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(54) **Title**: COMPOSITIONS AND METHODS FOR MITIGATING ADVERSE EFFECTS OF EXPOSURE TO CHLORINATING AND/OR BROMINATING AGENTS

(57) **Abstract**: Disclosed are methods of mitigating the effects on body and/or clothing fibers of exposure to chlorinating and/or brominating agents, such as those found in swimming pools, by treating the body and/or clothing fibers with an effective amount of ascorbic acid, salts, and/or derivatives thereof. Also disclosed are compositions comprising ascorbic acid, salts, and/or derivatives thereof, for use in treating body and/or clothing fibers to mitigate the effects on body and/or clothing fibers of exposure to chlorinating and/or brominating agents.

COMPOSITIONS AND METHODS FOR MITIGATING ADVERSE EFFECTS OF EXPOSURE TO CHLORINATING AND/OR BROMINATING AGENTS

CROSS-REFERENCE TO RELATED APPLICATION

[001] This application claims priority under 35 U.S.C. § 119 to U.S. Provisional Application 61/369, 360, filed July 30, 2010, which is incorporated herein by reference.

TECHNICAL FIELD

[002] The disclosure relates to compositions and methods for decreasing or eliminating adverse effects of chlorinating and/or brominating agents on the fibers that make up the exterior of the body and clothing.

BACKGROUND

[003] Swimming is a popular form of exercise and pastime. By its nature, swimming requires immersing oneself in a body of water. People may swim in either natural bodies of water (such as lakes, oceans, rivers, etc.), or man-made swimming pools.

[004] Man-made swimming pools (including traditional swimming pools, hot tubs, etc., collectively referred to generally herein as "pools") are usually smaller than naturally occurring bodies of water. They are also usually self-contained structures, consisting of a finite body of water separated from the surrounding environment, for example by walls. Pools provide an aqueous environment that is kept within a biologically habitable temperature range, such as about 65 – 90 ºF. Some pools may be kept cooler or warmer. For example, a hot tub may be maintained at more than 90 ºF.

[005] A swimmer brings a variety of living and non-living substances into the pool. For example, the swimmer's skin, hair, saliva, urine, sweat, and other secretions may come into contact with the pool water. Owing to the aqueous medium and adequate temperature, pools provide a suitable environment for living organisms, such as bacteria, to thrive.

[006] Pools are usually treated with chemicals chosen to prevent the growth of harmful organisms, such as bacteria. Properly used, these chemicals keep the pool water substantially free from harmful contaminants. For example, many pools are treated with chlorinating agents (e.g., chlorine, hypochlorite salts such as calcium hypochlorite or sodium hypochlorite, hypochlorous acid) or brominating agents (e.g., bromine, salts comprising bromine, etc).

[007] The chemicals used to treat pool water work by reacting with certain molecules that come into contact with the pool water. For example, these chemicals may react with bacteria's biologically important molecules, thereby killing the bacteria.

[008] In addition to reacting with bacteria and other contaminants, however, some pool chemicals react with elements of the swimmer, such as the swimmer's body and/or the swimmer's attire. For example, the fibers that make up the exterior of the body, such as skin, hair, eyes, and nails (collectively referred to herein as "body fibers," and intending to include keratinous fibers that make up the hair, skin, and nails, as well as mucous membranes), comprise proteins. By way of example, human hair is made largely from alpha keratin (α-keratin). Those proteins are made from amino acids. All amino acids, including those making up proteins, have one or more N-H bonds. In α-keratin, the most abundant amino acid is cystine, which accounts for about 15% of the protein. Monomeric L-cystine has two N-H bonds. The oxidized dimmer of cystine has four N-H bonds. When present within a protein, each cystine residue has one N-H bond.

[009] The N-H bonds in the amino acids in body fibers can react with the chemicals found in pool water. For example, one or more N-H bonds in an amino acid in the protein of hair or skin can react with a chlorinating agent used in pool water to form N-Cl, an amino chloride. Notably, the reacted amino acid, now containing an N-Cl bond, is still part of the protein in the hair or skin.

[0010] Although a swimmer can rinse the residual pool water from his or her skin, hair, attire, etc., after swimming, such rinsing may not effectively eliminate all the adverse effects of exposure to the chemically-treated pool water. For example, where the body's proteins have chemically reacted with the pool chemicals, they are physically

changed but, at least in part, remain part of the body, i.e. they are not all rinsed away such as during normal showering.

[0011] Those remaining pool chemicals can be released throughout the day, for example as a result of exposing the skin, hair, etc., to moisture, e.g. water. As discussed above, after swimming in a pool with a chlorinating and/or brominating agent, proteins of the human body may become chlorinated and/or brominated. Subsequent exposure of those chlorinated and/or brominated amino groups to water (e.g. rain or sweat) may release these volatile chemicals, which may be corrosive or irritating.

