(54) Title: SYSTEM AND METHOD FOR STRAIGHTENING OR SHAPING HAIR

(57) Abstract: Disclosed are systems and methods of straightening or shaping (e.g., curling or waving) hair, comprising: a) applying an aqueous reducing composition to the hair, comprising an effective amount of a consumable reducing agent, a first amino acid, and a first C2-C10 carboxylic acid; b) applying an aqueous fixing composition to the rinsed hair, wherein the fixing composition comprises a second amino acid, a second C2-C10 carboxylic acid, and a hair conditioning agent, wherein the first and second amino acids and the first and second C2-C10 carboxylic acids may be the same or different; and c) straightening or shaping the hair.
CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of the filing dates of United States Provisional Patent Applications No. 61/402,086, filed August 23, 2010, and No. 61/379,498, filed September 2, 2010, the disclosures of which are hereby incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] Human hair has many textures, from fine to coarse, from straight to curly, and from frizzy to non-frizzy. Hair is made of keratin which in turn is made of polypeptide chains bonded together by cysteine (or disulfide) bonds, hydrogen bonds and salt linkages. Curly hair is made of hair strands that have irregular surfaces that mesh and tangle with each other to make combing more difficult. Among individuals with very curly hair, it is especially popular to relax or straighten hair to increase hair manageability and ease of styling. Threads are composed of proteins of spiral structures, linked by sulfur bonds which are responsible for the hair structure. In order to straighten hair, these bonds must be broken. In general, hair straightening methods (also known as relaxing methods) entail chemical disruption of disulfide bonds by subjecting the hair to a very high pH, which typically involves application of a strong hydroxide base, combined with mechanical straightening of the hair (e.g., by combing). The straightening process is generally terminated by rinsing and/or the application of a neutralizing composition.

[0003] Permanent hair straightening systems are designed with the primary goals of achieving a balance in terms of performance (the desired straightening) while minimizing skin irritation, hair damage and discoloration. For persons having a "fine" type of hair, this can be achieved relatively easily. However, for persons having "normal" and especially "coarse to resistant"
hair, generally longer treatment (contact) times or greater concentrations of alkaline material or both are needed to effect permanent hair straightening. It is generally recognized in the hair straightening art that prolonged exposure (contact) of hair to the types of conditions and ingredients required for permanent hair straightening increases the possibilities of irritating the scalp and hair line skin, of weakening the strength of the treated hair, and of hair discoloration. Thus, even though the extent of permanent hair straightening tends to improve in direct proportion to increased alkalinity and treatment (contact) time, so does the advent or likelihood of these adverse, undesired problems. To avoid or minimize such problems, it is common to limit the treatment time to about 30 minutes, which compromises the hair straightening effect.

[0004] There are numerous commercially available methods to straighten or relax wavy, curly, kinky or frizzy hair. Some of these methods are relatively old and have existed in some fashion for many years. The most effective of these methods generally use harsh chemicals, including strong bases such as sodium hydroxide (also known as lye) and potassium hydroxide. Strong bases are formulated at a pH greater than 13.2, a level that is caustic and corrosive to unprotected skin or scalp even with exposure times of as short as 15 minutes. Lye-based products are also known to be very damaging to the hair, causing breakage and discoloration, as well as the general lack of desirable physical appearance, leaving the hair feeling rough and unconditioned. Other strong inorganic bases have been used in place of sodium hydroxide. For example, lithium hydroxide can be formulated at a slightly lower pH and therefore is more comfortable and can be applied for longer periods of time. However, the compromise is that lithium hydroxide is not nearly as efficient as sodium hydroxide in obtaining appropriate degrees of hair straightening.
Other methods for straightening hair, including the so-called Japanese and Brazilian methods are relatively new on the market. The Japanese treatment employs lye and the same types of harsh chemicals that have been used in hair care for many decades. The Brazilian hair treatment, at least in some versions, uses high levels of formalin. Upon exposure to the heat generated from a blow dryer or hot iron, formalin is converted to gaseous formaldehyde, which is known to irritate the respiratory tract as well as cause other health issues.

BRIEF SUMMARY OF THE INVENTION

Applicants' invention is directed to a uniquely blended hair straightening or shaping system and method that achieves high-level performance in terms of hair straightening or shaping effect while avoiding many of the disadvantages associated with current techniques. To break the disulfide bonds in hair, the present invention employs a reducing composition that contains a consumable or food-grade reducing agent that unlike strong bases, may be formulated at a relatively mild pH and applied to hair without causing caustic side effects. The present invention also entails use of a fixing composition. Both the reducing composition and the fixing composition contain two different kinds of small molecules, namely an amino acid and an aliphatic acid. Without intending to be bound by any particular theory of operation, it is believed that these small molecules penetrate the hair shafts, locking in moisture and providing enhanced protection against the heat treatment. The consecutive application of these hair care ingredients via the two compositions results in even deeper penetration into the hair shafts, allowing more time for re-linking of the broken disulfide bonds. The overall performance achieves a hair straightening or shaping effect that may last for at least several weeks, even with daily shampooing, while substantially minimizing damage to hair and scalp.
Accordingly, a first aspect of the present invention is directed to a method of straightening or shaping hair, comprising:

a) applying an aqueous reducing composition to the hair, comprising an effective amount of a consumable reducing agent, a first amino acid, and a first C2-C10 carboxylic acid;

b) applying an aqueous fixing composition to the hair, wherein the fixing composition comprises a second amino acid, a second C2-C10 carboxylic acid, and optionally, a hair conditioning agent, wherein the first and second amino acids and the first and second C2-C10 carboxylic acids may be the same or different; and

c) straightening or shaping the hair.

The method may involve additional steps. For example, in some embodiments, the hair is shampooed, at least once, prior to application of the reducing composition. The hair may be rinsed, e.g., after application of the reducing composition, after application of the fixing composition, or after the application of the reducing composition and after the application of the fixing composition. The hair may be at least partially (e.g., at least about 50% to about 90%) dried prior to straightening. The hair may be completed dried, e.g., following hair straightening. In other embodiments, a conditioning composition e.g., crème, is applied to the hair following the straightening step.

