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(54) Title: NATURALLY-DERIVED SURFACE SANITIZER AND DISINFECTANT

(57) Abstract: Food processing equipment, food contact surfaces, and non-food contact surfaces are sanitized or disinfected using an acid-anionic surfactant solution that has efficacy in hard water, is non-corrosive, and is stable at elevated temperatures. The sanitizing/disinfecting solution is prepared as a highly concentrated liquid and diluted to end use concentrations prior to application to food processing equipment or food or non-food contact surfaces. Efficacy in hard water is important for sanitizers and disinfectants that are diluted by the end user using potentially hard water. Stability at elevated temperatures is important for long-term storage and transportation. The diluted sanitizing/disinfecting solution exhibits strong antimicrobial activity against gram positive and gram negative bacteria even when diluted in hard water. The sanitizing/disinfecting solution exhibits low toxicity to humans and the environment since it is prepared from low toxicity ingredients that are readily biodegradable.

NATURALLY-DERIVED SURFACE SANITIZER AND DISINFECTANT

FIELD OF THE INVENTION

[0001] This invention relates to the sanitization and disinfection of food processing equipment and food and non-food contact surfaces using a sanitizing/disinfecting solution that is formulated with naturally derived ingredients and maintains efficacy when diluted in hard water. The sanitizing/disinfecting solution is prepared as a highly concentrated liquid that is stable at elevated temperature, which is important for long-term storage and transportation. The sanitizer/disinfectant is non corrosive, which is important when sanitizing or disinfecting food processing equipment and food and non-food contact surfaces. The sanitizing/disinfecting solution exhibits low human and environmental toxicity since it is prepared from low toxicity ingredients that are readily biodegradable.

BACKGROUND OF THE INVENTION

[0002] Food processing equipment and food contact surfaces (e.g., tables and countertops) require sanitization or disinfection between food preparations, particularly when processing raw food such as cutting meat, in order to prevent cross-contamination and the spread of food-borne diseases. In addition, non-food contact surfaces benefit from sanitization and disinfection to limit pathogen loads and the spread of potentially infectious agents (e.g., in hospital, industrial, commercial, or household settings). Food processing equipment is often cleaned using one solution and then sanitized/disinfected with a separate solution. The solutions described in this invention allow the same solution to be used for cleaning and sanitizing/disinfecting since the solution has good cleaning power and strong antimicrobial efficacy. Sanitization greatly reduces the bioburden (e.g., bacteria, yeasts, molds, viruses) on the food or non-food contact surface and thereby reduces the likelihood of the spread of microbial diseases. Disinfection provides an even greater reduction in the amount of bioburden and in turn an even greater reduction in the likelihood of the spread of microbial diseases. The sanitizing/disinfecting solution described in this invention has the ability to function as a sanitizer and a disinfectant.

[0003] Many sanitizing and disinfecting compositions have been developed. Many are not approved for food contact surface use since they are formulated with ingredients that would be harmful if their residues on the food contact surface were transferred to food and

were subsequently ingested by humans. Sanitizing and disinfecting compositions that are acceptable for food contact surface use are often corrosive to the food processing equipment or food contact surface since they often contain chlorine, chlorine dioxide, chlorinated or halogenated compounds, peracetic acid, or other corrosive ingredients. Therefore, there is a need for a low toxicity, non-corrosive sanitizing/disinfecting solution for food and non-food contact surface use.

[0004] Various patents have disclosed the antimicrobial properties of low pH (acidic)-anionic surfactant formulations, with some of the patents disclosing the use of low pH-anionic surfactant formulations on food contact surfaces. US Patent 6,953,772 discloses a food contact surface sanitizing solution including at least lactic acid and phosphoric acid, an anionic surfactant, and a sequestering agent. US Patent 5,143,720 discloses anhydrous sanitizing/disinfecting compositions including an acid and an anionic surfactant, and includes example anhydrous (dry) formulations including an acid, an anionic surfactant, and low concentrations of short chain fatty acids, although the purpose of including the fatty acids in the anhydrous formulations is not described. US Patent 4,715,980 discloses a food contact surface sanitizing composition including a dicarboxylic acid, another acid, and an anionic surfactant. US Patent 5,280,042 discloses food contact surface sanitizing and disinfecting compositions against cyst or oocyte forms of protozoa including an anionic surfactant and an acidic component. US Patent 6,867,233 discloses an acidic antimicrobial composition for use on food contact surfaces including an organic acid, an anionic surfactant, polypropylene glycol, and a carbonate. US Patent 7,851,430 discloses a food contact surface disinfecting composition containing an organic acid, an anionic surfactant, and a buffering agent.

[0005] US Patent 6,262,038 discloses a germicidal composition including a mixture of alpha-hydroxy fruit acid, anionic surfactant, and sophorose lipid biosurfactant for use on skin or hair. US Patent 5,490,992 discloses a disinfectant composition including a fatty acid monoester, an acid, and an anionic surfactant for use on poultry carcasses.

[0006] US Patent 4,404,040, discloses formulations for sanitizing dairy and brewery equipment using a solution comprising an aliphatic short chain fatty acid, a solubilizer (e.g., an anionic surfactant), and an acid. This patent further discloses the optional use of alcohols at low concentrations (≤0.2%) to help reduce the viscosity of the final concentrated solution.

[0007] A major limitation of the referenced low pH-anionic surfactant concentrate formulations is that their efficacy (cleaning ability and antimicrobial activity) may be adversely affected when diluted with hard water (e.g., water containing at least 300 ppm hardness ions such as calcium and magnesium, and especially at least 500 ppm hardness ions). Anionic surfactants such as sodium lauryl sulfate often have better hard water tolerance than soaps (saponified fatty acids); however, anionic surfactants may still suffer from reduced efficacy in hard water due to the formation of insoluble compounds when complexed with the calcium and magnesium ions typically present in hard water. In addition, acid-anionic surfactant formulations are inherently unstable due to hydrolysis of the anionic surfactant. This is particularly problematic at higher temperatures that may be encountered during storage of the product. It is accordingly an object of this invention to provide a stable, naturally-derived sanitizing/disinfecting solution that retains efficacy in hard water. In addition, the solution should exhibit low human and environmental toxicity and be non-corrosive.

SUMMARY OF THE INVENTION

[0008] In accordance with one embodiment, the invention is directed towards a sanitizing and disinfecting solution concentrate composition comprising: a) at least about 10 wt% water; b) one or more natural first organic acids at a total concentration of at least about 10 wt% and sufficient to provide a solution pH of from about 1.2 - 5.0; c) one or more sulfated fatty acid surfactants at a total concentration of at least about 5 wt%; d) one or more monocarboxylic fatty acids at a total concentration of at least about 0.1 wt%, wherein the one or more monocarboxylic fatty acids are distinct from the one or more natural first organic acids; and e) one or more alcohols at a total concentration of at least about 1 wt%. The invention further provides a method of cleaning, sanitizing, or disinfecting a food or non-food contact surface comprising diluting such a concentrate composition with at least 9 additional parts of water to one part of the concentrate composition to form a diluted solution having a pH of from about 1.2 - 5.0, and contacting the surface with the diluted solution.