[0012] Some of these corrosive molecules may be harmful to body and/or textile fibers (e.g. clothing such as swimming attire), or may cause an unpleasant sensation upon contact with the body and/or clothing fibers. Additionally, some of the volatile molecules may be perceived by the nose when liberated from the body and/or clothing, giving rise to odors. These odors are commonly referred to as simply “chlorine” or “pool odor,” and are considered a more chemical odor, rather than the type of odor naturally produced by the body.

[0013] Also, when pool chemicals, such as chlorine or bromine, react with the biological molecules forming the skin and/or eyes, those reactions may cause irritation. For example, some swimmers report itchy or inflamed skin following swimming in pools. Some swimmers indicate that mucous membranes, such as the sensitive nasal skin, become itchy and irritated following swimming.

[0014] Although some people have reported liking “pool odor,” as reminiscent of the pleasures associated with swimming itself, others do not like pool odor or, if strong enough, find the odor irritating, such as to the eyes and lungs. Additionally, since the chemicals liberated may irritate the skin and/or damage the hair, many people wish to prevent “pool odor” and/or the symptoms associated with it.

[0015] As discussed above, rinsing or washing, e.g. body fibers, does not by itself completely eliminate pool odor and/or skin irritation. Mitigating (i.e. decreasing to some extent or eliminating entirely) the effects of exposure to chlorinating and/or brominating agents requires reversing the chemical reaction between those chemicals and the proteins making up the human body. This requires converting the amino-halide bonds, e.g., chloramine (N-Cl) and/or bromamine (N-Br) groups into amino (N-H) groups.

However, the soaps, shampoos, and conditioners currently known do not effectively convert N-Cl and/or N-Br bonds on body fibers back into N-H bonds. Accordingly, N-Cl and/or N-Br remain bonded to the body fibers following rinsing, washing, shampooing, and/or conditioning the body fibers, such as the skin and/or hair.

[0016] Some known shampoo and soap formulations are directed to mitigating the effects of exposure to chlorinating and/or brominating agents. For example, U.S. Patent No. 4,295,985 discloses "a method of removal of chlorine retained by human skin and hair after exposure to chlorinated water, and soap and shampoo compositions adapted to effect said removal." That patent teaches applying urea and thiosulfate salts to the hair and/or body following exposure to chlorinating agents.

[0017] Other known formulations have sought to remove minerals from hair in an effort to prevent discoloration of the hair. For example, U.S. Patent No. 5,804,172 discloses compositions aimed at removing mineral deposits from hair exposed to hard water, particularly the calcium, magnesium, iron, and copper present in some municipal water sources. That patent discloses compositions including four ingredients, which are said to remove minerals from the hair due to the "synergistic combination" of ingredients. Within those compositions, a reducing agent, such as ascorbic acid, is included in an amount chosen to reduce oxidized cysteine-iron bonds. The patent discloses four-component compositions comprising 2.1 percent w/w of ascorbic acid, which is said to be sufficient to reduce the oxidation state of iron ions bonded to hair.

[0018] Additional known formulations have sought to remove chlorine from hair by treating the hair with ammonium lauryl sulfate, cocamide diethanolamine, sodium bicarbonate, cocobetaine, and water. See U.S. Patent No. 4,547,364.

[0019] Finally, a host of other formulations promise to treat damaged hair and/or skin following exposure to swimming pools by using various combinations of ingredients. For example, U.S. Patent No. 4,690,818 discloses a combination of hair and skin conditioners and moisturizers, namely, "a combination of cocodimonium hydrolyzed keratin and a mixture of monosaccharides and disaccharides . . . ."

[0020] However, there still exists a need for a convenient and effective method for mitigating the effects "pool odor" and other adverse effects on the body (e.g., skin

and eye itching and irritation) and/or textiles exposed to water having chlorinating and/or brominating agents in it, such as during swimming.

DESCRIPTION

[0021] Effective treatments for mitigating adverse effects of exposure to chlorinating and/or brominating agents, e.g. swimming pool chemicals and associated itching, irritation, and/or "pool odor," on body and/or clothing fibers have now been discovered. Specifically, it has been discovered that these effects may be mitigated by converting the amino chloride (N-Cl) and/or amino bromide groups (N-Br) bonded to such fibers back into amino (N-H) groups. Although not intending to be bound by theory, it is believed that this conversion reverses the effects of chlorinating and/or brominating agents because eliminating the N-Cl and/or N-Br groups from such fibers prevents those groups from reacting with water to liberate corrosive, odorous, or irritating chemicals throughout daily intercourse.

