a non-ionic hairstyling polymer. In at least one embodiment, the non-ionic hairstyling polymer is a natural or synthetic polymer. In at least one embodiment, the non-ionic hair styling polymers is a polymer obtained from the polymerisation of at least one type of monomer selected from: vinylpyrrolidone; vinylcaprolactam; vinyl esters; vinyl alcohol; vinyl acetate; (meth)acrylamide, and/or its derivatives; (meth)acrylic acid, its salts, and/or its derivatives; propylene and/or ethylene glycol acid; crotonic acid; or mixtures thereof. For example, such polymers are available under the trade names Luviskol® or Luviset Clear®.

In at least one embodiment, the crosslinking composition comprises an anionic hairstyling polymer. In at least one embodiment, the anionic hairstyling polymer is selected from the group consisting of: acrylic acid/alkyl acrylate/Nalkylacrylamide terpolymer; vinyl acetate/crotonic acid copolymer; C1-C5-alkyl acrylate/(meth)acrylic acid copolymer; sodium

polystyrenesulfonate; vinyl acetate/crotonic acid/vinyl alkanoate copolymer; vinyl acetate/crotonic acid/vinyl neodecanoate copolymer; aminomethylpropanol acrylate copolymer; vinylpyrrolidone/(meth)acrylic copolymer; methyl vinyl ether/maleic monoalkyl esters copolymer; aminomethylpropanol salts of allyl methacrylate/(meth)acrylate copolymer; ethyl acrylate/methacrylic acid copolymer; vinyl acetate/mono-nbutyl maleate/isobornyl acrylate copolymer; octylacrylamid/(meth)acrylic acid copolymer; polyesters of diglycol, cyclohexanedimethanol, isophthalic acid and sulfoisophthalic acid; and mixtures thereof.

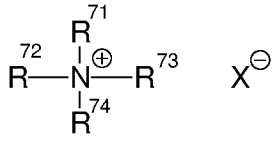
In at least one embodiment, the crosslinking composition comprises a zwitterionic or amphoteric hairstyling polymer. In at least one embodiment, the zwitterionic or amphoteric hairstyling polymer is selected from the group consisting of: alkylacrylamide/alkylaminoalkyl methacrylate/(meth)acrylic acid copolymers; copolymers which are formed from at least one first monomer type which has quaternary amine groups, and at least one second monomer type which has acid groups; copolymers of fatty alcohol acrylates, of alkylamine oxide methacrylate and at least one monomer chosen from acrylic acid and methacrylic acid; methacryloylethylbetaine/methacrylic acid and/or esters copolymers; polyquaternium-47; polyquaternium-43; oligomers or polymers, preparable from quaternary croton betaines or quaternary croton betaine esters; or mixtures thereof.

In at least one embodiment, the crosslinking composition comprises a cationic hairstyling polymer. In at least one embodiment, the cationic hairstyling polymer is selected from the group consisting of homopolymers or copolymers where a quaternary nitrogen groups are present either in the polymer chain or as substituent on one or more of the cationic monomers. The monomers containing ammonium groups may be copolymerized with non-cationic monomers. Suitable cationic monomers may be unsaturated, free-radically polymerizable compounds which carry at least one cationic group, in particular ammonium-substituted vinyl monomers, such as, for example, trialkylmethacryloxyalkylammonium, trialkylacryloxyalkylammonium, dialkyldiallylammonium and quaternary vinylammonium monomers with cyclic, cationic nitrogen-containing groups, such as pyridinium, imidazolium or quaternary pyrrolidones, e.g. alkylvinylimidazolium, alkylvinylpyridinium, or alkylvinylpyrrolidone salts. The alkyl groups of these monomers are preferably lower alkyl groups, such as, for example, C1 to C7-alkyl groups, particularly preferably C1 to C3-alkyl groups. Suitable non-cationic monomers may be selected from (meth)acrylamide, derivatives thereof; acrylate, its derivative thereof; vinylcaprolactone, vinylcaprolactam, vinylpyrrolidone, vinyl esters, vinyl alcohol, propylene glycol or ethylene glycol. For example, suitable cationic hairstyling polymers are available under the tradenames Gafquat 755 N; Gafquat 734; Gafquat HS 100; Luviquat HM 550; Merquat Plus 3300; Gaffix

VC 713; Aquaflex SF 40. In at least one embodiment, the crosslinking composition comprises a cationic hairstyling polymer derived from a natural polymer. In at least one embodiment, the cationic hairstyling polymer derived from a natural polymer is derived from a natural polymer selected from the group consisting of: cationic derivatives polysaccharides such as cellulose, starch and/or guar; chitosan, its salts, and/or its derivatives; or mixtures thereof. In at least one embodiment, the cationic hairstyling polymers are selected from the group consisting of: polyquaternium-4; polyquaternium-10; polyquaternium-24; guar hydroxypropyltrimonium chloride; chitosonium pyrrolidonecarboxylate; and mixtures thereof.

In at least one embodiment, the crosslinking composition comprises a conditioning agent, or a hair conditioning agent. The crosslinking composition may comprise any suitable and conventional hair conditioning agents. The term "hair conditioning agent" herein means any cosmetically acceptable compound having a cosmetic effect on hair, such as providing gloss to hair, making hair more manageable, improving hair touch, improving combability and/or giving hair more volume. Suitable hair conditioning agents may be found in the CTFA International Cosmetics Ingredient Dictionary and Handbook, "Hair conditioning agents", 12th edition (2008). In at least one embodiment, the hair conditioning agent is selected from the group consisting of: cationic surfactants, non-ionic surfactants, silicone compounds, organic oily conditioning agents, and mixtures thereof. Suitable hair conditioning agents are, for example, those materials disclosed from page 19, line 3 to page 27, line 33 of the European patent application 08151246.9 filed on 11 February 2008, which is incorporated herein by reference.