[0009] The present invention involves sanitizing and disinfecting food and non-food contact surfaces using low pH, anionic surfactant formulations, which retain efficacy (cleaning ability and antimicrobial activity) when diluted to end-use concentrations in hard water. Furthermore, the formulations are prepared from naturally-derived ingredients and the formulations exhibit low human and environmental toxicity. The low environmental toxicity

is particularly important for sanitizers/disinfectants that will be disposed of in commercial or residential waste water systems (e.g., rinsing of treated surfaces).

[0010] As described in the background information, this invention is partly predicated on the ability of low pH anionic surfactant formulations to kill microorganisms, such as food-borne bacterial pathogens. In accordance with the present invention, it has been discovered that adding a monocarboxylic fatty acid greatly improves the hard water tolerance of the sanitizing/disinfecting solution. Additionally, it has been discovered that further use of critical concentrations of organic alcohols provide elevated temperature stability to the formulations since both the anionic surfactant and fatty acid can separate out of solution during storage at elevated temperatures. The ingredients used to formulate the sanitizing/disinfecting solution are advantageously naturally-derived (i.e., found in nature, found in our bodies naturally, and/or undergone minimal chemical modifications [e.g., saponification or sulfation of fatty acids]) and exhibit low human and environmental toxicity when formulated and used at end-use concentrations. The formulations of the invention are further advantageously non-corrosive to stainless steel and aluminum, two materials often used in food and non-food contact surfaces, and leave little to no undesirable residue on the cleaned/sanitized/disinfected surface.

DETAILED DESCRIPTION OF THE INVENTION

[0011] The present invention pertains to the use of sanitizing and disinfecting formulations on food and non-food contact surfaces and which are stable and have high tolerance to hard water (e.g., water having at least 300 ppm hardness ions such as calcium and magnesium, and especially water having at least 500 ppm hardness ions). The invention applies to all types of food and non-food contact surfaces such as food processing equipment, tables, countertops, cutting boards, inanimate medical surfaces (e.g., examination tables, lights, equipment), and other general surfaces found in healthcare, industrial, commercial, and household settings. Of critical importance is the tolerance to hard water since that allows end-users of the product to dilute the concentrated sanitizing/disinfecting solution in regular tap water and maintain excellent efficacy (cleaning and antimicrobial properties). In addition, the use of critical concentrations of organic alcohol provides stability during storage at elevated temperatures, which is important for both short- and long-term storage of solutions.

[0012] The sanitizers and disinfectants are comprised of an organic acid, a naturally-derived anionic surfactant, a natural fatty acid, and an organic alcohol. The organic acid and anionic surfactant provide strong antimicrobial properties necessary for food and non-food contact surface sanitizers and disinfectants. The fatty acid provides greatly improved efficacy in hard water and also reduces the foaming properties inherent with an anionic surfactant. A critical concentration of at least about 1 wt% of the organic alcohol provides elevated temperature stability to the formulations. Sodium sulfate or sodium bisulfate can be optionally included to further increase the efficacy in hard water. An essential oil can be optionally included to add a natural scent to the sanitizer/disinfectant.

[0013] All ingredients in the formulations are naturally derived (i.e., found in nature, found naturally in the human body, and/or undergone limited chemical modification [e.g., saponification or sulfation of a fatty acid]) and exhibit low human and environmental toxicity at end-use concentrations. The organic acid can be provided by one or more (e.g., combinations) of the following natural organic acids: citric acid, fumaric acid, humic acid, acetic acid, or ascorbic acid. Other similar natural organic acids can also be used. The concentrated liquid sanitizer/disinfectant formulation contains at least about 10 wt% of one or more natural first organic acids sufficient to provide a solution pH of from about 1.2 - 5.0, e.g., from about 10 – 40 wt% of such one or more natural first organic acid, preferably 15 – 35 wt%, and most preferably 21 – 30 wt%. Upon dilution to end-use concentrations, the diluted solution may contain, e.g., 0.01 – 4.0 wt% of the organic acid, preferably, 0.015 – 3.5 wt%, and most preferably, 0.021 – 3.0 wt%.

[0014] A naturally-derived, sulfated fatty acid (e.g., sodium lauryl sulfate) is used as the anionic surfactant. The concentrated liquid sanitizer/disinfectant formulation contains at least about 5 wt%, e.g., 5 –30 wt%, of the anionic surfactant, preferably 8 – 20 wt%, and most preferably 10.5 – 12 wt%. Upon dilution to end-use concentrations, the diluted solution contains 0.005 – 3.0 wt% anionic surfactant, preferably, 0.008 – 2.0 wt%, and most preferably, 0.0105 – 1.2 wt%. The sulfated fatty acid in a particular embodiment comprises a C6-C18 alkyl sulfate, and in a more specific embodiment a C8-C14 alkyl sulfate. One or more (e.g., combinations) of any natural sulfated fatty acid (e.g., sodium lauryl sulfate, sodium caprylyl sulfate) can be used.

[0015] The monocarboxylic fatty acid can be provided by one or more (e.g., combinations) of the natural organic fatty acids, and in particular one or more saturated or

unsaturated C6-C18 monocarboxylic acids. In a particular embodiment, the fatty acids can be provided by one or more of the following natural organic fatty acids: caproic acid, caprylic acid, capric acid, lauric acid, myristic acid, palmitic acid, stearic acid, oleic acid, linoleic acid, gamma-linolenic acid, hexadecatrienoic acid, alpha-linolenic acid, pinolenic acid, or stearidonic acid. Other similar natural fatty acids can also be used. The monocarboxylic fatty acid employed is distinct from the one or more natural first organic acids sufficient to provide a solution pH of from about 1.2 - 5.0, as such fatty acids are typically not capable of themselves providing such low pH. The concentrated liquid sanitizer/disinfectant formulation contains at least about 0.1 wt%, e.g., 0.1 - 5 wt% moncarboxylic fatty acid, preferably 0.5 - 3 wt%, and most preferably 1 – 3 wt%. Upon dilution to end-use concentrations, the diluted solution may contain, e.g., 0.0001 – 0.5 wt% monocarboxylic fatty acid, preferably, 0.0005 – 0.3 wt%, and most preferably, 0.001 – 0.2 wt%.