[0022] According to one aspect of the disclosure, treatment compositions for mitigating adverse effects of exposure to chlorinating and/or brominating agents are disclosed, which may be applied to body and/or clothing fibers. Said treatment compositions comprise an effective amount of ascorbic acid (the L-enantiomer of which is commonly known as vitamin C). For example, one embodiment provides a hair and/or body treatment composition comprising an effective amount of ascorbic acid.

[0023] According to a further aspect of the disclosure, methods of mitigating adverse effects of exposure to chlorinating and/or brominating agents on body and/or clothing fibers are disclosed, comprising applying to said body and/or clothing fibers an effective amount of ascorbic acid.

[0024] In various embodiments, salts and/or derivatives (including but not limited to oxidized forms) of ascorbic acid may be used in place of, or in addition to, ascorbic acid. Salts and/or derivatives of ascorbic acid would function similarly within the context of the disclosed compositions and methods. As non-limiting examples, esters or ethers of ascorbic acid may be used in the compositions and methods of the disclosure. Unless otherwise noted, when the term "ascorbic acid" is used herein, it is intended to include salts and/or derivatives (e.g. oxidized forms) thereof, whether or not so stated.

For example, when present within an aqueous solution, the term “ascorbic acid” as used herein is intended to include products formed as a result of ascorbic acid reacting with water and/or oxygen, such as, for example, dehydroascorbic acid.

[0025] Furthermore, as known, ascorbic acid has stereogenic centers in its structure, for example the carbons modified by the (R)- and (S)- indicators in the chemical name (R)-3,4-dihydroxy-5-((S)- 1,2-dihydroxyethyl)furan-2(5H)-one. This disclosure contemplates use of any combination of stereoisomers of ascorbic acid, including isolated stereoisomers, and all mixtures thereof.

[0026] The term “effective amount of ascorbic acid” as used herein is intended to include any amount of ascorbic acid that is sufficient to convert any or all of the N-Cl and/or N-Br groups bound to body and/or clothing fibers being treated into N-H. In at least one embodiment, an effective amount of ascorbic acid means an amount sufficient to mitigate (i.e. reduce to any degree or eliminate completely) the perceptible adverse effects of pool exposure. For example, in one embodiment, an effective amount of ascorbic acid would be an amount sufficient to reduce or eliminate undesirable “pool odor.” In a further exemplary embodiment, an effective amount of ascorbic acid is an amount sufficient to reduce the number of N-Cl and/or N-Br bonds in body and/or clothing fibers by at least about 50%. In further exemplary embodiments, an effective amount may reduce the number of N-Cl and/or N-Br bonds in body and/or clothing fibers by at least about 60%, at least about 70%, at least about 80%, at least about 90%, at least about 95%, at least about 98%, or at least about 99%.

[0027] By way of example only, with reference to compositions according to the disclosure, an effective amount of ascorbic acid, salts, and/or derivatives (e.g., oxidative degradation products) thereof, may range from about 2.5% to about 25% within an aqueous solution. For example, an aqueous solution according to the disclosure may comprise a concentration of ascorbic acid ranging from about 0.5 to about 2 Molar.

[0028] In at least one embodiment, an effective amount of ascorbic acid means a saturated aqueous solution of ascorbic acid. At standard temperature and pressure a “saturated solution of ascorbic acid” is commonly accepted to be a solution made of 330 grams of ascorbic acid per one liter of water. This concentration will vary as a function of temperature, as will be appreciated by those of skill in the art. In various

embodiments, the disclosure relates to saturated solutions of ascorbic acid at any temperature, meaning the maximum amount of ascorbic acid that is soluble in water at the given temperature.

[0029] The amount of ascorbic acid required to mitigate adverse effects of exposure to chlorinating and/or brominating agents, e.g. pool odor and/or itching and/or skin irritation, may vary from person to person, depending on, for example, how much hair and/or skin that person has. Choosing an effective amount is within the skill of those of skill in the art, and may, for example, be done empirically, using more ascorbic acid where the pool odor and/or itching/ and/or skin irritation persists after applying an initial amount of ascorbic acid. By way of example only, an effective amount of ascorbic acid may range from about 0.2 to about 10 grams, such as about 0.5 to about 5 grams, or such as about 1 to about 3 grams.

[0030] Under some circumstances, the ascorbic acid present in an aqueous solution may degrade via oxidative pathways upon exposure to air. Various embodiments of the disclosure relate, therefore, to aqueous solutions comprising any combination of ascorbic acid and mixtures of these oxidative degradation products, such as dehydroascorbic acid, including aqueous solutions comprising only said oxidative degradation products.

[0031] In various exemplary embodiments, the compositions and methods disclosed herein comprise ascorbic acid solutions having a pH of less than about 6, such as, for example, less than about 5, less than about 4, or less than about 3. In further embodiments, the ascorbic acid solutions may have a pH of between about 3 and about 4. In yet further exemplary embodiments, the ascorbic acid solutions may have a pH of about 2. In one embodiment, the pH of the ascorbic acid solutions may range from about 1.9 to about 2.2.