In at least one embodiment, the conditioning agent is a cationic surfactant. In at least one embodiment, the cationic surfactant comprises amino or quaternary ammonium moieties. In at least one embodiment, the crosslinking composition comprises from about 0.05% to about 3.5%, or from about 0.1% to about 3.0%, or from about 0.5% to about 2.5%, or from about 1.0% to about 2.0% cationic surfactant. In at least one embodiment, cationic surfactant is according to Formula II:



II

wherein at least one of R^{71}, R^{72}, R^{73} and R^{74} is selected from: an aliphatic group of from 8 to 30 carbon atoms; an aromatic, alkoxy, polyoxyalkylene, alkylamido, hydroxyalkyl, aryl; or an alkylaryl group having from 7 to 22 carbon atoms; wherein the remainder of R^{71}, R^{72}, R^{73} and R^{74} are independently selected from the group consisting of: an aliphatic group consisting of from 1 to 22 carbon atoms; and an aromatic, alkoxy, polyoxyalkylene, alkylamido, hydroxyalkyl, aryl or

alkylaryl group having up to 22 carbon atoms; wherein X is selected from the group consisting of: halogen, acetate, citrate, lactate, glycolate, phosphate, nitrate, sulfonate, sulfate, alkylsulfate, alkyl sulfonate radicals, and mixtures thereof. In at least one embodiment, cationic surfactant is according to Formula II (see above), wherein at least one of R^{71}, R^{72}, R^{73} and R^{74} is an aliphatic group having from 16 to 24 carbon atoms; wherein the remainder of R^{71}, R^{72}, R^{73} and R^{74} are independently selected from the group consisting of aliphatic groups having from 1 to 4 carbon atoms; wherein X is selected from the group consisting of: chloride or sulfate. In at least one embodiment, the cationic surfactant is selected from the group consisting of: behenyltrimethylammonium chloride, methyl sulfate or ethyl sulfate; stearyltrimethylammonium chloride, methyl sulfate or ethyl sulfate; and mixtures thereof. It is believed that a longer alkyl group provides improved smoothness and soft feeling on wet and dry hair, compared to cationic surfactants with a shorter alkyl group. It is also believed that such cationic surfactants can provide reduced scalp irritation, compared to those having a shorter alkyl group. In at least one embodiment, the cationic surfactant is a di-long alkyl quaternized ammonium salt selected from the group consisting of: dialkyl (14-18 carbons) dimethyl ammonium chloride, ditallow alkyl dimethyl ammonium chloride, dihydrogenated tallow alkyl dimethyl ammonium chloride, distearyl dimethyl ammonium chloride, dicetyl dimethyl ammonium chloride, and mixtures thereof. In at least one embodiment, the cationic surfactant is a tertiary amidoamine having an alkyl group of from about 12 to about 22 carbons. In at least one embodiment, the cationic surfactant is selected from the group consisting of: cetyl trimethyl ammonium salts; behenyl trimethyl ammonium salts; dimethyl ditallow ammonium salts; stearyl amidopropyl dimethylamine; (di)esterquats; quaternium 8, 14, 15, 18, 22, 24, 26, 27, 30, 33, 37, 53, 60, 61, 72, 78, 80, 81, 82, 83, 84, and/or 91; or mixtures thereof.

In at least one embodiment, the conditioning agent is a non-ionic surfactant. Suitable non-ionic surfactants may be surfactants having a HLB of less than 8. Suitable nonionic surfactants may be selected from glyceryl esters; sugar esters; alkylpolyglucoside ethers; oleyl- or isostearylpolyglucoside; polyoxyethylene (20) sorbitan monostearate; or mixtures thereof.

In at least one embodiment, the conditioning agent is a silicone compound. In at least one embodiment, the silicone compound is volatile or nonvolatile, and/or soluble or insoluble silicones. For example, suitable silicone conditioning agents are available under the tradenames SF 1075 methyl phenyl fluid (Electric company); DC200 Fluid, DC244, DC245, DC345, Dow 5-7113, DC556 Cosmetic Grade Fluid, DC1248 (Dow Corning). In at least one embodiment, the crosslinking composition comprises a conditioning agent being the reaction product of: (a) an aminosilane; (b); polysiloxane; and optionally (c) a polyether. In at least one embodiment, the

crosslinking composition comprises a conditioning agent being the reaction product of: (a) an aminosilane; (b); polysiloxane; and (c) a polyether. In at least one embodiment, the crosslinking composition comprises a conditioning agent, and wherein the conditioning agent is selected from the group consisting of: epoxyaminosilane copolymers, and polysiloxane/polyurea block copolymers, and mixtures thereof. In at least one embodiment, the crosslinking composition comprises a conditioning agent being the reaction product of: (a) an aminosilane; (b) polysiloxane; and (c) a polyether; and optionally (d) an amine. In at least one embodiment, the polysiloxane is an epoxy encapped polysiloxane. In at least one embodiment, the polysiloxane comprises at least two oxirane or oxetane groups. In at least one embodiment, the polysiloxane comprises from about 10 to about 450 silicon atoms, or from about 40 to about 400 silicon atoms, from about 75 to about 350 silicon atoms, from about 150 to about 250 silicon atoms. In at least one embodiment, the polysiloxane is an epoxy encapped polysiloxane. In at least one embodiment, the polyether has the average structure $CH_2(O)CHCH_2O(CH_2(CH_3)CH_2O)_nCH_2CH(O)CH_2$ wherein n is an integer from 1 to 10. In at least one embodiment, the amine comprises from 1 to 10 carbon atoms, or from 2 to 5 carbon atoms. In at least one embodiment, the amine is an alkylamine that is substituted with at least one alkyl group. In at least one embodiment, the amine is selected from the group consisting of: methylamine, ethylamine, propylamine, ethanol amine, isopropylamine, butylamine, isobutylamine, hexylamine, dodecylamine, oleylamine, aniline aminopropyltrimethylsilane, aminopropyltriethylsilane, aminomorpholine, aminopropyldiethylamine benzylamine, napthylamine 3-amino-9-ethylcarbazole, 1-aminoheptaphlorohexane, 2,2,3,3,4,4,5,5,6,6,7,7,8,8,8-pentadecafluoro-1-octanamine, and mixtures thereof. In at least one embodiment, the amine is selected from the group consisting of: methylethylamine, methylhexylamine, methyloctadecylamine, diethanolamine, dibenzylamine, dihexylamine dicyclohexylamine, piperidine, pyrrolidine phthalimide, and mixtures thereof. In at least one embodiment, the conditioning agent is an epoxyaminosilane copolymer. In at least one embodiment, the conditioning agent is conditioning agent being the reaction product of: (a) an aminosilane; (b) polysiloxane, wherein the polysiloxane comprises from about 10 to about 450 silicon atoms, or from about 40 to about 400 silicon atoms; and (c) a polyether; and (d) an amine, wherein the amine is an alkylamine that is substituted with at least one alkyl group. Epoxyaminosilane copolymers are described in EP2214633B1 (filing date 30th Oct 2008, which is incorporated herein by reference) and are available from Momentive™ Performance Materials Inc., Columbus, Ohio, USA. Epoxyaminosilane copolymers have excellent durability benefits. Such an exemplary expoxyaminosilane copolymer may be synthesised as follows:

aminopropyltriisopropoxy silane (40.77g), an epoxy encapped polysiloxane with the average structure $CH_2(O)CHCH_2OCH_2CH_2Si(CH_3)_2O[Si(CH_3)_2O]_{50}Si(CH_3)_2CH_2CH_2CH_2OCH_2CH(O)CH_2$ (171.40g) and an epoxy endcapped polyether with the average structure $CH_2(O)CHCH_2O(CH_2(CH_3)CH_2O)_7CH_2CH(O)CH_2$ (37.83g) and isopropanol (425.68g) is combined in a 500 mL flask. The material is brought to reflux and stirred with an overhead stirrer. The refluxing continued for 15.5 hr until all epoxy groups are consumed as determined by titration. The material is transferred to a rotary evaporator and stripped at 70°C and 532 Pa (4 torr) for 2 hrs to remove the isopropanol. Another exemplary expoxyaminosilane copolymer may be synthesised as follows: aminopropyltriisopropoxy silane (14.27g), 3-(diethylamino)propylamine (7.05g), an epoxy encapped polysiloxane with the average structure $CH_2(O)CHCH_2OCH_2CH_2CH_2Si(CH_3)_2O[Si(CH_3)_2O]_{200}Si(CH_3)_2CH_2CH_2CH_2OCH_2CH(O)CH_2$ (447.87g) and an epoxy encapped polyether with the average structure $CH_2(O)CHCH_2O(CH_2CH_2O)_{14}CH_2CH(O)CH_2$ (30.81 g) and isopropanol (500 g) is combined in a 2000 mL flask. The material is brought to reflux and stirred with an overhead stirrer. The refluxing continued for 24 hr until all epoxy groups are consumed as determined by titration. The material is transferred to a rotary evaporator and stripped at 70°C and 532 Pa (4 torr) for 2 hrs to remove the isopropanol.

In at least one embodiment, the conditioning agent is selected from the group consisting of: epoxyaminosilane copolymers, and polysiloxane/polyurea block copolymers, and mixtures thereof. A polysiloxane/polyurea block copolymer is described in EP2074986B1 filed on 10th Dec 2008, which is incorporated herein by reference. In at least one embodiment, the polysiloxane/polyurea block copolymer comprises at least one polysiloxane sequence (or block) and at least one polyurea sequence (block) in the backbone of the copolymer. In at least one embodiment, the amount of polysiloxane present in the copolymer is greater than 90% by weight relative to the total weight of the polysiloxane/polyurea block copolymer. In at least one embodiment, the polysiloxane/polyurea block copolymer of the does not comprise polyurethane. By way of non-limiting example, the copolymer can be a non-ionic polysiloxane/polyurea copolymer, that is to say that it does not comprise an ionized or ionizable group. By way of example of a copolymer, non-limiting mention may be made of the dimethylpolysiloxane/polyurea block copolymer having the INCI name polyureadimethicone. Such a dimethylpolysiloxane/polyurea block copolymer can be obtained, for instance, by copolymerization of an α,ω-aminosilicone with a diisocyanate. Polysiloxane/polyurea block copolymers corresponding to these characteristics are, for example, the products sold under the

reference Wacker-Belsil® UD 60, Wacker-Belsil® UD 80, Wacker-Belsil® DU 140 and Wacker-Belsil® UD 200 by Wacker. In at least one embodiment, the polysiloxane/polyurea copolymer is non-ionic. In at least one embodiment, the crosslinking composition comprises from about 0.05 to about 20%, for example from 0.1 to 15%, or from 0.5 to 10% polysiloxane/polyurea block copolymer. In at least one embodiment, the conditioning agent is a polydimethylsiloxane-derivative comprising aminoalkyl groups and having an amine number of at least 0.1 meq/g of polydimethylsiloxane. Such polydimethylsiloxane-derivative can, for example, be methoxy-terminated or hydroxy-terminated, or mixtzures thereof. The polydimethylsiloxane-derivative can, for example be a mixture of methoxy- and hydroxy-terminated Poly[3-((2-aminoethyl)amino)propyl]methyl(dimethyl)siloxan as commercially sold under Wacker-Belsil® ADM 1370.

In at least one embodiment, the conditioning agent is an organic oily conditioning agent. In at least one embodiment, the organic oily conditioning agent is non-volatile, water-insoluble, oily or fatty. Organic oily conditioning agents may be selected from hydrocarbon oils and fatty esters. In at least one embodiment, the conditioning agent is a fatty alcohol. In at least one embodiment, the fatty alcohol is a non-volatile low melting point fatty alcohol. In at least one embodiment, the conditioning agent is a fatty alcohol and the fatty alcohol is selected from the group consisting of: capryl alcohol, lauryl alcohol, stearyl alcohol, cetyl alcohol, myristyl alcohol, palmitoleyl alcohol, and mixtures thereof.

The crosslinking composition may further comprise at least one direct hair dye. In at least one embodiment, the crosslinking composition comprises from about 0.01% to about 15%, or from about 0.1% to about 10 %, or from about 0.5% to about 8% direct hair dye.

The crosslinking composition may further comprise at least one viscosity-modifying agent. In at least one embodiment, the crosslinking composition comprises from about 0.01% to about 20%, or from about 0.05% to about 10%, or from about 0.1% to about 5% viscosity-modifying agent.

The crosslinking composition may further comprise at least one emulsifier and/or surfactant. In at least one embodiment, the emulsifier and/or surfactant is selected from nonionic surfactants; anionic surfactants; amphoretic surfactants; or mixtures thereof. In at least one embodiment, the crosslinking composition comprises from about 0.01% to about 20%, or from about 0.05% to about 10%, or from about 0.1% to about 5%, emulsifier and/or surfactant.

The crosslinking composition may further comprise at least one pigment. In at least one embodiment, the pigment is selected from natural pigments; synthetic pigments; or mixtures thereof. The pigments may be selected from organic pigment, inorganic pigment; or mixtures

thereof. The pigments may be selected from coloured pigments; pearlescent pigments; or mixtures thereof. Said crosslinking composition may comprise from about 0.01% to 10%, or from about 1% to about 2% pigment present in the product mass in undissolved form by weight of the total crosslinking composition. The crosslinking composition may comprise pigment materials such as inorganic, nitroso, monoazo, disazo, carotenoid, triphenyl methane, triaryl methane, xanthene, quinoline, oxazine, azine, anthraquinone, indigoid, thionindigoid, quinacridone, phthalocianine, botanical, natural colors, including: water-soluble components such as those having C.I. Names.