[0016] The organic alcohol can be provided by any organic alcohol, with ethanol and isopropanol being common examples. The concentrated liquid sanitizer/disinfectant formulation contains at least about 1 wt%, e.g., about 1 - 20 wt% alcohol, preferably 2 - 10 wt%, and most preferably 3 - 10 wt%. Upon dilution to end-use concentrations, the diluted solution may contain, e.g., 0.001 – 2 wt% alcohol, preferably, 0.0015 – 1.5 wt%, and most preferably, 0.002 – 0.7 wt%.

[0017] The concentrated solution is formulated to have a pH of from about 1.2 to 5, as a pH of greater than 5 results in a formulation that has poor antimicrobial properties, while a pH of less than about 1.2 results in strong irritating properties. Optionally, the pH of the resulting solution can be adjusted with a buffering agent, such that the pH of the final, diluted sanitizer/disinfectant solution remains under 5.0 (preferably from 1.8 to 4.0, most preferably 2.0 - 3.0) upon dilution since antibacterial efficacy is decreased as pH increases. The buffering agent can be selected from one of the following basic neutralizing agents: calcium carbonate, magnesium carbonate, potassium carbonate, potassium bicarbonate, sodium carbonate, or sodium bicarbonate. Alternatively, a combination of the organic acid, any sodium, potassium, magnesium, or calcium salt form of the organic acid, and/or one of the previously listed basic neutralizing agents can be combined in a ratio that results in the target pH.

[0018] Sodium sulfate or sodium bisulfate can optionally be added to the formulation to further increase tolerance to hard water. When combined with the fatty acid, sodium

sulfate or sodium bisulfate increase the tolerance to hard water even more than the fatty acid or sulfate salts alone. When added, the sodium sulfate or sodium bisulfate is preferably present in the concentrated solution formulation at from about 0.1 to 10 wt%, more preferably about 2 - 8 wt%. While use of too much sodium sulfate or sodium bisulfate alone to provide hard water tolerance control can lead to solution gelling, the combination of a fatty acid with such relatively low levels of sodium sulfate or sodium bisulfate in the concentrate formulation further advantageously enables effective hard water tolerance control in a concentrate solution with acceptable viscosity. Upon dilution to end-use concentrations, the diluted solution may preferably contain, e.g., 0.001 – 1 wt% sodium sulfate or sodium bisulfate, preferably, 0.01 – 0.5 wt%, and most preferably, 0.02 – 0.1 wt%.

[0019] In further specific embodiments, the weight ratio of the one or more natural first organic acids sufficient to provide a solution pH of from about 1.2 - 5.0 to the sulfated fatty acid surfactant is preferably from about 1-4, as such ratios effectively enable providing sufficient acid to maintain the desired low pH in the diluted solution, and simultaneously sufficient surfactant to aid with cleaning ability of the diluted solution. Additionally, the weight ratio of the one or more natural first organic acids sufficient to provide a solution pH of from about 1.2 - 5.0 to the one or more fatty acids is preferably from 5-29, and more preferably from 9-28, as such ratios enable formulations that are relatively easy to formulate (formulations with lower ratios may be relatively difficult to formulate as concentrated solutions) and that provide effective hard water tolerance control (formulations with higher ratios may not provide as effective hard water control).

[0020] Sanitizing and disinfecting solutions are prepared as highly concentrated solutions, which allow end users to prepare larger quantities of end-use solutions from small amounts of concentrated solution. This also facilitates shipping and handling by minimizing product volume. In a particular embodiment, e.g., the concentrated solution compositions of the invention are designed to be diluting with at least 9 additional parts of water to one part of the concentrate composition to form a diluted solution having a pH of from about 1.5 - 5.0 used for cleaning, sanitizing, or disinfecting a food or non-food contact surface. In particular embodiments, it is preferred that the highly concentrated solution be prepared as a 30 – 1000X concentrate (i.e., formulated for dilution of 1 part of concentrated solution in 29 to 999 parts of water, respectively, to prepare the 1X end-use diluted formulation), preferably 40 – 300X, and most preferably 60 – 150X.

[0021] The food or non-food contact surface may be treated with the 1X end-use diluted sanitizing or disinfecting solution by flooding, dipping, spraying, coating, wiping, or any other means that facilitates contact of the solution with the surface. The surface is exposed to the sanitizing or disinfecting solution for, e.g., from 10 seconds to 15 minutes, preferably 20 seconds to 10 minutes, and most preferably 30 seconds to 5 minutes. After exposure of the surface to the sanitizing or disinfecting solution, the surface may be allowed to dry. If a method such as flooding is used, excess solution is preferably removed (e.g., drained) prior to drying. When food contact surfaces are treated in this manner, they are sanitized or disinfected and the risk of transmission of pathogens is greatly reduced.

[0022] The following are examples of several concentrated sanitizing and disinfecting formulations prepared according to this invention:

[0023] Example 1: A 64X concentrate is prepared as outlined in the following Table 1.1:

[0024] Table 1.1

	WEIGHT PERCENT	
INGREDIENT	64X Concentrate	1X Dilution
Citric acid	25.6	0.40
Lauric acid	1.3	0.02
Sodium lauryl sulfate	10.5	0.16
Sodium bicarbonate	2.6	0.04
Isopropanol	5.5	0.09
Water	to 100%	To 100%

[0025] The pH of the resulting concentrated solution is approximately 2.20. The 64X concentrate is then diluted to prepare a 1X end-use diluted sanitizing/disinfecting solution by diluting 1 part of the 64X concentrate with 63 parts of water. The pH of the resulting end-use solution is approximately 2.50.

[0026] Example 2: A 64X concentrate is prepared as outlined in the following Table 1.2:

[0027] Table 1.2

INGREDIENT	WEIGHT PERCENT	
	64X Concentrate	1X Dilution
Citric acid	25.6	0.40
Lauric acid	1.3	0.02
Sodium lauryl sulfate	10.5	0.16
Sodium bicarbonate	2.6	0.04
Isopropanol	5.5	0.09
Sodium sulfate	5.1	0.08
Water	to 100%	To 100%

[0028] The pH of the resulting concentrated solution is approximately 2.21. The 64X concentrate is then diluted to prepare a 1X end-use diluted sanitizing/disinfecting solution by diluting 1 part of the 64X concentrate with 63 parts of water. The pH of the resulting end-use solution is approximately 2.56.

[0029] Example 3: A 64X concentrate is prepared as outlined in the following Table 1.3:

[0030] Table 1.3

INGREDIENT	WEIGHT PERCENT	
	64X Concentrate	1X Dilution
Citric acid	25.6	0.40
Capric acid	1.3	0.02
Sodium lauryl sulfate	10.5	0.16
Sodium bicarbonate	2.6	0.04
Isopropanol	5.5	0.09
Water	to 100%	To 100%

[0031] The pH of the resulting concentrated solution is approximately 2.18. The 64X concentrate is then diluted to prepare a 1X end-use diluted sanitizing/disinfecting solution by diluting 1 part of the 64X concentrate with 63 parts of water. The pH of the resulting end-use solution is approximately 2.53.