[0032] In further exemplary embodiments, the ascorbic acid used in the compositions and/or methods described herein may be replaced with, or used in combination with, one or more aqueous acids, salts, and/or derivatives thereof, to form acidic aqueous solutions. Any acid, salt, and/or derivative thereof that is safe for contact with the human hair and/or skin and/or clothing may be used. For example, one or more of the following acids may be used in an acidic aqueous solution contemplated

by the disclosure: acetic acid, citric acid, aconitic acid, adipic acid, benzoic acid, caprylic acid, cholic acid, desoxycholic acid, erythorbic acid, formic acid, glutamic acid, glycocholic acid, hydrochloric acid, lactic acid, linoleic acid, malic acid, nicotinic acid, oleic acid, pectinic acid, phosphoric acid, propionic acid, sorbic acid, stearic acid, succinic acid, sulfamic acid, sulfuric acid, tannic acid, tartaric acid, taurocholic acid, and/or thiodipropionic acid. As such, throughout the disclosure where compositions and methods comprising ascorbic acid, salts, and/or derivatives thereof are described, it should be understood that the ascorbic acid, salts, and/or derivatives may be replaced with, or used in combination with, one or more aqueous acid, salt, and/or derivative thereof.

[0033] In one embodiment, the acidic aqueous solutions may have a pH of less than about 6, such as, for example, less than about 5, less than about 4, or less than about 3. In further embodiments, the acidic aqueous solutions may have a pH of between about 3 and about 4. In yet further exemplary embodiments, the acidic aqueous solutions may have a pH of about 2. In one embodiment, the pH of the acidic aqueous solutions may range from about 1.9 to about 2.2.

[0034] Exemplary compositions according to the disclosure may be aqueous or non-aqueous, and may be in any known form. For example, they may be solutions, powders, tablets, creams, gels, emulsions, etc. In one embodiment, for example, the compositions may be in the form of a tablet, such as an effervescent tablet, which may be placed in water or another solvent before use. In yet a further exemplary embodiment, the composition may be an aqueous solution.

[0035] As non-limiting examples of aqueous ascorbic acid compositions useful according to the disclosure, there may be any amount of (5*R*)-[(1*S*)-1,2-dihydroxyethyl]-3,4-dihydroxyfuran-2(5*H*)-one and dehydroascorbic acid present in various embodiments of the disclosure, as long as at least some amount of ascorbic acid, salts, and/or derivatives thereof is present, such as, for example, one of the following:

[0036] In one embodiment, the aqueous solution of ascorbic acid comprises greater than 99% (5*R*)-[(1*S*)-1,2-dihydroxyethyl]-3,4-dihydroxyfuran-2(5*H*)-one and less than 1% dehydroascorbic acid.

[0037] In one embodiment, the aqueous solution of ascorbic acid comprises from 95-100% (5*R*)-[(1*S*)-1,2-dihydroxyethyl]-3,4-dihydroxyfuran-2(5*H*)-one and from 0-5% dehydroascorbic acid.

[0038] In one embodiment, the aqueous solution of ascorbic acid comprises from 90-100% (5*R*)-[(1*S*)-1,2-dihydroxyethyl]-3,4-dihydroxyfuran-2(5*H*)-one and from 0-10% dehydroascorbic acid.

[0039] In one embodiment, the aqueous solution of ascorbic acid comprises from 80-95% (5*R*)-[(1*S*)-1,2-dihydroxyethyl]-3,4-dihydroxyfuran-2(5*H*)-one and from 5-20% dehydroascorbic acid.

[0040] In one embodiment, the aqueous solution of ascorbic acid comprises from 60-80% (5*R*)-[(1*S*)-1,2-dihydroxyethyl]-3,4-dihydroxyfuran-2(5*H*)-one and from 20-40% dehydroascorbic acid.

[0041] In one embodiment, the aqueous solution of ascorbic acid comprises from 30-60% (5*R*)-[(1*S*)-1,2-dihydroxyethyl]-3,4-dihydroxyfuran-2(5*H*)-one and from 40-70% dehydroascorbic acid.

[0042] In one embodiment, the aqueous solution of ascorbic acid comprises from 0.1-30% (5*R*)-[(1*S*)-1,2-dihydroxyethyl]-3,4-dihydroxyfuran-2(5*H*)-one and from 70-99.9% dehydroascorbic acid.

[0043] In another exemplary embodiment, the composition may be a soap composition. Soap compositions contemplated herein may comprise, *inter alia*, water, ascorbic acid, and soap. In one exemplary embodiment, the composition consists essentially of water, ascorbic acid, and soap.