In at least one embodiment, the crosslinking composition comprises at least one particulate substance. In at least one embodiment, the particulate substance is selected from silica; silicates; aluminates; clay earths; mica; insoluble salts, particularly insoluble inorganic metal salts; metal oxides; minerals; insoluble polymer particles; or mixtures thereof. In at least one embodiment, the crosslinking composition comprises from about 0.01% to about 10%, or from about 0.05% to about 5% of at least one particulate substance. In at least one embodiment, the crosslinking composition is substantially free of a particulate substance such as clay.

In at least one embodiment, the crosslinking composition comprises at least one preservative. In at least one embodiment, the crosslinking composition may comprise from about 0.01% to about 5% by weight, or from about 0.05% to about 1% preservative.

A variety of additional optional ingredients may be incorporated into the crosslinking composition of the present invention. Non-limiting examples of these additional ingredients may be selected from preservatives; antioxidants; sequestering agents; solvents; fragrances & perfumes; fillers; screening agents; odour absorbers; colouring materials; lipid vesicles; detersive surfactants; thickening agents and suspending agents; viscosity modifiers; pearlescent aids; UV-filters and sunscreens; agents for combating free radicals; polyvinyl alcohol; pH adjusting agents; salts; colouring agents; polymer plasticizing agents; direct dyes; or mixtures thereof. The crosslinking composition may comprise from about 0%, or from about 0.1% to about 5% antimicrobial agents. In at least one embodiment, the crosslinking composition comprises an organic acid selected from the group consisting of: glycine, L-methionine, L-arginine, biotin, creatine, and mixtures thereof. In at least one embodiment, the crosslinking composition comprises an antidandruff agent. In at least one embodiment, the crosslinking composition comprises zinc pyrithione. In at least one embodiment, the crosslinking composition comprises panthenol. In at least one embodiment, the crosslinking composition comprises a wax compound. In at least one embodiment, the crosslinking composition comprises beeswax.

In at least one embodiment, the crosslinking composition has a viscosity, measured at

25°C, of from about 0.1 mPa·s to about 1,000,000 mPas, or from about 1 mPa·s to about 80,000 mPa·s, or from about 5 mPa·s to about 3,500 mPa·s. The viscosity is measured by HAAKE Rotation Viscometer VT 550 with cooling/heating vessel and sensor systems according to DIN 53019 (MV-DIN, SV-DIN), shear rate is 12.9 s^{-1}.

In at least one embodiment, the crosslinking composition is substantially free of: formaldehyde, derivatives of formaldehyde, methylene glycol, formalin, and any compound that produces formaldehyde upon heating. "Heating" means raising the temperature of the compound above 25°C. In at least one embodiment, the crosslinking composition comprises 0% formaldehyde. In at least one embodiment, the derivatives of formaldehyde are 1,3,5-trioxane and paraformaldehyde. In at least one embodiment, the crosslinking composition is substantially free of: formaldehyde, 1,3,5-trioxane, paraformaldehyde, methylene glycol, formalin. Formaldehyde is not preferred in view of its safety profile. Formalin is not advantageous because formalin is a derivative of formaldehyde. Formaldehyde exists in multiple forms. In water, formaldehyde becomes hydrated and forms methylene glycol. A saturated solution of formaldehyde (about 40% formaldehyde) in water is more commonly known as formalin. Methanol and/or methylene diol can be used as a stabilizer in formalin and is therefore not advantageous. In at least one embodiment, the crosslinking composition is substantially free of a quaternary ammonium compound and/or a surfactant. In at least one embodiment, the crosslinking composition is substantially free of: ceramide compound, an alpha-hydroxy acid, a thioglycolate and/or thiolactate compound, a bisulfate compound, clay, a reducing agent. In at least one embodiment, the crosslinking composition is substantially free of: ceramide compound, an alpha-hydroxy acid, a thioglycolate and/or thiolactate compound, a bisulfate compound. In at least one embodiment, the crosslinking composition is substantially free of a carbonate compound. In at least one embodiment, the crosslinking composition is substantially free of: ceramide compound, an alpha-hydroxy acid, a thioglycolate or thiolactate compound, a bisulfate compound, clay, formaldehyde, 1,3,5-trioxane, paraformaldehyde, methylene glycol, quaternary ammonium compound, surfactant.

In at least one embodiment, the crosslinking composition has a pH of from about pH 6 to about pH 11. In at least one embodiment, the crosslinking composition has a pH of from about pH 6.5 to about pH 10.75, or from about pH 7.0 to about pH 10.5, or from about pH 7.5 to about pH 10.25, or from about pH 8.0 to about pH 10.0. A basic pH is useful for sugars in view of penetration into hair. In at least one embodiment, the crosslinking composition comprises a buffering agent. In at least one embodiment, the buffering agent is a phosphate buffer. In at least one embodiment, the buffering agent is a borate buffer or a carbonate buffer. In at least one

embodiment, the buffering agent is selected from the group consisting of: glycine/sodium hydroxide; sodium carbonate/sodium hydrogen carbonate, sodium tetraborate/sodium hydroxide; sodium bicarbonate/sodium hydroxide; ammonium chloride/ammonia. The buffering agent has the advantage of controlling the pH, which aids the stability of the crosslinking composition. In at least one embodiment, the crosslinking composition comprises an alkalizing agent and/or an agent for adjusting the pH value. The crosslinking composition may further comprise a protonating agent. The protonating agent may be a monoprotic or polyprotic acid, water-soluble or water-insoluble acid, and/or an organic or inorganic acid. In at least one embodiment, the protonating agent is selected from formic acid, acetic acid, sulfuric acid, hydrochloric acid, citric acid, and mixtures thereof. In at least one embodiment, the protonating agent is citric acid. Citric acid is useful because it is naturally available from lemons.

Method

Described herein is a hair straightening and/or hair relaxing method comprising: (a) applying a crosslinking composition to hair; (b) optionally hair drying; (c) providing a hair straightening appliance at a temperature of from about 100°C to about 280°C and mechanically straightening the hair with the appliance; wherein the method does not comprise a rinsing step between step (a) and step (c). The method steps are in the order (a) then (b) then (c). In the method of the present invention, the hair care composition may be applied on wet hair and/or on dry hair.