[0032] Example 4: A 64X concentrate is prepared as outlined in the following Table 1.4:

[0033] Table 1.4

INGREDIENT	WEIGHT PERCENT	
	64X Concentrate	1X Dilution
Citric acid	25.6	0.40
Capric acid	1.3	0.02
Sodium lauryl sulfate	10.5	0.16
Sodium bicarbonate	4.8	0.08
Isopropanol	5.5	0.09
Sodium bisulfate	5.2	0.04
Water	to 100%	To 100%

[0034] The pH of the resulting concentrated solution is approximately 1.97. The 64X concentrate is then diluted to prepare a 1X end-use diluted sanitizing/disinfecting solution by diluting 1 part of the 64X concentrate with 63 parts of water. The pH of the resulting end-use solution is approximately 2.45.

[0035] Example 5: A 128X concentrate is prepared as outlined in the following Table 1.5:

[0036] Table 1.5

INGREDIENT	WEIGHT PERCENT	
	128X Concentrate	1X Dilution
Citric acid	25.6	0.20
Capric acid	2.6	0.02
Sodium lauryl sulfate	10.5	0.08
Sodium bicarbonate	2.6	0.02
Isopropanol	5.5	0.04
Water	to 100%	To 100%

[0037] The pH of the resulting concentrated solution is approximately 2.17. The 128X concentrate is then diluted to prepare a 1X end-use diluted sanitizing/disinfecting solution by diluting 1 part of the 128X concentrate with 127 parts of water. The pH of the resulting end-use solution is approximately 2.66.

[0038] Example 6: A 128X concentrate is prepared as outlined in the following Table1.6:

[0039] Table 1.6

INGREDIENT	WEIGHT PERCENT	
	128X Concentrate	1X Dilution
Citric acid	25.6	0.20
Capric acid	2.6	0.02
Sodium lauryl sulfate	10.5	0.08
Sodium bicarbonate	2.6	0.02
Isopropanol	5.5	0.04
Sodium bisulfate	5.2	0.04
Water	to 100%	To 100%

[0040] The pH of the resulting concentrated solution is 1.96. The 128X concentrate is then diluted to prepare a 1X end-use diluted sanitizing/disinfecting solution by diluting 1 part of the 128X concentrate with 127 parts of water. The pH of the resulting end-use solution is approximately 2.58.

[0041] Example 7: A 128X concentrate is prepared as outlined in the following Table 1.7:

[0042] Table 1.7

INGREDIENT	WEIGHT PERCENT	
	128X Concentrate	1X Dilution
Citric acid	25.6	0.20
Capric acid	2.6	0.02
Sodium lauryl sulfate	10.5	0.08
Sodium bicarbonate	2.9	0.02
Isopropanol	5.5	0.04
Water	to 100%	To 100%

[0043] The pH of the resulting concentrated solution is approximately 2.49. The 128X concentrate is then diluted to prepare a 1X end-use diluted sanitizing/disinfecting solution by diluting 1 part of the 128X concentrate with 127 parts of water. The pH of the resulting end-use solution is approximately 2.85.

[0044] Example 8: A 128X concentrate is prepared as outlined in the following Table 1.8:

[0045] Table 1.8

INGREDIENT	WEIGHT PERCENT	
	128X Concentrate	1X Dilution
Citric acid	25.6	0.20
Capric acid	2.6	0.02
Sodium lauryl sulfate	10.5	0.08
Sodium bicarbonate	5.1	0.04
Isopropanol	5.5	0.04
Sodium bisulfate	5.2	0.04
Water	to 100%	To 100%

[0046] The pH of the resulting concentrated solution is 2.21. The 128X concentrate is then diluted to prepare a 1X end-use diluted sanitizing/disinfecting solution by diluting 1 part of the 128X concentrate with 127 parts of water. The pH of the resulting end-use solution is approximately 2.61.

[0047] Example 9: A concentrate that can be diluted either 1:64 or 1:128 is prepared as outlined in the following Table 1.9:

[0048] Table 1.9

INGREDIENT	WEIGHT PERCENT	
	128X Concentrate	1X Dilution
Citric acid	25.6	0.20
Lauric acid	1.3	0.01
Sodium lauryl sulfate	10.5	0.08
Sodium citrate	1.8	0.01
Isopropanol	2.3	0.02
Water	to 100%	To 100%

[0049] The pH of the resulting concentrated solution is 2.23. The concentrate is then diluted 1:64 or 1:128 to prepare the end-use diluted sanitizing/disinfecting solution by diluting 1 part of the concentrate with 63 or 127 parts of water, respectively. The pHs of the resulting end-use solutions are 2.32 and 2.41 for the 1:64 and 1:128 dilutions, respectively.

[0050] Example 10: A concentrate that can be diluted either 1:64 or 1:128 is prepared as outlined in the following Table 1.10:

[0051] Table 1.10

INGREDIENT	WEIGHT PERCENT	
	128X Concentrate	1X Dilution
Acetic acid	21.0	0.16
Capric acid	2.6	0.02
Sodium lauryl sulfate	10.5	0.08
Isopropanol	2.3	0.02
Water	to 100%	To 100%

[0052] The pH of the resulting concentrated solution is 2.08. The concentrate is then diluted 1:64 or 1:128 to prepare the end-use diluted sanitizing/disinfecting solution by diluting 1 part of the concentrate with 63 or 127 parts of water, respectively. The pHs of the resulting end-use solutions are 2.58 and 2.63 for the 1:64 and 1:128 dilutions, respectively.

[0053] Example 11: A concentrate that can be diluted either 1:64 or 1:128 is prepared as outlined in the following Table 1.11:

[0054] Table 1.11

INGREDIENT	WEIGHT PERCENT	
	128X Concentrate	1X Dilution
Citric acid	25.6	0.20
Lauric acid	1.3	0.01
Sodium lauryl sulfate	10.5	0.08
Sodium citrate	1.8	0.01
Ethanol	5.5	0.04
Water	to 100%	To 100%

[0055] The pH of the resulting concentrated solution is 2.32. The concentrate is then diluted 1:64 or 1:128 to prepare the end-use diluted sanitizing/disinfecting solution by diluting 1 part of the concentrate with 63 or 127 parts of water, respectively. The pHs of the resulting end-use solutions are 2.36 and 2.51 for the 1:64 and 1:128 dilutions, respectively.