[0044] Exemplary soap compositions according to the disclosure may be made, for example, by mixing (A) an aqueous solution of ascorbic acid as described herein with (B) a liquid soap composition. In various embodiments, the soap compositions according to the disclosure have a pH of less than about 6, such as, for example, less than about 5, less than about 4, or less than about 3.

[0045] In another exemplary embodiment, the composition may be a foaming composition. Foaming compositions contemplated herein may comprise, *inter alia,* water, ascorbic acid, and a foaming agent.

[0046] Exemplary foaming compositions according to the disclosure may be made, for example, by mixing an aqueous solution of ascorbic acid with a foaming agent (e.g, an appropriate shampoo, soap, or body wash) to form a liquid that is capable of providing a foam when dispensed through a foaming hand soap dispenser. In various embodiments, the foaming compositions according to the disclosure have a pH of less than about 6, such as, for example, less than about 5, less than about 4, or less than about 3.

[0047] In addition to ascorbic acid, salts, and/or derivatives thereof, the compositions of the disclosure may also optionally include other component(s) useful in compositions intended to be applied to body and/or clothing fibers (including, but not limited to emollients, preservatives, perfumes, thickeners, cleansing agents, etc.), as long as the additional component(s) do not substantially interfere with the intended function of the ascorbic acid, i.e. the conversion of the N-Cl and/or N-Br bonds to N-H bonds. It may also be desirable in various embodiments that the additional components do not damage or otherwise adversely affect the body and/or clothing fibers. One of skill in the art would be able, through routine experimentation, to formulate acceptable compositions comprising an effective amount of ascorbic acid, salts, and/or derivatives thereof, and formulations thereof, for treatment of body and/or clothing fibers as described herein.

[0048] Further aspects of the disclosure provide methods of mitigating adverse effects of exposure to chlorinating and/or brominating agents, e.g. swimming pool chemicals and associated itching, irritation, and/or “pool odor.” Said methods comprise treating body and/or clothing fibers with an effective amount of ascorbic acid, e.g. applying an effective amount of said ascorbic acid to said body and/or clothing fibers. Additional embodiments comprise methods of treating body and/or clothing fibers with salts and/or derivatives of ascorbic acid, in place of or in addition to ascorbic acid. As above, any combination of stereoisomers of ascorbic acid are contemplated for use in the methods of the disclosure. Also, any and all degradation products of ascorbic acid are contemplated for use in the methods of the disclosure.

[0049] In at least one exemplary method, the effective amount of ascorbic acid is applied by spraying an effective amount of aqueous solution of ascorbic acid onto the

body fibers of a subject, such as, for example, the skin and/or hair, or onto clothing. The effective amount of ascorbic acid may be sprayed by any method known, such as, for example, an aerosol spray or a non-aerosol pump bottle.

[0050] In at least one exemplary embodiment, the effective amount of ascorbic acid is applied by using a foaming composition comprising ascorbic acid, water, and a foaming agent. In some exemplary embodiments, the foaming composition is applied by dispensing said foaming composition through a dispenser (e.g. a foaming hand- or body-soap, or shampoo, dispenser), thereby creating a foaming lather, which is applied to the hair and/or skin.

[0051] In at least one exemplary embodiment, a person exposed to a swimming pool may optionally first rinse the residual pool water from his/her hair and/or body, then apply an effective amount of ascorbic acid to his/her hair and/or body. In some embodiments, the person may thereafter immediately or substantially immediately wash the hair and/or body with soap, or may apply shampoo and/or conditioner. In further embodiments, the effective amount of ascorbic acid is sprayed onto the hair and/or body after rinsing off residual pool water without subsequently immediately or substantially immediately washing the hair and/or body.

[0052] This disclosure also contemplates applying an effective amount of ascorbic acid without first rinsing. When ascorbic acid is applied without first rinsing, more ascorbic acid may, in at least some embodiments, be required than when applied subsequent to rinsing.

[0053] In at least one exemplary embodiment, the method of applying an effective amount of ascorbic acid is intended to include a method where a subject, such as a swimmer, applies an amount of ascorbic acid sufficient to reduce and/or eliminate his/her own “pool odor” and/or irritation as perceived by the subject. For a particular aqueous solution according to the disclosure, the effective amount of ascorbic acid required to reduce and/or eliminate the subject’s odor and/or irritation may depend on the amount of hair and/or skin that the subject has. Generally speaking, a subject may adjust the amount of ascorbic acid applied based on his or her own observations—if the subject experiences “pool odor” and/or irritation following administering aqueous ascorbic acid, more may be applied.