It may not be preferred to employ a rinsing step between step (a) and step (c) because less straightening durability is observed. Indeed, it is believed that reduced penetration into the hair shaft exists when the sugar molecules are rinsed off prior to step (c).

In an embodiment, prior to step (a) the hair is washed with a shampoo, for example a cleansing shampoo. In an embodiment, following step (c) the hair is washed with a shampoo, for example a cleansing shampoo. In an embodiment, following step (c) the hair is washed with a shampoo, for example a cleansing shampoo, and subsequently conditioned with a conditioning formulation comprising a conditioning agent. Conditioning agents are disclosed herein and are suitable for this embodiment. In an embodiment, following step (c) the hair is washed with a shampoo and then conditioned with a conditioning formulation comprising a conditioning agent and then dried using a blow dryer and a brush. In an embodiment, the method comprises, prior to step a), providing hair that has already been straightened. Indeed, providing hair that has already been straightened has the advantage that the present treatment is relatively gentle and therefore highly suitable for hair that has been previously damaged by less gentle treatments. Consumers believe that where they have used e.g. a formaldehyde-based treatment previously, they cannot

use another straightening treatment until the damage has grown out/been trimmed off. This is not the case for the present invention since it offers a semi-durable and gentle, yet efficacious straightening treatment that is highly suited to hair that has already been straightened.

In an embodiment, the method relates to a hair straightening and/or hair relaxing method comprising: (a) applying a hair care composition to hair, wherein the composition comprises from about 1% to about 16% arabinose:ethylene carbonate at a weight ratio of 2:1, 1:3 or 1:6; (b) optionally hair drying; (c) providing a hair straightening appliance at a temperature of from about 100°C to about 280°C and mechanically straightening the hair with the appliance; wherein the composition is substantially free of: formaldehyde, derivatives of formaldehyde, methylene glycol, formalin, and any compound that produces formaldehyde upon heating; and wherein the composition has a pH of from about pH 6 to about pH 11; wherein the method does not comprise a rinsing step between step (a) and step (c); and wherein the method does not use any coating material; and optionally wherein the composition comprises a conditioning agent, and wherein the conditioning agent may be an epoxyaminosilane copolymer.

Applying a hair care composition to hair

The present invention relates to a hair straightening and/or hair relaxing method comprising: (a) applying a hair care composition to hair. In an embodiment, applying a hair care composition to hair involves applying onto hair from about 0.01 gram to about 5 gram of said composition per gram hair. In an embodiment, the composition is on the hair for at least 2 min, or from about 5 min to about 45 min, or from about 10 min to about 40 min, or from about 20 min to about 35 min, prior to carrying out step b) or c).

Hair drying

The hair straightening and/or hair relaxing method may optionally comprise (b) hair drying. In an embodiment, the hair drying is carried out by a blow drier. In an embodiment, the hair drying is carried out for a duration of from about 1 min to about 45 min, or from about 2 min to 20 min, or from about 5 min to 15 min. In general, following the hair drying, the hair can still be damp, but needs to have reasonable e.g. 75% hair fibre separation of the head of hair. Some residual moisture in the hair is acceptable. In an embodiment, the hair is not wetted or rinsed prior to step (c). A high level of moisture is not preferred in view of hair damage caused by steam during step (c). Thus, the hair drying step (b) provides a method with reduced hair damage versus conventional methods.

In an embodiment, the hair drying is carried out by a hood appliance. In an embodiment, the hair drying is carried out by towelling hair and/or by pressing hair with hands.

Hair dryer or blow dryer distances between device and head are typically down to about 10 cm. Blow dryers direct hot air through some sort of attachment for combing or otherwise treating the hair. A blow dryer is typically used such that the distance to the hair (for example at a distance of 20 or 30 or 40 centimetres) and often is used with the aid of a comb or a brush. In an embodiment, the hair drying is carried out by a blow drier at a temperature of from about from 50°C to about 100°C. In an embodiment, the hair drying is carried out by a blow drier at a temperature of up to 130°C. In an embodiment, the hair drying (b) is carried out with a blow drier with brushing to help straightening the hair.

Providing a hair straightening appliance and mechanically straightening the hair

The hair straightening and/or hair relaxing method comprises (c) providing a hair straightening appliance at a temperature of from about 100°C to about 280°C and mechanically straightening the hair with the appliance. In an embodiment, the temperature is from about 110°C to about 250°C, or from about 120°C to about 240°C, or from about 140°C to about 230°C, or from about 160°C to about 220°C, or from about 180°C to about 210°C, or from about 190°C to about 200°C.

In an embodiment, the hair straightening appliance comprises metal or ceramic plates. In an embodiment, the metal or ceramic plates are provided to a temperature of from about 100°C to about 280°C. In an embodiment, the metal or ceramic plates are provided to a temperature of from about 110°C to about 250°C, or from about 120°C to about 240°C, or from about 140°C to about 230°C, or from about 160°C to about 220°C, or from about 180°C to about 210°C, or from about 190°C to about 200°C.

In an embodiment, the 'mechanically straightening the hair with the appliance' is carried out for a duration of from about 1 min to about 45 min, or from about 2 min to 20 min, or from about 5 min to 15 min. In an embodiment, the 'mechanically straightening the hair with the appliance' is carried out for a duration of for at least 10 min, or for at least 12 min.

In an embodiment, the 'mechanically straightening the hair with the appliance' is carried out by a hair straightening appliance. In an embodiment, the hair straightening appliance comprises metal or ceramic plates. In an embodiment, the hair straightening appliance is a pair of straightening irons. Hair straightening appliances comprising metal or ceramic plates, such straightening irons typically rely on resistive heating, but heat is not transported through hot air, but by direct contact of the plates with the keratin fibres. The direct contact is often made by bringing the hair in contact with some metal or ceramic surface of the appliance. These devices typically are not or at least not primarily used to dry the hair. Rather are they used to change the hair style, typically either to create curls or to straighten hair. The surfaces meant for hair contact

(e.g. metal or ceramic plates) of these devices typically reach temperatures from 130°C to 250°C. Most devices have metal or ceramic plates used with temperatures from 160°C to 230°C.

US5,612,849 and US6,191,930, which are incorporated herein by reference, disclose a heat generating hair care appliance in the form of a hot air hair care appliance. The respective devices are typically referred to as hair dryers or blow dryers. USD383245, which is incorporated herein by reference, discloses another heat generating hair care appliance in the form of a hot air hair care appliance. The respective devices are typically referred to as hot air stylers or hair stylers. US2008/0196739, which is incorporated herein by reference, discloses a heat generating hair care appliance in the form of a hot surface hair care appliance, typically referred to as a straightening irons.