[0056] Example 12: A concentrate that can be diluted either 1:64 or 1:128 is prepared as outlined in the following Table 1.12:

[0057] Table 1.12

INGREDIENT	WEIGHT PERCENT	
	128X Concentrate	1X Dilution
Acetic acid	21.0	0.16
Capric acid	2.6	0.02
Sodium lauryl sulfate	10.5	0.08
Ethanol	5.5	0.04
Water	to 100%	To 100%

[0058] The pH of the resulting concentrated solution is 2.11. The concentrate is then diluted 1:64 or 1:128 to prepare the end-use diluted sanitizing/disinfecting solution by diluting 1 part of the concentrate with 63 or 127 parts of water, respectively. The pHs of the resulting end-use solutions are 2.68 and 2.69 for the 1:64 and 1:128 dilutions, respectively.

[0059] Example 13: A concentrate that can be diluted either 1:64 or 1:128 is prepared as outlined in the following Table 1.13:

[0060] Table 1.13

	WEIGHT PERCENT	
INGREDIENT	128X Concentrate	1X Dilution
Citric acid	25.6	0.20
Capric acid	2.6	0.02
Sodium lauryl sulfate	10.5	0.08
Isopropanol	2.3	0.02
Water	to 100%	To 100%

[0061] The pH of the resulting concentrated solution is 1.47. The concentrate is then diluted 1:64 or 1:128 to prepare the end-use diluted sanitizing/disinfecting solution by diluting 1 part of the concentrate with 63 or 127 parts of water, respectively. The pHs of the resulting end-use solutions are 2.23 and 2.30 for the 1:64 and 1:128 dilutions, respectively.

[0062] Example 14: A concentrate that can be diluted either 1:64 or 1:128 is prepared as outlined in the following Table 1.14:

[0063] Table 1.14

	WEIGHT PERCENT	
INGREDIENT	128X Concentrate	1X Dilution
Citric acid	25.6	0.20
Capric acid	2.6	0.02
Sodium lauryl sulfate	10.5	0.08
Ethanol	2.3	0.02
Water	to 100%	To 100%

[0064] The pH of the resulting concentrated solution is 1.45. The concentrate is then diluted 1:64 or 1:128 to prepare the end-use diluted sanitizing/disinfecting solution by diluting 1 part of the concentrate with 63 or 127 parts of water, respectively. The pHs of the resulting end-use solutions are 2.25 and 2.36 for the 1:64 and 1:128 dilutions, respectively.

[0065] Scenting of Formulations. Natural essential oils can be added to the sanitizing/disinfecting formulations to provide a natural, pleasing fragrance. Orange oil, lemon

oil, and cinnamon oil were added to the formulations at up to 3 percent v/v. All three oils provided a pleasing scent to the concentrated and end-use diluted sanitizing/disinfecting formulations.

[0066] Evaluation of Tolerance to Hard Water. The solutions prepared in Examples 1 to 8 were diluted to 1X using an appropriate volume of 375 or 500 ppm artificial hard water. The hard water was prepared shortly before use by combining the appropriate amount of calcium chloride (2.5 or 3.4 mM calcium ion for the 375 or 500 ppm hard water, respectively), magnesium chloride (1.3 or 1.7 mM magnesium ion for the 375 or 500 ppm hard water, respectively), and sodium bicarbonate (3.4 or 4.5 mM for the 375 or 500 ppm hard water, respectively) in distilled water. Each concentrated solution was then diluted in the 375 or 500 ppm hard water. Each solution was tested in triplicate. After dilution, the time to clouding and final appearance of the solutions after 24 hours were measured and the results are presented in Tables 1 and 2. Clouding of the solutions is a result of the interaction of sodium lauryl sulfate with the calcium (primarily) and magnesium ions in the hard water to create an insoluble precipitate that no longer has surfactant properties. In the case of the sanitizing and disinfecting formulations, formation of precipitates is undesired since it greatly reduces the cleaning and antibacterial properties of the solutions. Therefore, clouding is directly related to the ability of the sanitizing and disinfecting solutions to provide the desired efficacy (cleaning and antibacterial properties).

[0067] Two control solutions without the fatty acid were used to compare the clouding results of the example formulations. The first control was 10.5% sodium lauryl sulfate in distilled water (Control Solution 1). The second control solution (Control Solution 2)was prepared as outlined in the following Table 2:

[0068] Table 2: Control Solution 2

INGREDIENT	WEIGHT %
Citric acid	25.6
Sodium lauryl sulfate	10.5
Sodium bicarbonate	4.5
Isopropanol	5.5
Water	to 100%

[0069] The control solutions were diluted 1 part of concentrated solution in 63 (1:64 dilution) or 127 (1:128 dilution) parts of 375 or 500 ppm hard water. Clouding was defined as not being able to read 2.5 mm tall numbers on the opposite side of a clear polystyrene tube

28.5 mm in diameter containing the 1X diluted solution. Immediately after preparation, all solutions were clear. All example formulations prolonged the time until clouding when compared to the control solutions. Results are presented in the following Tables 3.1 and 3.2.

[0070] Table 3.1: Time to clouding of sanitizing/disinfecting solutions diluted to 1X end-use concentrations in 375 ppm artificial hard water

Test Solution	Time to Clouding (minutes) (mean ±SD)	Appearance of Solution at 24 Hours
64X Concentrate Diluted to 1X		
Example 1	15.7 ±0.6	Completely opaque
Example 2	40.0 ±3.5	Completely opaque
Example 3	39.3 ±0.6	Completely opaque
Example 4	211.7 ±0.6	Can discern numbers but not legible
Control Solution 1 (64X)	3.0 ±0.0	Completely opaque
Control Solution 2 (64X)	10.0 ±0.0	Completely opaque
128X Concentrate Diluted to 1X		
Example 5	>1,440	Slightly hazy
Example 6	>1,440	Slightly hazy
Control Solution 1 (128X)	2.0 ±0.0	Completely opaque
Control Solution 2 (128X)	3.7 ±1.2	Completely opaque

[0071] Table 3.2: Time to clouding of sanitizing/disinfecting solutions diluted to 1X end-use concentrations in 500 ppm artificial hard water

Test Solution	Time to Clouding (minutes) (mean ±SD)	Appearance of Solution at 24 Hours
64X Concentrate Diluted to 1X		
Example 1	10.3 ±0.6	Completely opaque
Example 2	21.3 ±1.5	Completely opaque
Example 3	20.7 ±0.6	Completely opaque
Example 4	55.3 ±0.6	Can discern numbers but not legible
Control Solution 1 (64X)	2.0 ±0.0	Completely opaque
Control Solution 2 (64X)	5.0 ±1.0	Completely opaque
128X Concentrate Diluted to 1X		
Example 5	>1,440	Slightly hazy
Example 6	>1,440	Slightly hazy
Example 7	>1,440	Slightly hazy
Example 8	>1,440	Slightly hazy
Control Solution 1 (128X)	1.3 ±0.6	Completely opaque
Control Solution 2 (128X)	6.0 ±0.0	Completely opaque

[0072] Evaluation of Antimicrobial Effectiveness of 1X End-Use Diluted Solutions. The effectiveness of the sanitizing/disinfecting solutions from Examples 1 to 8 diluted to 1X end-use concentrations in 300 or 500 ppm artificial hard water was assessed in a suspension time kill assay against model gram positive (Staphylococcus aureus) and gram negative (Escherichia coli) bacteria. In brief, the bacterial suspension (~1x1010 CFU/ml) was added to 9.9 times the volume of 1X end-use sanitizing/disinfecting solution prepared in 300 or 500 ppm artificial hard water. After 30 seconds, an aliquot of the test solution was removed and neutralized with culture broth. The neutralized solution containing bacteria was then plated on solid agar medium and allowed to incubate at 36 ± 1°C for 24 – 48 hours to identify viable colonies. Tables 4.1 and 4.2 summarize the results of duplicate replicates including the log-fold reduction in bacteria for the two replicates combined for each solution and bacterium. All example formulations provided dramatic reductions in bacterial counts with a very short contact time (30 seconds).