The order of the application of the aqueous fixing composition and the straightening, as well as the rinsing and partial drying (when those steps are utilized) may be varied. For example, following step a), the hair may be partially dried (e.g., via blow dryer) and then straightened, followed by application of the fixing composition, and then rinsing. In other embodiments, following step a), the hair may be rinsed followed by application of the fixing composition and another rinsing, followed by partial drying (e.g., via blow dryer) and
then straightening. In yet other embodiments, following step a), the fixing composition is applied, followed by rinsing, and then partial drying (e.g., via blow dryer) and then straightening. In some embodiments, straightening is conducted by at least one round of hot iron treatment, typically about 4 to about 10 rounds.

[0010] A second aspect of the present invention is directed to a multi-component system for straightening or shaping hair, comprising a package which includes separate first and second containers (or a single container with two separate chambers), wherein the first container comprises an aqueous reducing composition comprising an effective amount of a consumable reducing agent, a first amino acid, and a first C2-C10 carboxylic acid; and wherein the second container comprises an aqueous fixing composition, wherein the fixing composition comprises a second amino acid, a second C2-C10 carboxylic acid, and a hair conditioning agent, wherein the first and second amino acids and the first and second C2-C10 carboxylic acids may be the same or different. A shampoo and/or a conditioning composition may be present in a third and/or fourth container.

[0011] In some embodiments, the consumable reducing agent is selected from sodium and potassium salts of sulfite and metabisulfite; the first and second amino acids, which may be the same or different, are selected from glycine and alanine; the first and second C2-C10 carboxylic acids, which may be the same or different, are selected from glycolic acid, glyoxylic and lactic acids; and the hair conditioning agent includes a polyalkyleneimine.

[0012] Further aspects of the invention are directed to the reducing compositions, and the fixing compositions, *per se*. Even further aspects of the invention, including methods of making the reducing and fixing compositions, and methods of making and packaging the two-component system, are also provided.
In addition to the aforementioned advantages, the present invention features compositions that are formalin-free (or otherwise do not contain or generate formaldehyde); they do not require the use of any other hair straightening agent such as strong bases and additional reducing agents, nor do they require use of oxidizing or neutralizing agents.

DETAILED DESCRIPTION

The Compositions

The reducing composition contains an amount of a consumable reducing agent effective to reduce (break) disulfide bonds in hair in order to allow the hair to be straightened or shaped. The term "consumable" is synonymous with "food-grade", which as used herein refers to an ingredient that is ingestible by, and non-toxic, to humans. A consumable or food-grade ingredient, as used in the present invention, does not necessarily impart palatability or nutrition to a food product. Thus, Applicants' usage of the term "food-grade" is believed to be substantially consistent with the criteria described in Chapter 21 of the Code of Federal Regulations, promulgated by the U.S. Food and Drug Administration. Plainly, formalin and formaldehyde are not "food grade" or consumable materials.

Representative examples of consumable reducing agents suitable for use in the reducing compositions include cosmetically acceptable salts (e.g., alkali metal (e.g., sodium and potassium) and ammonium salts), esters (e.g., lower alkyl), amines (e.g., triethanolamine (TEA), monoethanolamine (MEA) and aminomethyl propanol (AMP)), of sulfite, disulfite, bisulfite, metabisulfite, hydrosulfite, hyposulfite and pyrosulfite. Both anhydrous and hydrated forms of these agents may be used. Specific examples of suitable consumable reducing agents thus include sodium metabisulfite, potassium metabisulfite, sodium sulfite, potassium sulfite, sodium thiosulfate, potassium thiosulfate, ammonium bisulfite, ammonium sulfite, ammonium metabisulfite, MEA sulfite, MEA metabisulfite, potassium
bisulfite, sodium bisulfite, ammonium bisulfite, sodium hydrosulfite, potassium hydrosulfite, ammonium hydrosulfite, anhydrous sodium sulfite, diammonium sulfite, dipotassium disulfite, dipotassium pyrosulfite, AMP sulfite, AMP metabisulfite, TEA sulfite, TEA metabisulfite, sodium acid sulfite, sodium hyposulfite, sodium pyrosulfite, and sodium thiosulfate pentahydrate.

[0016] The consumable reducing agent is present in the reducing composition in an amount effective to reduce (break) disulfide bonds in hair in order to allow the hair to be straightened or shaped. The amount generally ranges from about 0.1% to about 30%, and in some embodiments about 5.0% to about 25.0%, and in other embodiments, about 10.0% to about 20.0%, and in yet other embodiments from about 10% to about 15% by weight, based on the total weight of the composition.

[0017] Common to both the reducing composition and the fixing composition is the presence of an amino acid and a C2-C10 carboxylic acid. The amino acid may belong to the L- or D-series or may be racemic. Representative amino acids useful in the both the reducing and the conditioning compositions include naturally occurring amino acids such as glycine, alanine, arginine, aspartic acid, cysteine, glutamine, glutamic acid, isoleucine, leucine, methionine, histidine, isoleucine, phenylalanine, threonine, serine and valine, and/or precursors and derivatives (e.g., salts and hydrosalts such as hydrohalides) thereof. The amino acids may be added singly, in the case when two or more different amino acids are present, in mixtures or in the form of peptides, e.g., di- and tripeptides. The amino acids may also be added in the form of a protein hydrolysate, such as a keratin or collagen hydrolysate. In some embodiments, the amino acid is glycine, alanine, or a combination thereof.

[0018] The amino acid is present in each of the reducing and fixing compositions in an amount that is effective to aid in
moisture retention and the relinking of peptide bonds in the
hair under conditions of heat, and which generally ranges from
about 0.1% to about 10%, and in some embodiments about 0.5% to
about 8.5%, and in yet other embodiments, about 1.0% to about
7.0%, by weight, based on the total weight of the composition.