[0054] In various embodiments, the methods according to the disclosure relate to methods of treating hair comprising applying an effective amount of a composition comprising ascorbic acid, as described herein. It is contemplated that a person with little or no hair would recognize that using a smaller amount of ascorbic acid provides effective reduction or elimination of "pool odor" and/or irritation, and thus, in at least certain embodiments, an effective amount may be less than in an embodiment where a person has a lot of hair.

[0055] In various additional embodiments, such methods comprise treating body and/or clothing fibers comprising applying an effective amount of a compositions comprising ascorbic acid, as described herein.

[0056] The ascorbic acid, salts and/or derivatives thereof, and/or the compositions comprising ascorbic acid, salts and/or derivatives thereof, may, in various embodiments, be applied to the body and/or clothing fibers and immediately removed (e.g. by rinsing the fibers right away), or may be left on the fibers for a period of time after application. For example, the body and/or clothing fibers may be washed (e.g. with soap or shampoo) subsequent to the application of ascorbic acid.

[0057] As described herein, the invention is set forth with regard to "people" for ease of reference only. However, the invention is not limited to humans, but rather is intended to include any mammal having body fibers that can form an N-Cl or N-Br bond. As such, the use of the terms "swimmer" or "people" is intended to include any mammal that swims or is otherwise exposed to swimming pool chemicals such as chlorine and/or bromine.

[0058] The terms "pool chemicals" and the like are used generally throughout the disclosure for ease of reference, but should not be considered limited to chemical exposure in a swimming pool. Rather, any chemical such as chlorinating agents (e.g., hypochlorite salts such as calcium hypochlorite or sodium hypochlorite, hypochlorous acid) or brominating agents (e.g., bromine, salts comprising bromine, hypobromous acid, etc.) are intended to be included with reference to "pool chemicals" and the like, whether or not a person is actually exposed to those chemicals in a swimming pool.

[0059] Further embodiments of the disclosure are related to methods for treating textiles, such as, for example, towels, swimming attire, swimming accessories, etc.,

exposed to chlorinated and/or brominated pool water, with an aqueous solution of ascorbic acid. Such treatment may reduce the "pool odor" of, and/or "wear" associated with such exposure on, the textiles. For example, treating swimming attire exposed to chlorinated and/or brominated pool water with an aqueous solution of ascorbic acid as described herein has been found to reduce the "pool odor" of that swimming attire. Treating swimming attire exposed to chlorinated and/or brominated pool water with an aqueous solution of ascorbic acid has also been found to reduce the oxidative damage done to the swimming attire, thereby prolonging its life and reducing the fading and/or discoloration of its materials, typically associated with such textiles. As used herein, the terms "clothing" and "textiles" should be considered interchangeable in that when the term "clothing" is used, it is intended to include any textiles within the scope of the disclosure. For example, when reference is made to treatment of a swimmer's clothing or attire, it is intended that a swimmer's towel, etc., is included in said disclosure and claims.

[0060] In at least one exemplary method, an effective amount of ascorbic acid is applied by treating the textiles with an aqueous solution of ascorbic acid, such as by applying an aqueous solution of ascorbic acid by contacting the textiles with said solution. Any method for treating textiles known in the art may be used, such as, for example, spraying the textile with a solution of ascorbic acid with an aerosol or non-aerosol spray; immersing the textile into a solution of ascorbic acid; and/or washing the textile with a soap composition comprising ascorbic acid.

[0061] In one exemplary embodiment, the textiles may optionally first be rinsed with standard tap water before applying the ascorbic acid as described herein, and optionally thereafter be rinsed a second time with standard tap water after the application of the ascorbic acid. In another embodiment, the effective amount of ascorbic acid is applied without first rinsing the textiles with standard tap water. The textiles may optionally be washed as normal, subsequent to the application of the ascorbic acid as described herein.

[0062] In at least one exemplary embodiment, the textiles may be treated with about 0.2 to about 10 grams of ascorbic acid, such as about 0.5 to about 5 grams of ascorbic acid, or about 1 to about 3 grams of ascorbic acid.

[0063] Although the present disclosure herein has been described with reference to various exemplary embodiments, it is to be understood that these embodiments are merely illustrative of the principles and applications of the present disclosure. Those having skill in the art would recognize that various modifications to the exemplary embodiments may be made, without departing from the scope of the invention.

[0064] Moreover, it should be understood that various features and/or characteristics of differing embodiments herein may be combined with one another. 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 scope of the invention.

[0065] It will be appreciated that there is an implied “about” prior to all numerical values recited herein, whether or not so stated. It should also be understood that the precise numerical values used in the specification and claims form additional embodiments. Efforts have been made to ensure the accuracy of the numerical values disclosed herein. Any measured numerical value, however, can inherently contain certain errors resulting from the standard deviation found in its associated measuring technique.