[0073] Table 4.1: Antibacterial efficacy of example sanitizing/disinfecting solutions diluted to 1X in 300 ppm hard water.

CONCENTRATE SANITIZING/ DISINFECTING SOLUTION	BACTERIUM	REPLICATE	EXPOSURE TIME (SECS)	INITIAL BACTERIAL CONCNTRTN. (CFU/ML)	VIABLE COLONIES (CFU/ML)	AVERAGE LOG_{10} REDUCTION IN BACTERIA
Example 1 (64X)	Staphylococcus aureus	1	30	$6.65x10^7$	$2.70x10^4$	3.67
		2			$1.58x10^3$	
	Eschericia coli	1	30	$8.80x10^7$	No growth	>7.25
		2			No growth	
Example 2 (64X)	Staphylococcus aureus	1	30	$6.65x10^7$	$1.00x10^1$	>6.95
		2			No growth	
	Escherichia coli	1	30	$8.80x10^7$	No growth	>7.25
		2			$5.00x10^0$	
Example 3 (64X)	Staphylococcus aureus	1	30	$9.90x10^6$	No growth	>6.30
		2			No growth	
Example 4 (64X)	Staphylococcus aureus	1	30	$9.90x10^6$	No growth	>5.90
		2			$2.00x10^1$	
Example 5 (128X)	Staphylococcus aureus	1	30	$9.90x10^6$	No growth	>6.30
		2			No growth	
Example 6 (128X)	Staphylococcus aureus	1	30	$9.90x10^6$	No growth	>6.30
		2			No growth	
Example 7 (128X)	Staphylococcus aureus	1	30	$4.20x10^8$	No growth	>6.92
		2			No growth	
	Escherichia coli	1	30	$1.09x10^9$	No growth	>7.34
		2			No growth	

Example 8 (128X)	Staphylococcus aureus	1	30	$4.20x10^8$	No growth	>6.92
		2			No growth	
	Escherichia coli	1	30	$1.09x10^9$	No growth	>7.34
		2			No growth	

[0074] Table 4.2: Antibacterial efficacy of example sanitizing/disinfecting solutions diluted to 1X in 500 ppm hard water.

CONCENTRATE SANITIZING/ DISINFECTING SOLUTION	BACTERIUM	REPLICATE	EXPOSURE TIME (SECS)	INITIAL BACTERIAL CONCNTRTN (CFU/ML)	VIABLE COLONIES (CFU/ML)	AVERAGE LOG_{10} REDUCTION IN BACTERIA
Example 7 (128X)	Staphylococcus aureus	1	30	$4.20x10^8$	No growth	>6.92
		2			No growth	
	Escherichia coli	1	30	$1.09x10^9$	No growth	>7.34
		2			No growth	
Example 8 (128X)	Staphylococcus aureus	1	30	$4.20x10^8$	No growth	>6.92
		2			No growth	
	Escherichia coli	1	30	$1.09x10^9$	No growth	>7.34
		2			No growth	

[0075] Evaluation of Corrosion of Concentrated and 1X End-Use Diluted Solutions. The corrosiveness of several of the concentrated and 1X end-use diluted solutions was tested by immersing pieces of stainless steel and aluminum in the concentrated or 1X end-use diluted solutions. The visual appearance of the metal pieces was assessed over time as summarized in Tables 5.1 and 5.2.

[0076] Table 5.1: Appearance of stainless steel after constant immersion in concentrated or 1X end-use diluted solutions.

Test Solution	Appearance					
	1 Day	2 Days	4 Days	7 Days	14 Days	21 Days
Example 1						
64X concentrate	Normal	Normal	Normal	Normal	Normal	Normal
1X end-use dilution	Normal	Normal	Normal	Normal	Normal	Normal
Example 5						
128X concentrate	Normal	Normal	Normal	Normal	Normal	Normal
1X end-use dilution	Normal	Normal	Normal	Normal	Normal	Normal
Example 6						
128X concentrate	Normal	Normal	Normal	Normal	Normal	Normal
1X end-use dilution	Normal	Normal	Normal	Normal	Normal	Normal
Positive Controls						
10.5% hypochlorite	Minimal yellow surface coating.	Minimal yellow surface coating. Moderate black corrosion.	Moderate yellow surface coating. Moderate black corrosion.	Marked yellow surface coating. Moderate black corrosion.	Marked yellow surface coating. Moderate black corrosion.	Marked yellow surface coating. Moderate black corrosion.
0.246% hypochlorite	Slight yellow surface coating.	Slight yellow surface coating.	Minimal yellow surface coating. Slight black corrosion.	Moderate yellow surface coating. Slight black corrosion.	Marked yellow surface coating. Minimal black corrosion.	Marked yellow surface coating. Minimal black corrosion.
0.042% hypochlorite	Normal	Normal	Slight yellow surface coating.	Slight yellow surface coating.	Slight yellow surface coating.	Slight yellow surface coating.
Negative Control						
Distilled Water	Normal	Normal	Normal	Normal	Normal	Normal

Note: for severity of findings, slight < minimal < moderate < marked

[0077] Table 5.2: Appearance of aluminum after constant immersion in concentrated or 1X end-use diluted solutions.