Each of the reducing and fixing compositions also
contains a C2-C10, substituted or unsubstituted carboxylic
acid. Suitable carboxylic acids include C2-C10, substituted or
unsubstituted α-hydroxy acids and C2-C10, substituted or
unsubstituted β-hydroxy acids. In some embodiments, the
carboxylic acids are C2-C8, and in yet other embodiments C2-C6,
C2-C5, or C2-C4 carboxylic acids, such as α-hydroxy or β-hydroxy
carboxylic acids. Preferably, the acids do not contain amine
groups. Representative examples of substitutions include
hydroxyl, keto, benzyl and substituted benzyl (e.g., with
hydroxyl, alkoxyl (e.g., C1-C3 alkoxyl)), and carboxyl (e.g., in
which cases the acid may be a di-carboxylic acid). Thus,
representative examples of such acids that may be suitable for
use in the reducing and fixing compositions of the present
invention include glycolic acid, glyoxylic acid, lactic acid,
methacetic acid, mandelic acid, 4-hydroxymandelic acid,
3-hydroxy 4-methoxymandelic acid, 3-((2-hydroxyphenyl) lactic
acid, 3-((4'-hydroxyphenyl) lactic acid, 3,4-dihydromandelic
acid, glyceric acid, malic acid, tartaric acid, citric acid,
pinelic acid, adipic acid, malonic acid, succinic acid, and
glutaric acid. These acids are organic and soluble in water and
in water and alcohol mixtures. Preferred acids are glyoxylic
acid and α-hydroxy acids such as glycolic and lactic acids.
Combinations of two or more acids may be present in the
compositions.

The C2-C10 carboxylic acid is present in the reducing
compositions in amounts that are effective to help the hair
shafts retain moisture and relink peptide bonds under conditions
of heat, and generally range from about 0.1 to about 10%, and in
some embodiments from about 0.3% to about 8.5%, and in yet other embodiments about 0.5% to about 2.5%, or about 0.5% to about 2.0% by weight, based upon the total weight of the reducing composition.

[0021] The C2-C10 carboxylic acid is present in the fixing compositions in amounts that are effective to help the hair shafts retain moisture and relink peptide bonds under conditions of heat, and that generally range from about 0.1 to about 10%, and in some embodiments from about 0.3% to about 8.5%, and in yet other embodiments about 0.5% to about 7.0%, and in yet other embodiments from about 0.5% to about 1.5%, 2.0% or 2.5% by weight, based upon the total weight of the fixing composition.

[0022] The hair fixing compositions can contain one or more hair conditioning agents. One type of such agent is a cationic conditioning ingredient, e.g., as represented by the following formula,

\[
\begin{align*}
R_3 & \quad \text{(i)} \\
\text{N'} & \\
R_5 & \quad \text{X'} \\
R_6 &
\end{align*}
\]

wherein \( R_3 \) (i) is a saturated or unsaturated, branched or nonbranched alkyl with 8 to 22 carbon atoms; (ii) has the structure \( R_7 \text{CONH}(\text{CH}_2)_n \) wherein \( R_7 \) is a saturated or unsaturated, branched or nonbranched alkyl with 7 to 21 carbon atoms and \( n \) has typical value of 1-4; or (iii) has the structure \( R_8 \text{COO}(\text{CH}_2)_n \) wherein \( R_8 \) is a saturated or unsaturated, branched or nonbranched alkyl with 7 to 21 carbon atoms and \( n \) has typical value of 1-4; wherein \( R_4 \) (i) is \( H \) or a unsaturated or saturated, branched or nonbranched alkyl with 1 to 22 carbon atoms; (ii) has the structure \( R_7 \text{CONH}(\text{CH}_2)_n \), or (iii) has the structure \( R_8 \text{COO}(\text{CH}_2)_n \), wherein \( R_7, R_8 \) and \( n \) are same as above; wherein \( R_5 \) and \( R_6 \) are individually hydrogen or an alkyl of an integer of 1 to 4 carbon
atoms, and $X^-$ is an anion. Representative examples of cationic conditioning agents embraced by the formula are cetyl trimethyl ammonium chloride, steardimonium chloride, dipalmitoyl dimonium chloride, distearyl dimethyl ammonium chloride, stearamidopropyl trimonium chloride, dioleolethyl dimethyl ammonium methosulfate, and dioleoylethyl hydroxyethylmonium methosulfate. Other cationic hair conditioning agents that may be useful in the present invention include quaternium-8; quaternium-14; quaternium-15; quaternium-1^43; quaternium-22; quaternium-24; quaternium-26; quaternium-27; quaternium-30; quaternium-33; quaternium-37; quaternium-53; quaternium-60; quaternium-61; quaternium-72; quaternium-7<; quaternium-80; quaternium-81; quaternium-82; quaternium-83; quaternium-84; and quaternium-91.

[0023] Quaternary ammonium compounds are another type of hair conditioning agent that may be useful in the hair fixing compositions. Representative quaternary ammonium compounds, or salts, have the following formula:

$$R_1 + \text{N} \quad \text{X}^- \quad R_2 \quad R_3 \quad R_4$$

wherein $R_1$, $R_2$, $R_3$, and $R_4$ are each independently an aliphatic group of 1 to 22 carbon atoms, or aromatic, alky1, hydroxyalkyl, aryl, or alkaryl group having 12 to 22 carbon atoms; with the proviso that there is at least one alkyl group having 12 to 22 carbon atoms. In some embodiments, at least one of $R_1$, $R_2$, $R_3$, and $R_4$ are methyl while the remaining substituents are $C_{12-22}$ aliphatic radicals. $X$ is an anion selected from halogen, acetate, phosphate, nitrate and methyl sulfate, tosylate, and hydroxide radicals. The aliphatic groups may contain, in addition to carbon atoms, ether linkages as well as amido groups. Suitable quaternary ammonium compounds may be mono-long
chain alkyl, di-long chain alkyl, tri-long chain alkyl, and the like. Examples of such quaternary ammonium salts embraced by the formula include behenalkonium chloride, behentrimonium chloride, behentrimonium methosulfate, benzalkonium chloride, benzethonium chloride, benzyl triethyl ammonium chloride, cetalkonium chloride, cetrimonium chloride, cetrimonium bromide, cetrimonium methosulfate, cetrimonium tosylate, cetylpyridinium chloride, dibehenyl/diarachidyl dimonium chloride, dibehenylldimonium chloride, dibehenylldimonium methosulfate, and dicapryl/dicaprylyl dimonium chloride. [0024] Silicone conditioning agents may also be used in the present invention. Nonvolatile silicones, both water soluble and water insoluble, are particularly suitable. In some embodiments, such silicones have a viscosity of 10 to 600,000 centistokes, and in some other embodiments 20 to 100,000 centistokes at 25°C. Suitable water insoluble silicones include amodimethicone, bisphenylhexamethicone, dimethicone, hexadecyl methicone, methicone, phenyl trimethicone, simethicone, dimethylhydrogensiloxane, stearoxytrimethylsilane, vinyldimethicone, and mixtures thereof. Also suitable are water soluble silicones such as dimethicone copolyol, dimethiconol, and the like. Such silicones are available from Dow Corning as the 3225C formulation aid, Dow 190 and 193 fluids, or similar products marketed by Goldschmidt under the ABIL tradename. In some embodiments, the silicone conditioning agent is a silicone emulsion such as those formed from silicones such as polydiorganosiloxanes, in particular polydimethylsiloxanes which have the CTFA designation dimethicone, polydimethyl siloxanes having hydroxyl end groups which have the CTFA designation dimethiconol, and amino-functional polydimethyl siloxanes which have the CTFA designation amodimethicone and bis-cetearyl amodimethicone. [0025] Polyalkyleneimines, such as polyethyleneimines (PEI) and their derivatives, are further examples of hair conditioning
agents. These polymers are described, for example, in European Patent Application No. 1 426 035 and International Patent Application Publication No. WO 2005/092274. Polyethyleneimines are described, for example, in: "Kirk-Othmer Encyclopedia of Chemical Technology", 3rd edition, vol. 20, 1982, pp. 214-216, and "Polyethyleneimine Prospective Application", H. N. Feigenbaum, Cosmetics & Toiletries, 108, 1993, p. 73. The polyethyleneimines which can be used in accordance with the present disclosure generally exhibit the following formula:

\[ (\text{CH}_2\text{--CH}_2\text{--NH})_n \]

wherein \( n \) is the mean number of ethyleneimine units, \( n \) ranging from 5 to 10 000.

[0026] The ethyleneimine homopolymers can be branched. Representative examples of such polymers include PEI-7 \( (n=7) \), PEI-10 \( (n=10) \), PEI-14M, PEI-15 \( (n=15) \), PEI-30 \( (n=30) \), PEI-35 \( (n=35) \), PEI-45 \( (n=45) \), PEI-250 \( (n=250) \), PEI-275 \( (n=275) \), PEI-700 \( (n=700) \), PEI-1000 \( (n=1000) \) (and hydroxyethyl PEI-1000), PEI-1400 \( (n=1400) \), PEI-1500 \( (n=1500) \) (any hydroxyethyl PEI-1500), PEI-1750 \( (n=1750) \), and PEI-2500 \( (n=2500) \). Further examples include polyethyleneimines of the Lupasol range, such as the products sold under the names Lupasol G35, FG, PS, HF, and P, and Polymin SK from BASF.

[0027] The polyethyleneimines (PEI) can be modified by grafts, such as hydrophilic grafts (for example, polyethylene glycol (PEG), polyvinyl acetate (PVA), and polyacrylate) and hydrophobic grafts (for example, silicone and/or \( \text{C}_8\text{-C}_{30} \) carbonaceous fatty chains), as described in International Patent Application Publication Nos. WO 97/20879, WO 97/23456, WO 02/095122, and WO 02/15854, U.S. Patent 5,756,080, European Patent No. 0 524 612, and in H. Petersen, et al., Macromolecules, 2002, 35, p. 6867. PEI-PEG compounds are sold, for example, under the names Lupasol SC61B, SC62J, LU158, and HEO1 by BASF. PEI compounds comprising fatty chains are, for instance, under the names Lupasol ESA 51685 and LU157 by BASF.
Yet other PEI-based conditioning agents that may be useful in the present invention include glycidoxypropyl trimethyloxsilane/PEI-250 cross-polymer fluorescent brightener 230 salt, HDI/PEI-45/SMDI cross-polymer, PEI-14 PEG-10/PPG-7 cross-polymer and sodium PEG-4 PEI-6 phosphonate.

[0028] Useful hair conditioning agents further include hydrolyzed organic materials such as hydrolyzed casein; hydrolyzed collagen; hydrolyzed hair keratin; hydrolyzed milk protein; hydrolyzed jojoba esters; hydrolyzed soy protein; hydroxypropyltrimonium hydrolyzed rice bran protein; hydrolyzed amaranth protein; palmityoyl hydrolyzed pea amino proteins; amino acids; peptides, and the like.

[0029] Yet further hair conditioning agents that may be useful in the fixing compositions of the present invention include fatty alkyl esters (e.g., C10-C30 fatty alkyl benzoates), fatty acids (e.g., C10-C30 fatty acids such as lauric acid and stearic acid), C10-C30 fatty amides (e.g., lauric diethanolamide), long chain hydrocarbons, fatty alcohols (which as used herein refers to fatty alcohols (e.g., a C10-C30 alcohol, such as lauryl, cetyl, stearyl and behenyl alcohols, and mixtures thereof, e.g., cetearyl alcohol), alkoxylated fatty alcohols (e.g., ethoxylated or propoxylated fatty alcohols such as ethylene glycol cetyl ether, polyoxyethylene (2) stearyl ether, and polyoxyethylene (4) cetyl ether), and mixtures thereof.

[0030] The hair conditioning agent is present in the fixing compositions in amounts that generally range from about 0.1% to about 30%, and in some embodiments from about 5.0% to about 25%, and in yet other embodiments about 10.0% to about 20.0% by weight, based upon the total weight of the fixing composition.