[0066] Furthermore, other embodiments of the disclosure will be apparent to those skilled in the art from consideration of the specification and practice of the invention disclosed herein. It is intended that the specification and examples be considered as exemplary only, with a scope and spirit being indicated by the claims.

[0067] Finally, it is noted that, as used in this specification and the appended claims, the singular forms "a," "an," and "the," include plural referents unless expressly and unequivocally limited to one referent, and vice versa. Thus, by way of example only, reference to "a composition" can refer to one or more compositions, and reference to “a salt of ascorbic acid” can refer to one or more salts of ascorbic acid. As used herein, the terms “comprise”, “comprises”, “comprising”, “contain”, “contains”, “containing”, “have”, “having”, “include”, “includes”, and “including” are intended to be non-limiting, such that recitation of an item or items is not to the exclusion of other like items that can be substituted or added to the recited item(s).

EXAMPLES

[0068] The following examples are illustrative only, and are not intended to be limiting of the invention, as claimed.

Example 1

[0069] At standard temperature and pressure, 330 grams of ascorbic acid were dissolved in 1 L of water. This solution 1 was then applied to hair that had been exposed to swimming pool chemicals.

Example 2

[0070] At standard temperature and pressure, 300 grams of ascorbic acid were dissolved in 1 L of water. This solution 2 was then applied to hair that had been exposed to swimming pool chemicals.

Example 3

[0071] At standard temperature and pressure, 270 grams of ascorbic acid were dissolved in 1 L of water. This solution 3 was then applied to hair that had been exposed to swimming pool chemicals.

Example 4

[0072] At standard temperature and pressure, 240 grams of ascorbic acid were dissolved in 1 L of water. This solution 4 was then applied to hair that had been exposed to swimming pool chemicals.

Example 5

[0073] At standard temperature and pressure, 210 grams of ascorbic acid were dissolved in 1 L of water. This solution 5 was then applied to hair that had been exposed to swimming pool chemicals.

Example 6

[0074] At standard temperature and pressure, 180 grams of ascorbic acid were dissolved in 1 L of water. This solution 6 was then applied to hair that had been exposed to swimming pool chemicals.

Example 7

[0075] At standard temperature and pressure, 150 grams of ascorbic acid were dissolved in 1 L of water. This solution 7 was then applied to hair that had been exposed to swimming pool chemicals.

Example 8

[0076] At standard temperature and pressure, 120 grams of ascorbic acid were dissolved in 1 L of water. This solution 8 was then applied to hair that had been exposed to swimming pool chemicals.

Example 9

[0077] At standard temperature and pressure, 90 grams of ascorbic acid were dissolved in 1 L of water. This solution 9 was then applied to hair that had been exposed to swimming pool chemicals.

Example 10

[0078] At standard temperature and pressure, 60 grams of ascorbic acid were dissolved in 1 L of water. This solution 10 was then applied to hair that had been exposed to swimming pool chemicals.

Example 11

[0079] At standard temperature and pressure, 30 grams of ascorbic acid were dissolved in 1 L of water. This solution 11 was then applied to hair that had been exposed to swimming pool chemicals.

Example 12

[0080] At standard temperature and pressure, 180 grams of ascorbic acid were dissolved in 1 L of water. The resulting solution 12 was transferred into 3 oz spray bottles. Following swimming in a chlorinated swimming pool, a subject's skin and hair were rinsed with warm shower water for about 30 seconds. Then, the solution 12 was applied to the subject by spraying the solution onto the skin and hair. A total of 10 mL of solution 12 was evenly sprayed onto the subject's skin, and a total of 20 mL of solution 12 was evenly sprayed onto the subject's hair. The subject was then allowed to wash and rinse their skin with soap, and shampoo, rinse, and condition their hair, as normal. The shampoo was applied to the hair without first rinsing out the solution 12, so that the shampoo and lather distributed the solution.

Example 13

[0081] At standard temperature and pressure, 240 grams of ascorbic acid were dissolved in 1 L of water. The resulting solution 13 was transferred into 3 oz spray bottles.

[0082] Six swimmers were immersed in a swimming pool (Washington Lee High School swimming pool in Arlington, Virginia) for a period of one hour. Each of the subjects was assigned to one of two groups: three to the Swim Spray group and three to the control group.

[0083] After exiting the pool, the three swimmers in the Swim Spray group rinsed their skin and hair with warm shower water for about 30 seconds and then applied the solution 13 by spraying the solution onto their skin and hair. A total of 5 mL of solution 13 was sprayed onto each subject's skin, and a total of 10 mL of solution 13 was sprayed onto each subject's hair. After exiting the pool, the three swimmers in the control group similarly rinsed their hair and skin with warm shower water, but did not apply the solution.