In an embodiment, method (a) to (c) is repeated at least 3 times at a frequency of at least once every 48 hours. All the description in relation to the other aspects is suitable for and combinable with this aspect as well. In an embodiment, the complete method (a) to (c) is repeated at least 2 times at a frequency of at least once every 24 hours. In an embodiment, the complete method (a) to (c) is repeated at least 5 times at a frequency of at least once every 48 hours, or once every 24 hours.

In an embodiment, method (a) to (c) is repeated from 2 to 5 times per week on an ongoing basis for the purpose of controlling frizz.

In an embodiment, the crosslinking composition may comprise a first, second, and third crosslinking agent. The first crosslinking agent may be arabinose, the second may be ethylene carbonate, and the third crosslinking agent may be 1,2-bis(2-maleimidoethoxy)ethane (CAS#115597-84-7).

In an embodiment, the crosslinking composition may comprise:

- from about 4% to about % 20% arabinose:ethylene carbonate, wherein arabinose:ethylene carbonate is present at a weight ratio of 1:3, 1:6 or 2:1;
- optionally, a buffering agent;
- a cosmetically acceptable carrier;
- a conditioning agent being the reaction product of: (a) an aminosilane; (b); polysiloxane; and optionally (c) a polyether;

and wherein the composition has a pH of from about pH 6 to about pH 11.

In an embodiment, the formulation is for curling and/or perming hair. In an embodiment, the formulation is for shaping hair. In an embodiment, the formulation comprises from about 0.1% to about 15%, or from about 1% to about 10%, or from about 2% to about 5% conditioning agent being the reaction product of: (a) an aminosilane; (b); polysiloxane; and optionally (c) a

polyether. In an embodiment, the conditioning agent is the reaction product of: (a) an aminosilane; (b); polysiloxane; (c) a polyether.

In an embodiment, a kit may comprise: (i) a crosslinking composition; (ii) a heating device comprising a flat iron. In an embodiment, the kit may be for perming and/or curling hair. In an embodiment, the kit may be for semi-permanent shaping of hair.

In an embodiment, the crosslinking agent may be used for straightening and/or shaping hair. In an embodiment, the crosslinking composition may be used for curling and/or perming hair.

EXAMPLES

The following examples further describe and demonstrate embodiments within the scope of the present invention. The examples are given solely for the purpose of illustration, and are not to be construed as limitations of the present invention since many variations thereof are possible without departing from its scope.

Example compositions

Liquid A: 10 g arabinose, 5 g ethylene carbonate, 2 g epoxyaminosilane copolymer, QSP water

Liquid B: 5 g arabinose, 15 g ethylene carbonate, 1 g epoxyaminosilane copolymer, 0.1 g NaOH, QSP water.

Liquid C: 8 g arabinose, 4 g ethylene carbonate, 2 g epoxyaminosilane copolymer, pH10 buffer (buffer is borate or carbonate), QSP water.

Liquid gel: 3 g arabinose, 9 g ethylene carbonate; 1.00 g Luviset Clear, 1.50 g surfactant 193, 0.30 g Carbomer, 0.30g aminomethylpropanol (aka AMP) 95%, 0.20g Emulgin L, 0.15g perfume, 0.40g Natrosol G, 16.50 g ethanol, QSP water.

Rapid Drying Gel:10 g arabinose, 5 g ethylene carbonate, 1.00 g Luviset Clear, 1.80 g Polyvinylpyrrolidone K 90; 1.00 g direct dye; 1.50 g surfactant 193; 1.00 g Synthalen W 2000; 0.30g AMP (95%); 0.30 g PEG-25 PABA (Uvinul P 25); 0.15 g Panthenol; 0.30 g perfume; 34.20 g ethanol; 0.10g keratin hydrolysate; QSP water.

Pump, setting foam: 6 g arabinose, 18 g ethylene carbonate, 1.80g Luviset Clear, 1.90 g direct dye, 0.40 g Cocamidopropyl Hydroxysultaine, 0.10 g Rosemary leaf extract (Extrapon Rosemary), 8.90 g ethanol, 0.10 g Extrapon seven herbs – extract, 0.10 g Panthenyl ethyl ether, 0.15 g Perfume, QSP water. The composition is packaged in a packaging with mechanically operated pump foaming device.

Aerosol - setting foam - extra strong hold: 14 g arabinose, 7 g ethylene carbonate, 2.10 g Luviset Clear, 0.60 g Vinyl acetate/crotonic acid copolymer, 0.50g Polyquaternium-7, 4.00g butane, 4.00g propane, 8.90g ethanol 510, 0.40 g PEG-25 PABA, 0.20 g Panthenol, 0.20 g perfume, 0.20

g Laureth-4, 0.07 g C9-C11 Pareth-8, QSP 100.00g water. The composition is bottled in an aerosol can with foaming head.

Setting spray: 8 g arabinose, 24 g ethylene carbonate, 1.00g Luviset Clear, 0.65 g Octylacrylamide/Acrylates/Butylaminoethylmethacrylate Copolymer (Amphomer), 0.20 g Celquat L200, 28.5 g ethanol, 0.60 g aminomethylpropanol 95%, 0.25 g perfume, 0.20 g Cetyltrimethylammonium chloride, QSP 60.00 g water. The composition is bottled in a packaging with pump spray device.

Rinse-out conditioner: 16 g arabinose, 8 g ethylene carbonate, 1.00 g cetyltrimethyl ammonium chloride, 1.00 g polymethylphenyl siloxane, 0.40 g phenoxy ethanol, 0.20 g PHB-methylester, 1.00 g Dow Corning 949 Cationic Emulsion®, 5.00 g isododecane, 0.40 g perfume oil, QSP water.

Rinse-out Conditioner: 18g arabinose, 9 g ethylene carbonate, 1.00 g cetyltrimethyl ammonium chloride, 1.00 g polymethylphenyl siloxane, 0.40 g phenoxyethanol, 0.20 g PHB-methylester, 8.00 g Dow Corning 57113 Cationic Emulsion®, 5.00 g isododecane, 0.40 g perfume oil, QSP water.