[0031] The primary solvent in both the reducing and the fixing compositions is water, which is present in an amount that generally ranges from about 1.0% to about 99%, and in some embodiments about 5.0% to about 95%, and in yet other
embodiments 10% to about 90% and in yet other embodiments from about 50% to about 80% by weight, based on the total weight of the compositions. Secondary, water-miscible solvents, such as lower monohydric and dihydric alkanols, may also be present to the extent desired. Examples include ethanol, propanol, and isopropanol, and glycerin and propylene glycol respectively.

[0032] The relative amounts of the ingredients in the compositions may be chosen with reference to the disclosed ranges in order to formulate the reducing composition at a pH that generally ranges from about 4 to about 10, and in some embodiments about 5 to about 8 and in some other embodiments about 5.5 to about 7, and to formulate the fixing composition at a pH that generally ranges from about 3 to about 7, and in some embodiments from about 3.5 to about 6.5, and in some other embodiments from about 4.0 to about 6. If desired, pH adjustment may be facilitated by the inclusion of a pH-modifying agent (e.g., AMP, sodium hydroxide or potassium hydroxide), typically in an amount of about 0.01% to about 10.0%, and in some embodiments from about 0.01% to about 2.0% by weight, based on the total weight of the composition.

[0033] The composition(s) of the present invention may further comprise one or more optional components known or otherwise effective for use in hair care or personal care products, provided that the optional components are physically and chemically compatible with the essential components described herein, or do not otherwise unduly impair product stability, aesthetics, or performance. Non-limiting examples of such optional components that may be present in the reducing and/or fixing compositions of the present invention are disclosed in The International Cosmetic Ingredient Dictionary, Ninth Edition, 2002, and CTFA Cosmetic Ingredient Handbook, Tenth Edition, 2004. Some non-limiting examples of such optional components are disclosed below, and include plasticizers, surfactants (which may be anionic, cationic, amphoteric or
nonionic), inorganic salts, hydrophilic colloids, hydrating active agents, anhydrous solvents, humectants, neutralizing agents, propellants, moisturizers (e.g., urea (which may also useful as an agent that facilitates penetration of the small molecule actives (e.g., the C2-C10 carboxylic acid and the amino acids into the hair shafts) and guanidinium salts), emollients, lubricants and penetrants such as various lanolin compounds, vitamins, proteins, preservatives, dyes, tints, colorants, sunscreens, thickening agents (e.g., polymeric thickeners, such as xanthan gum), physiologically active compounds for treating the hair or skin (e.g., anti-dandruff actives, hair growth actives), non-polymeric thickeners including clays, perfume and fragrance, and natural hair root nutrients (e.g., sugars such as sucrose, glucose, dextrose and fructose, which are typically added singly or in the form of fruit extracts). Additives, to the extent they are present, are in amounts generally ranging from about 0.1% to about 20%, based on the total weight of the composition to which they are added.

[0034] Representative examples of zwitterionic surfactants include betaines, for example higher alkyl betaines such as coco dimethyl carboxymethyl betaine, lauryl dimethyl carboxymethyl betaine, lauryl dimethyl alphacarboxyethyl betaine, cetyl dimethyl carboxymethyl betaine, lauryl bis-(2-hydroxyethyl )carboxymethyl betaine, stearyl bis-(2-hydroxypropyl )carboxymethyl betaine, oleyl dimethyl gamma-carboxylethyl betaine, and mixtures thereof. Also suitable are sulfo- and amido- betaines such as coco dimethyl sulfopropyl betaine, cocomidopropyl betaine, stearyl dimethyl sulfopropyl betaine, and the like.

[0035] Representative examples of suitable inorganic salts include aluminum, sodium, potassium, and magnesium salts of inorganic or organic acids. Examples of suitable salts include sodium metasilicate, sodium chloride, sodium silicate, aluminum citrate, calcium saccharin, calcium salicylate, calcium citrate,
calcium benzoate, magnesium acetate, magnesium ascorbate, magnesium PCA, magnesium gluconate, potassium acetate, potassium benzoate, potassium citrate, potassium sorbate, sodium acetate, sodium ascorbate, sodium citrate, sodium gluconate, sodium pyruvate, and mixtures thereof.

[0036] Representative examples of suitable hydrophilic colloids include hydroxyethylcellulose, locust bean, maltodextrin, methylcellulose, agar, dextran, dextran sulfate, gelatin, pectin, potassium alginate, sodium carboxymethylchitin, xanthan gum, and the like.

[0037] Representative examples of suitable humectants include monomeric, homopolymeric, and/or block copolymeric ethers as well as mono-, di-, or polyhydric alcohols.

[0038] Representative examples of suitable hydrating active agents (which act on the barrier function with a view to maintaining the hydration of the stratum corneum or an occlusive compound) include ceramides, sphingoid-based compounds, lecithins, glycosphingolipids, phospholipids, cholesterol and its derivatives, phytosterols (stigmasterol, β-sitosterol, campesterol), essential fatty acids, 1,2-diacylglycerol, 4-chromanone, pentacyclic triterpenes, petroleum jelly and lanolin; compounds which directly increase the water content of the stratum corneum, such as urea and its derivatives, threalose and its derivatives, hyaluronic acid and its derivatives, glycerol, pentanediol, pidolates, serine, xylitol, lactic acid and sodium lactate, glyceryl polyacrylate, ectoin and its derivatives, chitosan, oligosaccharides and polysaccharides, cyclic carbonates, N-lauroylpyrrolidonecarboxylic acid and N-octylbenzoyl-L-arginine; and compounds which activate the sebaceous glands, such as steroidal derivatives (including DHEA), and vitamin D and its derivatives.

[0039] Representative examples of suitable anhydrous solvents include dimethiconol, dimethicone, cyclomethicones, phenyl trimethicone and amodimethicone.
Representative examples of humectants include glycols in monomeric or polymeric form such as polyethylene and polypropylene glycols such as PEG 4-200, which are polyethylene glycols having from 4 to 200 repeating ethylene oxide units; as well as Cl-6 alkylene glycols such as propylene glycol, butylene glycol, pentylene glycol, ethylhexylglycerin, trehalose, trehalose dihydrate, and the like.