[0084] All six swimmers were then allowed to wash and rinse their skin with soap, and shampoo, rinse, and condition their hair, as normal. All subjects used the same shampoo and conditioner (Garnier Fructis for regular hair). In the Swim Spray group, the shampoo was applied to the hair without first rinsing out the solution 13, so that the

shampoo and lather distributed the solution. Both groups then towel dried and waited for 30 minutes.

[0085] After 30 minutes, water was applied to a 3 cm x 3 cm area of the subject's forearm, by gently swabbing with a warm, damp cloth. The subjects were then smelled by a blind judge (i.e., having no knowledge of whether any subject did or did not use the solution). The judge noted that each member of the control group smelled like "pool" or "chlorine," whereas the judge found that odor either "faint" or "not at all" for the members of the Swim Spray group.

[0086] The experiment was repeated, and consistent results were obtained.

WHAT IS CLAIMED IS:

1. A method of mitigating adverse effects of exposure to chlorinating and/or brominating agents on body and/or clothing fibers, said method comprising applying to said body and/or clothing fibers an effective amount of ascorbic acid, salts, and/or derivatives thereof.

2. The method according to claim 1, wherein the ascorbic acid is present in an amount sufficient to reduce the number of N-Cl and/or N-Br bonds in body and/or clothing fibers by at least 50%.

3. The method according to claim 2, wherein the ascorbic acid is present in an amount sufficient to reduce the number of N-Cl and/or N-Br bonds in body and/or clothing fibers by at least 70%.

4. The method according to claim 3, wherein the ascorbic acid is present in an amount sufficient to reduce the number of N-Cl and/or N-Br bonds in body and/or clothing fibers by at least 90%.

5. The method according to claim 4, wherein the ascorbic acid is present in an amount sufficient to reduce the number of N-Cl and/or N-Br bonds in body and/or clothing fibers by at least 99%.

6. The method according to claim 1, comprising applying an aqueous solution comprising an effective amount of ascorbic acid, salts, and/or derivatives thereof, onto said body and/or clothing fibers.

7. A method according to claim 6, wherein the body fibers are chosen from human hair, skin, mucous membranes, and/or nails.

8. A composition for treating body and/or clothing fibers comprising from about 5 wt% to about 25 wt% of ascorbic acid, salts, and/or derivatives thereof.

9. The composition according to claim 8, wherein the composition is in the form of an aqueous solution.

10. The composition according to claim 9, wherein the aqueous solution is substantially free of other components.

11. The composition according to claim 9, consisting essentially of water and at least one of ascorbic acid, salts of ascorbic acid, and derivatives of ascorbic acid.

12. The composition according to claim 9, wherein the aqueous solution has an ascorbic acid concentration ranging from about 0.5 to about 2 Molar.

13. The composition according to claim 12, wherein the said ascorbic acid concentration ranges from about 1 to about 2 Molar.

14. The composition according to claim 10, wherein the aqueous solution has an ascorbic acid concentration ranging from about 0.5 to about 2 Molar.

15. The composition according to claim 14, wherein the said ascorbic acid concentration ranges from about 1 to about 2 Molar.

16. The composition of claim 10, wherein said aqueous solution is a saturated solution of ascorbic acid.

17. The method of claim 1, wherein the step of applying an effective amount of ascorbic acid, salts, and/or derivatives thereof comprises spraying a solution of ascorbic acid onto said body and/or clothing fibers.

18. The method of claim 1, wherein said effective amount of ascorbic acid, salts, and/or derivatives thereof ranges from about 0.2 grams to about 10 grams of ascorbic acid.

19. The method of claim 18, wherein said effective amount ranges from about 1 gram to about 3 grams of ascorbic acid.

20. The method of claim 17, wherein said effective amount of ascorbic acid, salts, and/or derivatives thereof ranges from about 0.2 grams to about 10 grams of ascorbic acid.

21. The method of claim 17, wherein said body fibers comprise hair.

22. The method of claim 17, wherein said body fibers comprise skin.

23. A method for mitigating adverse effects of exposure to chlorinating and/or brominating agents on body and/or clothing fibers, said method comprising applying to said body and/or clothing fibers an aqueous solution comprising water and ascorbic acid,

wherein the ascorbic acid comprises from about 0.01 to about 99.99% (5*R*)-[(1*S*)-1,2-dihydroxyethyl]-3,4-dihydroxyfuran-2(5*H*)-one, and from about 0.01 to about 99.99% dehydroascorbic acid.

24. An aqueous solution for treating body and/or clothing fibers, said aqueous solution comprising water and ascorbic acid,

wherein the ascorbic acid comprises from about 0.01 to about 99.99% (5*R*)-[(1*S*)-1,2-dihydroxyethyl]-3,4-dihydroxyfuran-2(5*H*)-one, and from about 0.01 to about 99.99% dehydroascorbic acid.