Leave-in Conditioner: 6 g arabinose, 3 g ethylene carbonate, 1.00 g cetyltrimethyl ammonium chloride, 1.00 g polymethylphenyl siloxane, 0.40 g phenoxy ethanol, 0.20 g PHB-methylester, 8.00 g Momentive™ Cationic Emulsion®, 5.00 g isododecane, 0.40 g perfume oil, QSP water.

Leave-in Conditioner: 10g arabinose, 5 g ethylene carbonate, 0.10 g vitamin E-acetate, 0.50 g polymethylphenyl siloxane, 10.00 g propylene glycol, 0.50 g behenyl trimethylammonium chloride, 0.05 g sodium chloride, 0.30 g d-panthenol, 0.30 g PHB-propylester, 2.00 g isododecane, 0.20 g perfume oil, QSP water.

Shampoo: 5 g arabinose, 15 g ethylene carbonate, 0.20 g Jaguar C-162, 40.00 g sodium laureth sulfate (LES 28%), 5.00 g Cocamidopropyl betaine, 2.00 g Dow Corning 200 Fluid/350 CS, 0.15 g perfume, QSP water.

*(examples include a total of 9-32g arabinose:ethylene carbonate at 2:1, 1:3 or 1:6 ratio)

Further compositions disclosed in the European patent application 08151246.9 filed on 11 February 2008 referenced as examples 2 to 7, 9 to 17, 19 to 21, 23, 24, 26 to 35, 37, 39 to 45, and 46 -- which are incorporated herewith by reference – are also suitable as a chassis for the composition according to the present invention.

The trade names/raw materials used in the examples are: Abilquat 3270 (Quaternium-80, 50% in propylene glycol) from Goldschmidt; Aculyn 48 (PEG-150/stearyl alcohol/SMDI copolymer, 19% in water) from Rohm and Haas; AMP 95% (aminomethylpropanol, 95% aqueous solution); Amphomer (octylacrylamide/acrylates/butylaminoethylmethacrylate

copolymer); Aristoflex AVC (Ammonium Acryloyldimethyltaurate/VP copolymer); Aquaflex FX-64 (isobutylene/ethylmaleimide/hydroxyethylmaleimide copolymer, 40% strength in water/ethanol) from ISP; Aquaflex SF 40 (VP/vinyl caprolactam//DMAPA acrylates copolymer, 40% in ethanol) from ISP; Advantage S (vinyl caprolactam/VP/dimethylaminoethyl methacrylate copolymer); Carbomer – Carbopol (acrylic acid homopolmer); Celquat L200 (copolymer of hydroxyethylcellulose and diallyldimethylammonium chloride; Polyquaternium-4); GENAMIN CTAC 50 (cetrimonium chloride; cetyltrimethylammonium chloride); Copolymer 845 (VP/Ddimethylaminoethylmethacrylate copolymer, 20% in water) from ISP; Dehydol LS 4 (Lauryl alcohol tetraoxyethylen ether); Dekaben LMB (iodopropynyl butylcarbamate, 10% strength in butylene glycol); Dekaben LMP (Phenoxyethanol and iodopropynyl butylcarbamate); Diaformer Z-711 (acrylates/lauryl acrylate/stearyl acrylate/ethylamine oxide methacrylate copolymer, 40%) from Clariant; Dow Corning 1401 (High molecular weight Dimethiconol, 13% in cyclomethicone); Eumulgin L (PEG-1-PEG-9 lauryl glycol ether; Flexan (Sodium polystyrenesulfonate); GAFQUAT 755 N (Polyquaternium-11); Jaguar C-17/162 (guar hydroxylpropyltrimonium chloride) Laureth-4 (Lauryl alcohol tetraoxyethylen ether); Luviset Clear (Terpolymer of vinylpyrrolidone, methacrylamide and vinylimidazole) from BASF; Luviskol VA 64 (vinylpyrrolidone/vinylacetate copolymer); Luviskol K 90 Powder (vinylpyrrolidone); Luvimer 100 P (t-butyl acrylate/ethyl acrylate/methacrylic acid copolymer); Natrosol G (hydroxyethylcellulose); Pemulen (acrylates/C10-30 alkyl acrylate crosspolymer); Structure 3001 (acrylates/ceteth-20 itaconate copolymer, 30% strength in water) from National Starch; Surfactant 193 (Ethoxylated dimethylpolysiloxane) from Dow Corning); Synthalen W 2000 (acrylates/palmeth-25 acrylate copolymer, 31% in water); Tego Betain L 5045 (cocamidopropyl betaine).

Data

The hair straightening efficacy is tested for the crosslinking compositions of the present invention. Switches of low lift naturally curly hair are employed. These are shampooed with a Pantene clarifying shampoo to ensure the hair is in a clean state with no residues that could affect the end result. The switches are then rinsed. Excess water is removed from the hair by wringing out the switches. The switches are treated with a crosslinking composition; which comprises: active agents as listed in TABLE 1; QSP water buffered at pH 10. These ingredients are mixed on a spinner plate for 30 mins. 0.5 g of crosslinking composition per 1 g hair is employed. The crosslinking composition is left on the hair for 30 minutes. After this time, the hair is blow dried and brushed. The switches are then mechanically straightened with a flat iron (at 450°F [232°C] with 8 passes.

The switches are then imaged. To simulate durability, the switches are then given one wash-and-dry cycle. One wash-and-dry cycle involves shampooing with a Hairtrition shampoo (Hairtrition Color Protect sulfate-free shampoo from Zotos), rinsing and then drying in a hot box. Once dry the switches are imaged again. The switches are then given 9 further wash-and-dry cycles. Once dry the switches are imaged again. An expert grader gives the images of the switches a score on a 0-10 scale. The scale is a standard scale set as curly hair having 4-5 nodes of curls is a score of 0 and very straight hair is a 10. Thus, the switches are compared to a normal state of hair. Using an expert grader is reliable because the grader is trained on measuring/scaling the configuration of the hair from straight to curly in a consistent way. Numeric data obtained by this method is averaged, and statistical analysis is conducted using JMP statistical software available from the SAS Institute at the 90% confidence level. Treatments not containing the same significance grouping letter are significantly different. For example, the 10% arabinose + 10% ethylene carbonate and the 5% arabinose + 10% ethylene carbonate treatments contain the letter "C" for their significance grouping, and are not considered to be significantly different from each other.