The composition(s) of the present invention further may comprise from about 0.1% to about 10%, and in some other embodiments from about 0.2% to about 5.0%, of a gelling agent to help provide the desired viscosity to the composition(s). Representative examples of suitable optional gelling agents include crosslinked carboxylic acid polymers; unneutralized crosslinked carboxylic acid polymers; unneutralized modified crosslinked carboxylic acid polymers; crosslinked ethylene/maleic anhydride copolymers; unneutralized crosslinked ethylene/maleic anhydride copolymers (e.g., EMA 81 commercially available from Monsanto); unneutralized crosslinked alkyl ether/acrylate copolymers (e.g., Salcare™ SC90 commercially available from Allied Colloids); unneutralized crosslinked copolymers of sodium polyacrylate, mineral oil, and PEG-1 trideceth-6 (e.g., Salcare™ SC91 commercially available from Allied Colloids); unneutralized crosslinked copolymers of methyl vinyl ether and maleic anhydride (e.g., Stabileze™ QM-PVM/MA copolymer commercially available from International Specialty Products); hydrophobically modified nonionic cellulose polymers; hydrophobically modified ethoxylate urethane polymers (e.g., Ucare™ Polyphobe Series of alkali swellable polymers commercially available from Union Carbide); and combinations thereof. In this context, the term "unneutralized" means that the optional polymer and copolymer gelling agent materials contain unneutralized acid monomers.
**Methods**

[0042] Prior to applying the reducing composition, the hair may be shampooed, at least once, and then towel-dried. The reducing composition may be applied to the hair by a device such as a brush, preferably combed through the hair to saturate the hair. It is allowed to remain on the hair for about 10 minutes to about 60 minutes, and in some embodiments for about 30 to about 40 minutes, and in some other embodiments for about 35 minutes to about 45 minutes and in some other embodiments, from about 40 minutes to about 50 minutes. The reducing composition is allowed to remain on the hair relatively longer for thick or coarse hair as compared to color-treated hair. The leave-on time may be relatively low e.g., about 20 minutes, if the reducing composition is applied with heat.

[0043] The fixing composition may also be applied by a device such as a brush, as well as by hand. It is typically allowed to stay on the hair for about 1 to about 10 minutes, and in some embodiments, for about 5 to about 10 minutes. The hair may be rinsed one or more times, e.g., after application of the reducing composition, after application of the fixing composition, or after the application of the reducing composition and after the application of the fixing composition.

[0044] Straightening or shaping steps may be conducted prior to or after application of the fixing composition. Straightening may be achieved by application of at least one round, and more typically about 4 to about 10 or from about 8 to about 10 rounds of a straight or flat iron (typically with heat at a temperature of about 400°F to about 450°F). More than 10 such treatments may be applied, e.g., 11, 12, 13, 14, 15 or more. Prior to straightening, the hair may be at least partially (e.g., about 50% to about 90% dried) using a heat source such as a blow dryer.

[0045] Once straightening or shaping is completed, the hair may then be completely dried, using a heat source typically a
blow dryer. Once straightening is completed, the hair may be further treated with a conditioning composition such as a crème which helps to restore moisture balance. To enhance straightening or waving results, the hair is not washed or subjected to water for about 48 hours following treatment.

[0046] In some embodiments, the reducing composition may be applied to the hair (e.g., until saturation), and allowed to stay on the hair for about 40 to about 60 minutes. The hair may then be at least partially dried optionally in combination with combing. The hair may then be straightened e.g., by applying at least one round and more typically from about 4 to about 10 rounds of hot iron treatment. The fixing composition may then be applied to the hair, (e.g., to saturation), and allowed to stay on the hair for about 5 to about 10 minutes, which may then be optionally followed by even combing and rinsing.

[0047] In some other embodiments, the reducing composition may be applied to the hair (e.g., until saturation), and allowed to stay on the hair for about 40 to about 60 minutes, followed by rinsing. The fixing composition may then be applied to the hair, (e.g., to saturation), and allowed to stay on the hair for about 5 to about 10 minutes, followed by rinsing. The hair may then be at least partially dried optionally in combination with combing. The hair may then be straightened e.g., by applying at least one round and more typically from about 4 to about 10 rounds of hot iron treatment.

[0048] In yet other embodiments, the reducing composition may be applied to the hair (e.g., until saturation), and allowed to stay on the hair for about 40 to about 60 minutes, followed by application of the fixing composition (e.g., to saturation), which is allowed to stay on the hair for about 5 to about 10 minutes, followed by rinsing with water. The hair may then be at least partially -dried optionally in combination with combing. The hair may then be straightened by applying at least one round and more typically from about 4 to about 10 rounds of
hot iron treatment then, if desired, drying (e.g., blow drying) to completion.

[0049] In the embodiments wherein straightening is desired, a straight (hot) iron may be used, whereas in embodiments wherein shaping is desired, a curling iron may be used.

[0050] In addition to the primary benefit of straightening or shaping the hair, which may last for at least about 3-6 weeks or even longer, use of the present invention may provide additional benefits which include, for example, increased shape retention and/or durability, increased appearance of volume, increased resistance to the effects of humidity, for example, upon the style of the hair and/or upon the condition of the hair.

[0051] The compositions and methods of the present invention may be used on all types of hair, female and male alike, including Caucasian, Asian, Hispanic, African and African-American hair types. The systems and methods of the present invention are suitable for use both in the salon and at home.

[0052] The reducing and fixing compositions may be included in separate containers the form of a kit or package - thus providing a two-component hair straightening system. Alternatively, the system may be included in a single container having two separate chambers designed so as to prevent admixing of the two compositions during storage and prior to or during use. The packaging may be of a size suitable for a single application, or unit dose, of the reducing and conditioning compositions. The kit may comprise a number of unit doses suitable for an indicated hair straightening regimen. The package may further include at least one additional composition (such as a shampoo, a colorant, or a styling aid such as a gel, a mousse, a pomade, etc.), at least one device such as an implement (e.g., applicator brush, and comb), an energy delivery device (blow dryer or hot (straight and/or curling) iron), printed materials (e.g., instructions for complying with or carrying out a hair straightening or shaping regimen), and
combinations thereof. The instructions for complying with a hair treatment regimen may be directed toward treatment by a professional stylist or toward treatment by a consumer who is not a professionally-trained stylist. In addition to the instructions, other printed materials may include printed material attached directly or indirectly to the package that contains the compositions, or placed directly or indirectly near at least one of the compositions, or in the form of an electronic or a broadcast message associated with the compositions, or images comparing the appearance of a person prior to use of the compositions to the appearance of the same person (with straightened or shaped hair) after use of the hair straightening or shaping system.