Test Solution	Appearance					
	1 Day	2 Days	4 Days	7 Days	14 Days	21 Days
Example 1						
64X concentrate	Normal	Normal	Normal	Normal	Slight white film.	Slight white film.
1X end-use dilution	Normal	Normal	Normal	Normal	Slight gray film.	Slight gray film.
Example 5						
128X concentrate	Normal	Normal	Normal	Normal	Slight white film.	Slight white film.
1X end-use dilution	Normal	Normal	Normal	Normal	Normal	Slight gray film.
Example 6						
128X concentrate	Normal	Normal	Normal	Normal	Slight white film.	Slight white film.
1X end-use dilution	Normal	Normal	Normal	Normal	Slight gray film.	Slight gray film.
Positive Controls						
10.5% hypochlorite	Moderate black and yellow surface coating and spots.	Marked black and yellow corrosion.	Marked black and yellow corrosion.	Marked black and white corrosion.	Marked black and white corrosion.	Marked black and white corrosion.
0.246% hypochlorite	Moderate black surface coating.	Moderate black surface coating.	Marked black surface coating.	Marked black surface coating.	Marked black surface coating.	Marked black surface coating.
0.042% hypochlorite	Slight gray surface coating.	Minimal black surface coating.	Marked black surface coating.	Marked black surface coating.	Marked black surface coating.	Marked black surface coating.
Negative Control						
Distilled Water	Normal	Normal	Normal	Normal	Normal	Slight white film.

Note: for severity of findings, slight < minimal < moderate < marked

[0078] Stability of Concentrated Solutions During Elevated Temperature Storage. The stability of the concentrated solutions was tested by placing example solutions at 54°C for 2 weeks and assessing when the solutions became cloudy or separated, both of which indicate instability of the solutions. The temperature and duration of the test was selected since the US Environmental Protection Agency recommends these parameters when assessing the stability of sanitizer/disinfectant formulations. Tables 6 and 7 demonstrate that isopropanol or ethanol increase the elevated temperature stability of the acid-anionic surfactant-fatty acid formulations. In addition, Table 8 demonstrates that the concentration of alcohol is critical since too low and stability is decreased.

[0079] Table 6: Influence of isopropanol on the elevated temperature stability (54°C) of acid-anionic surfactant-fatty acid formulations

Aqueous Formulation	Time to Cloud or Separate (Days)
• 25.6% citric acid • 10.5% sodium lauryl sulfate	10
• 25.6% citric acid • 10.5% sodium lauryl sulfate • 7% (v/v) isopropanol	Stable and clear at 2 weeks
• 25.6% citric acid • 10.5% sodium lauryl sulfate • 2.8% (v/v) decanoic acid	1
• 25.6% citric acid • 10.5% sodium lauryl sulfate • 7% (v/v) isopropanol • 2.8% (v/v) decanoic acid	Stable and clear at 2 weeks
• 25.6% citric acid • 10.5% sodium lauryl sulfate • 1.4% (v/v) decanoic acid	6
• 25.6% citric acid • 10.5% sodium lauryl sulfate • 7% (v/v) isopropanol • 1.4% (v/v) decanoic acid	Stable and clear at 2 weeks

[0080] Table 7: Influence of isopropanol or ethanol on the elevated temperature stability (54°C) of acid-anionic surfactant-fatty acid formulations

Aqueous Formulation	Time to Cloud or Separate (Days)
• 25.6% citric acid • 10.5% sodium lauryl sulfate	11
• 25.6% citric acid • 10.5% sodium lauryl sulfate • 7% (v/v) ethanol	Stable and clear at 2 weeks
• 25.6% citric acid • 10.5% sodium lauryl sulfate • 2.8% (v/v) decanoic acid	2
• 25.6% citric acid • 10.5% sodium lauryl sulfate • 7% (v/v) ethanol • 2.8% (v/v) decanoic acid	Stable and clear at 2 weeks
• 25.6% citric acid • 10.5% sodium lauryl sulfate • 1.3% (w/v) lauric acid	8
• 25.6% citric acid • 10.5% sodium lauryl sulfate • 7% (v/v) isopropanol • 1.3% (w/v) lauric acid	Stable and clear at 2 weeks

[0081] Table 8: Influence of varying isopropanol concentrations on the elevated temperature stability (54°C) of acid-anionic surfactant-fatty acid formulations

Aqueous Formulation	Time to Cloud or Separate (Days)
• 25.6% citric acid • 10.5% sodium lauryl sulfate • 2.8% (v/v) decanoic acid	2
• 25.6% citric acid • 10.5% sodium lauryl sulfate • 0.1% (v/v) isopropanol • 2.8% (v/v) decanoic acid	1
• 25.6% citric acid • 10.5% sodium lauryl sulfate • 0.2% (v/v) isopropanol • 2.8% (v/v) decanoic acid	1
• 25.6% citric acid • 10.5% sodium lauryl sulfate • 1% (v/v) isopropanol • 2.8% (v/v) decanoic acid	4
• 25.6% citric acid • 10.5% sodium lauryl sulfate • 2% (v/v) isopropanol • 2.8% (v/v) decanoic acid	Stable and clear at 2 weeks
• 25.6% citric acid • 10.5% sodium lauryl sulfate • 3% (v/v) isopropanol • 2.8% (v/v) decanoic acid	Stable and clear at 2 weeks
• 25.6% citric acid • 10.5% sodium lauryl sulfate • 4% (v/v) isopropanol • 2.8% (v/v) decanoic acid	Stable and clear at 2 weeks
• 25.6% citric acid • 10.5% sodium lauryl sulfate • 5% (v/v) isopropanol • 2.8% (v/v) decanoic acid	Stable and clear at 2 weeks
• 25.6% citric acid • 10.5% sodium lauryl sulfate • 6% (v/v) isopropanol • 2.8% (v/v) decanoic acid	Stable and clear at 2 weeks
• 25.6% citric acid • 10.5% sodium lauryl sulfate • 7% (v/v) isopropanol • 2.8% (v/v) decanoic acid	Stable and clear at 2 weeks

[0082] Evaluation of Foaming of 1X End-Use Diluted Solutions. The foaming of 1X end-use diluted solutions of Examples 1 to 8 was assessed by applying 15 ml of each 1X end-

use diluted solution to a stainless steel countertop. A rectangular paper towel with the dimensions of 10.5 by 11 inches was used to wipe the solution in a circular motion in a clockwise followed by a counterclockwise direction on the countertop. Foaming was visually assessed along with the time to dissipation of foaming and residue remaining on the countertop. As positive controls, a solution of 10.5% sodium lauryl sulfate diluted in water to 0.164% (64X control) or 0.082% (128X control) were used. Results are presented in Table 9.

[0083] Table 9

Test Solution	Test Concentration	Foaming	Time to Foam Dissipation (seconds)	Residue After Drying
64X Concentrate Diluted to 1X				
Example 1 (64X concentrate)	1X	Minimal	30	None
Example 2 (64X concentrate)	1X	Minimal	22	None
Example 3 (64X concentrate)	1X	Minimal	16	None
Example 4 (64X concentrate)	1X	Minimal	44	None
Positive Control (64X)	0.164% SLS	Moderate	106	None
128X Concentrate Diluted to 1X				
Example 5 (128X concentrate)	1X	Slight	5	None
Example 6 (128X concentrate)	1X	Slight	5	None
Example 7 (128X concentrate)	1X	Slight	6	None
Example 8 (128X concentrate)	1X	Slight	5	None
Positive Control (128X)	0.082% SLS	Minimal	52	None

Note: foaming was assessed as slight < minimal < moderate < marked; SLS = sodium lauryl sulfate

[0084] While the invention has been described in connection with several presently preferred embodiments thereof, those skilled in the art will appreciate that many modifications and changes may be made without departing from the true spirit and scope of the invention which accordingly is intended to be defined solely by the appended claims.