Table 1. Straightening efficacy results after 10 wash cycles

Treatment	Significance grouping	Straightening efficacy Mean grade
10% arabinose + 5% ethylene carbonate	A	6.33
2.5% arabinose + 15% ethylene carbonate	A	5.67
5% arabinose + 15% ethylene carbonate	B	5.33
10% arabinose + 10% ethylene carbonate	C	4.33
15% arabinose + 15% ethylene carbonate	C	4.33
5% arabinose + 10% ethylene carbonate	C	4.33
5% arabinose + 5% ethylene carbonate	C	4.33
10% arabinose + 15% ethylene carbonate	D	3.33
15% arabinose + 10% ethylene carbonate	D	3.00
15% arabinose + 5% ethylene carbonate	D	3.00

As can be seen in Table 1, significance groupings "C" and "D" while being significantly different, also have the lowest straightening efficacy. However, the compostions with an arabinose: ethylene carbonate ratio of 2:1, 1:3, and 1:6 (significance groupings A and B) have the

highest straightening efficacy after 10 washes and are significantly different from the other treatments.

In relation to eyelashes as keratin fibres, the following procedure may be carried out: the eyelashes used are artificial eyelashes that are made from scalp hair glued to a bar and artificially shaped and dried to look like eyelashes. The eyelashes are bent out of shape. Firstly the eyelashes are washed with a clarifying shampoo to get them clean and remove any residue. The eyelashes are soaked in one of the crosslinking compositions comprising either: treatment A) 10g arabinose, 5 g ethylene carbonate, QSP water buffered at pH 10; or treatment B) 5g arabinose, 15 g ethylene carbonate, QSP water buffered at pH 10. The eyelashes are submerged overnight in the crosslinking composition. Afterwards, the eyelashes are shaped, for example by pulling the lashes straight with tweezers or by curling them. The eyelashes are wiped with an Olay facial wipe to simulate a consumer washing step. The eyelashes are then further wiped with Olay facial wipes to simulate a further consumer washing steps. The eyelashes are imaged at various points in the process.

The dimensions and values disclosed herein are not to be understood as being strictly limited to the exact numerical values recited. Instead, unless otherwise specified, each such dimension is intended to mean both the recited value and a functionally equivalent range surrounding that value. For example, a dimension disclosed as “40 mm” is intended to mean “about 40 mm.”

Every document cited herein, including any cross referenced or related patent or patent publication, is hereby incorporated herein by reference in its entirety unless expressly excluded or otherwise limited. The citation of any document is not an admission that it is prior art with respect to any document disclosed or claimed herein or that it alone, or in any combination with any other reference or references, teaches, suggests or discloses any such embodiment. Further, to the extent that any meaning or definition of a term in this document conflicts with any meaning or definition of the same term in a document incorporated by reference, the meaning or definition assigned to that term in this document shall govern.

While particular embodiments have been illustrated and described herein, it should be understood that various other changes and modifications may be made without departing from the spirit and scope of the claimed subject matter. Moreover, although various aspects of the claimed subject matter have been described herein, such aspects need not be utilized in combination. It is therefore intended that the appended claims cover all such changes and modifications that are within the scope of the claimed subject matter.

CLAIMS

What is claimed is:

1. A method for shaping keratin fibres comprising:
   (a) providing a crosslinking composition, wherein the crosslinking composition comprises:
      – ethylene carbonate;
      – arabinose; and
      – a cosmetically acceptable carrier;
   (b) applying the crosslinking composition to keratin fibres; and
   (c) mechanically shaping the keratin fibres with an appliance at a temperature of from 50°C to 250°C.

2. The method according to Claim 1, wherein the mechanical shaping of keratin fibres is selected from the group consisting of: straightening keratin fibres, such as human scalp hair, and curling keratin fibres, such as human scalp hair or human eyelashes.

3. The method according to Claim 1 or 2, wherein the crosslinking composition comprises from 1% to 13% arabinose, more preferably from 4% to 6% arabinose, by weight of the crosslinking composition.

4. The method according to any preceding claim, wherein the crosslinking composition comprises from 9% to 11% arabinose, by weight of the crosslinking composition.

5. The method according to any preceding claim, wherein the crosslinking composition comprises from 1.5% to 3.5% arabinose, by weight of the crosslinking composition.

6. The method according to any preceding claim, wherein the crosslinking composition comprises from 2% to 18% ethylene carbonate, more preferably from 4% to 6% ethylene carbonate, by weight of the crosslinking composition.

7. The method according to any preceding claim, wherein the crosslinking composition comprises from 14% to 16% ethylene carbonate, by weight of the crosslinking composition.

8. The method according to any preceding claim, wherein the arabinose and the ethylene carbonate have a weight ratio of from 7:4 to 9:4, more preferably of 2:1.

9. The method according to any preceding claim, wherein the arabinose and the ethylene carbonate have a weight ratio of from 3:12 to 5:12, more preferably of 1:3.

10. The method according to any preceding claim, wherein the arabinose and the ethylene carbonate have a weight ratio of from 1:12 to 3:12, more preferably of 1:6.

11. The method according to any preceding claim, wherein the crosslinking composition comprises a conditioning agent being the reaction product of an aminosilane and a polysiloxane.

12. The method according to any preceding claim, wherein the crosslinking composition is substantially free of the group consisting of formaldehyde, derivatives of formaldehyde, formalin, and any compound that produces formaldehyde upon heating.

13. The method according to any preceding claim, wherein the method does not comprise a rinsing step.

14. The method according to any preceding claim, wherein the crosslinking composition further comprises 1,2-bis(2-maleimidoethoxy)ethane.

15. A crosslinking composition for shaping keratin fibres comprising:
    (a) ethylene carbonate;
    (b) arabinose; and
    (c) a cosmetically acceptable carrier;
    wherein the arabinose and the ethylene carbonate have a weight ratio of 2:1, 1:3, or 1:6 arabinose:ethylene carbonate.

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2015/065673

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61Q5/06 A61K8/37 A61K8/49 A61K8/60
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61Q A61K

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data, BIOSIS, CHEM ABS Data, EMBASE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	WO 2014/123805 A1 (LUBRIZOL ADVANCED MAT INC [US]) 14 August 2014 (2014-08-14) paragraph [0144] - paragraph [0150] claims	1-7, 11-14 8-10,15
Y A	JP 2001 302460 A (POLA CHEM IND INC) 31 October 2001 (2001-10-31) paragraph [0003] claims	1-7, 11-14 8-10,15
X,P	WO 2015/094760 A1 (PROCTER & GAMBLE [US]) 25 June 2015 (2015-06-25) claims	1-15

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"P" document published prior to the international filing date but later than the priority date claimed

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

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
2 March 2016	10/03/2016

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2015/065673

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