[0053] As used herein, the term "about" refers to ±10-15% (e.g., ±10%, ±11%, ±12%, ±13%, ±14%, and ±15%, of the referenced value.

[0054] The invention will now be described in terms of the following non-limiting examples. Unless otherwise specified, all parts are by weight.

Example 1: Cleansing Shampoo

[0055] An illustrative embodiment of a shampoo suitable for use in the present invention, along with a method for making it, are described below.

<table>
<thead>
<tr>
<th>INCI Names</th>
<th>Percentage Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water (Aqua)</td>
<td>77.9%</td>
</tr>
<tr>
<td>Sodium Laureth Sulfate</td>
<td>12.0%</td>
</tr>
<tr>
<td>TEA-Lauryl Sulfate</td>
<td>4.0%</td>
</tr>
<tr>
<td>Cocamidopropyl Betaine</td>
<td>2.0%</td>
</tr>
<tr>
<td>Sodium Chloride</td>
<td>1.0%</td>
</tr>
<tr>
<td>Lauramine Oxide</td>
<td>0.6%</td>
</tr>
<tr>
<td>Polyquaternium-10</td>
<td>0.3%</td>
</tr>
</tbody>
</table>
The batch was made at room temperature. In a primary container with a side sweep and turbine, all surfactants were mixed together with slow mixing. In a secondary container, Polyquaternium-10 was dispersed into small amount water and the dispersed solution was added into main container. The viscosity was adjusted with sodium chloride to be in the range of 6,000 to 10,000 cps.

Example 2 Reducing Composition (Treatment I)

<table>
<thead>
<tr>
<th>INCI Names</th>
<th>Amount (wt %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water (Aqua)</td>
<td>58.3%</td>
</tr>
<tr>
<td>Sodium Metabisulfite</td>
<td>13.0%</td>
</tr>
<tr>
<td>Aminomethyl Propanol</td>
<td>6.0%</td>
</tr>
<tr>
<td>Urea</td>
<td>5.0%</td>
</tr>
<tr>
<td>Glycine</td>
<td>3.0%</td>
</tr>
<tr>
<td>Glycerin</td>
<td>2.0%</td>
</tr>
<tr>
<td>Hydroxyethylcellulose</td>
<td>1.1%</td>
</tr>
<tr>
<td>Glycolic Acid</td>
<td>0.6%</td>
</tr>
<tr>
<td>Preservatives</td>
<td>1.0%</td>
</tr>
<tr>
<td>Other additives</td>
<td>10.0%</td>
</tr>
</tbody>
</table>

The batch was made at room temperature. In a suitable container with a side sweep and turbine, hydroxyethylcellulose was dispersed into water to form lump-free solution. The other ingredients were then added.

Example 3 Fixing Composition (Treatment II)

<table>
<thead>
<tr>
<th>INCI Names</th>
<th>Amount (wt %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water (Aqua)</td>
<td>74.8%</td>
</tr>
<tr>
<td>Cetearyl Alcohol</td>
<td>8.0%</td>
</tr>
<tr>
<td>Quaternium-91</td>
<td>3.0%</td>
</tr>
<tr>
<td>Cetrimonium Methosulfate</td>
<td>2.0%</td>
</tr>
<tr>
<td>Component</td>
<td>Percentage</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Bis-Cetearyl Amodimethicone</td>
<td>1.5%</td>
</tr>
<tr>
<td>Dimethicone</td>
<td>1.5%</td>
</tr>
<tr>
<td>PEI-1750</td>
<td>1.5%</td>
</tr>
<tr>
<td>Glycolic Acid</td>
<td>1.0%</td>
</tr>
<tr>
<td>Carthamus Tinctorius (Safflower) Seed Oil</td>
<td>1.0%</td>
</tr>
<tr>
<td>Hydroxyethylcellulose</td>
<td>0.7%</td>
</tr>
<tr>
<td>Other additives</td>
<td>5.0%</td>
</tr>
</tbody>
</table>

[0058] The batch was made at 75-80°C. In a suitable container with a side sweep and turbine, hydroxyethylcellulose was dispersed into water to form a lump-free solution. As the solution was being heated to 75-80°C, the other ingredients were added. Once all ingredients were melted completely, the batch was cooled.

**Example 4: Method**

[0059] An illustrative embodiment of the method of the present invention, and the results obtained thereby, are described below.

[0060] Samples of dark brown curly human hair (Willow Bee Accessories, Hacienda Heights, CA) were used in the tests. Two different versions of the present method were used. In both embodiments, the Hot Tools™ hot iron used had a variable temperature from 280°F to about 450°F. The hair was washed with deep cleansing shampoo twice, and then rinsed followed by towel drying. The reducing composition described in Example 1 was then applied to the hair until saturation, and allowed to stand for 40 to 60 minutes, followed by rinsing with water and towel-dried. The fixing composition of Example 2 was then applied to the hair to saturation, followed by even combing. The hair was blow-dried to about 90% dry, followed by four or five rounds of hot iron treatment. The hair was then rinsed with water and then dried to completion.
Two bundles of hair from the same hair crimp were used for long term testing. A photo of two hair bundles, side-by-side, was taken before the testing started (photo not shown). One bundle served as control, i.e., without exposure to the inventive treatment method. The other was washed with deep cleansing shampoo twice and then treated as described herein. The hair bundles (both control and treated hair) were washed with commercial shampoo (Fekkai Advanced Essential Shea Shampoo) every Monday, Wednesday and Friday. The photos of side-by-side hair bundles were taken after every wash and dried (photos not shown). The visual contrast of photos of the untreated hair bundle and the photos of the treated hair bundle showed the progression of testing over time and iterations of washing. The treat hair bundle was still very straight after 4 months with numerous washes compared to curly control.

Although the invention herein has been described with reference to particular embodiments, it is to be understood that these embodiments are merely illustrative of the principles and applications of the present invention. It is therefore to be understood that numerous modifications may be made to the illustrative embodiments and that other arrangements may be devised without departing from the spirit and scope of the present invention as defined by the appended claims.
CLAIMS

1. A method of straightening or shaping hair, comprising:
   a) applying an aqueous reducing composition to the hair, comprising an effective amount of a consumable reducing agent, a first amino acid, and a first C2-C10 carboxylic acid;
   b) applying an aqueous fixing composition to the hair, wherein the fixing composition comprises a second amino acid, a second C2-C10 carboxylic acid, and a hair conditioning agent, wherein the first and second amino acids and the first and second C2-C10 carboxylic acids may be the same or different; and
   c) straightening or shaping the hair.

2. The method of claim 1, wherein the consumable reducing agent comprises at least one agent selected from the group consisting of cosmetically acceptable salts, esters, and amines of sulfite, disulfite, bisulfite, metabisulfite, hydrosulfite, hyposulfite and pyrosulfite.

3. The method of claim 1, wherein the consumable reducing agent comprises at least one agent selected from the group consisting of sodium metabisulfite, potassium metabisulfite, sodium sulfite, potassium sulfite and aminomethyl propanol.

4. The method of claim 1, wherein the first amino acid, the second amino acid or each of the first and second amino acids is glycine.

5. The method of claim 1, wherein the first C2-C10 carboxylic acid, the second C2-C10 carboxylic acid or each of the first and second C2-C10 carboxylic acids is selected from the group consisting of glycolic acid, glyoxylic acid and lactic acid.

6. The method of claim 1, wherein the aqueous fixing agent further comprises at least one additional amino acid selected.
from the group consisting arginine, alanine, aspartic acid, glycine, serine, valine, isoleucine, proline, threonine, histidine and phenylalanine.

7. The method of claim 1, wherein the hair conditioning agent is at least one agent selected from the group consisting of a cationic conditioning agent, a quaternary ammonium compound or cosmetically acceptable salt thereof, a silicone conditioning agent, a polyalkyleneimine, a hydrolyzed animal or vegetable protein, a fatty alkyl ester, a fatty acid, a C10-C30 fatty amide, a long-chain hydrocarbon and a fatty alcohol.

8. The method of claim 1, wherein in a) the reducing composition is allowed to stay on the hair for about 40 to about 60 minutes.

9. The method of claim 1, wherein the aqueous fixing composition is allowed to stay on the hair for about 1 to about 10 minutes.

10. The method of claim 1, wherein the straightening is conducted using from about 4 to about 10 rounds of hot iron treatment.

11. The method of claim 1, wherein the straightening or shaping is preceded by partially drying the hair.

12. The method of claim 1, wherein the hair is rinsed with water after application of the reducing composition, after application of the fixing composition, or after the application of the reducing composition and after the application of the fixing composition.

13. The method of claim 1, wherein the consumable reducing agent comprises at least one agent...
selected from the group consisting of sodium metabisulfite, potassium metabisulfite, sodium sulfite, potassium sulfite and aminomethyl propanol and at least amino acid comprising glycine, and at least one C2-C10 carboxylic acid comprising glycolic acid, wherein the reducing composition has a pH of about 4 to about 10; and wherein the aqueous fixing agent comprises at least amino acid comprising glycine, at least one second amino acid selected from the group consisting of arginine, alanine, aspartic acid, glycine, serine, valine, isoleucine, proline, threonine, histidine and phenylalanine, at least one C2-C10 carboxylic acid comprising glycolic acid, and at least one hair conditioning agent selected from the group consisting of a cationic conditioning agent, a quarternary ammonium compound or cosmetically acceptable salt thereof, a silicone conditioning agent, a polyalkyleneimine, a hydrolyzed animal or vegetable protein, and a fatty alcohol, and wherein the fixing composition has a pH of about 3 to about 7.

14. The method of claim 1, wherein the reducing composition is allowed to stay on the hair for about 40 to about 60 minutes, followed by partial drying (e.g., via blow dryer) prior to straightening, wherein the straightening comprises at least about 4 to about 10 rounds of hot iron treatment, and wherein the fixing composition is applied to the hair subsequent to the straightening, and allowed to stay on the hair for about 1 to about 10 minutes, followed by rinsing.

15. The method of claim 1, wherein the reducing composition is allowed to stay on the hair for about 40 to about 60 minutes, followed by rinsing, application of the fixing composition which is allowed to stay on the hair for about 5 to about 10 minutes, followed by rinsing, partial drying and the straightening which comprises about 4 to about 10 rounds of hot iron treatment.
16. The method of claim 1, wherein the reducing composition is allowed to stay on the hair for about 40 to about 60 minutes, followed by application of the fixing composition which is allowed to stay on the hair for about 5 to about 10 minutes, followed by rinsing, partial drying and the straightening which comprises about 4 to about 10 rounds of hot iron treatment.

17. The method of claim 1, wherein the shaping comprises treatment with a curling iron, thereby shaping the hair.

18. A two-component system for straightening or shaping hair, comprising a package which includes separate first and second containers, wherein the first container comprises an aqueous reducing composition comprising an effective amount of a consumable reducing agent, a first amino acid, and a first C2-C10 carboxylic acid; and wherein the second container comprises an aqueous fixing composition, wherein the fixing composition comprises a second amino acid, a second C2-C10 carboxylic acid, and a hair conditioning agent, wherein the first and second amino acids and the first and second C2-C10 carboxylic acids may be the same or different.

19. An aqueous reducing composition useful in conjunction with an aqueous fixing composition for straightening hair, comprising an effective amount of a consumable reducing agent, an amino acid, and a C2-C10 carboxylic acid.

20. An aqueous fixing composition useful in conjunction with an aqueous reducing composition containing a consumable reducing agent for straightening hair, wherein the fixing composition comprises an amino acid, a C2-C10 carboxylic acid and optionally a hair conditioning agent.