CLAIMS

1. A sanitizing and disinfecting solution concentrate composition comprising:

a. at least 10 wt% water;

b. one or more natural first organic acids at a total concentration of at least 10 wt% and sufficient to provide a solution pH of from about 1.2 - 5.0;

c. one or more sulfated fatty acid surfactants at a total concentration of at least 5 wt%;

d. one or more monocarboxylic fatty acids at a total concentration of at least 0.1 wt%, wherein the one or more monocarboxylic fatty acids are distinct from the one or more natural first organic acids; and

e. one or more alcohols at a total concentration of at least 1 wt%.

2. The composition of claim 1, wherein the one or more natural organic acids are selected from the group consisting of citric acid, fumaric acid, humic acid, acetic acid, and ascorbic acid.

3. The composition of claim 1, wherein the one or more natural organic acids are selected from the group consisting of citric acid and acetic acid.

4. The composition of claim 1, wherein the one or more monocarboxylic fatty acids comprise one or more saturated or unsaturated C6-C18 monocarboxylic acids.

5. The composition of claim 1, wherein the one or more monocarboxylic fatty acids are selected from the group consisting of caproic acid, caprylic acid, capric acid, lauric acid, myristic acid, palmitic acid, stearic acid, oleic acid, linoleic acid, gamma-linolenic acid, hexadecatrienoic acid, alpha-linolenic acid, pinolenic acid, and stearidonic acid.

6. The composition of claim 1, wherein the one or more monocarboxylic fatty acids are selected from the group consisting of caprylic acid, capric acid, and lauric acid.

7. The composition of claim 1, wherein the one or more sulfated fatty acid surfactants comprise one or more C6-C18 alkyl sulfate.

8. The composition of claim 1, wherein the one or more sulfated fatty acid surfactants comprises sodium lauryl sulfate.

9. The composition of claim 1, wherein the one or more alcohols comprises isopropanol or ethanol.

10. The composition of claim 1, further comprising a basic buffering agent selected from the group consisting of calcium carbonate, magnesium carbonate, potassium bicarbonate, potassium carbonate, sodium bicarbonate, and sodium carbonate.

11. The composition of claim 1, further comprising a buffering sodium, potassium, magnesium, or calcium salt of the one or more natural first organic acids.

12. The composition of claim 1, further comprising sodium sulfate or sodium bisulfate.

13. The composition of claim 1, further comprising an essential oil.

14. The composition of claim 1, wherein the total concentration of the one or more natural first organic acids sufficient to provide a solution pH of from 1.2 - 5.0 is from 10 – 40 wt%, the total concentration of the one or more sulfated fatty acid surfactants is from 5 – 30 wt%, the total concentration of the one or more monocarboxylic fatty acids is from 0.1 – 5 wt%, and the total concentration of the one or more alcohols is from 1 - 20 wt%.

15. The composition of claim 1, wherein of claim 1, wherein the total concentration of the one or more alcohols is from 2 – 10 wt%.

16. The composition of claim 1, wherein the total concentration of the one or more alcohols is from 3 – 10 wt%.

17. The composition of claim 1, consisting essentially of water; from 10 – 40 wt% of the one or more natural first organic acids sufficient to provide a solution pH of from 1.2 - 5.0; from 5 – 30 wt% of the one or more sulfated fatty acid surfactants; from 0.1 – 5 wt% of the one or more monocarboxylic fatty acids; from 1 -20 wt% of the one or more alcohols; optionally a basic buffering agent selected from the group consisting of calcium carbonate, magnesium carbonate, potassium bicarbonate, potassium carbonate, sodium bicarbonate, and sodium carbonate; optionally a buffering sodium, potassium, magnesium, or calcium salt of the one or more natural first organic acids; optionally a sodium sulfate or sodium bisulfate; and optionally an essential oil.

18. The composition of claim 17, consisting essentially of water; from 10 – 40 wt% of one or more natural first organic acids selected from the group consisting of citric acid, fumaric acid, humic acid, acetic acid, and ascorbic acid; from 5 – 30 wt% of sodium lauryl sulfate; from 1 – 5 wt% of one or more monocarboxylic fatty acids acids selected from the group consisting of caprylic acid, capric acid, and lauric acid; from 2 - 10 wt% of one or more alcohols selected from the group consisting of ethanol and isopropanol; optionally a basic buffering agent selected from the group consisting of calcium carbonate, magnesium carbonate, potassium bicarbonate, potassium carbonate, sodium bicarbonate, and sodium carbonate; optionally a buffering sodium, potassium, magnesium, or calcium salt of the one or more natural first organic acids; optionally a sodium sulfate or sodium bisulfate; and optionally an essential oil.

19. A method of cleaning, sanitizing, or disinfecting a food or non-food contact surface comprising diluting a concentrate composition of any one of claims 1-18 with at least 9 additional parts of water to one part of the concentrate composition to form a diluted solution having a pH of from 1.2 - 5.0, and contacting the surface with the diluted solution.

20. The method of claim 19, wherein ordinary tap water is used to dilute the concentrate composition to form the diluted solution.

21. The method of claim 19, wherein concentrate composition is diluted with from 29 to 999 additional parts water to one part of the concentrate composition to form the diluted solution having a pH of from 1.2 - 5.0.

22. The method of claim 21, wherein water having a hardness of at least 300 ppm hardness ions is used to dilute the concentrate composition to form the diluted solution.

23. The method of claim 21, wherein water having a hardness of at least 500 ppm hardness ions is used to dilute the concentrate composition to form the diluted solution.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2015/051410

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - C11D 3/16 (2015.01)
CPC - C11D 3/16 (2015.10)
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) - A01N 25/30, 41/04; C11D 1/12, 1/75, 3/16, 3/22, 3/43, 17/08 (2015.01)
CPC - A01N 25/30, 41/04; C11D 1/12, 1/75, 3/16, 3/22, 3/43, 17/08 (2015.10)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC - 510/101, 108, 284, 331, 340, 463; IPC(8) - A01N 25/30, 41/04; C11D 1/12, 1/75, 3/16, 3/22, 3/43, 17/08; CPC - A01N 25/30, 41/04; C11D 1/12, 1/75, 3/16, 3/22, 3/43, 17/08 (keyword delimited)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PatBase, Google Patents, Google Scholar, Google.
Search terms used: sanitize, disinfect, citric, acid, acetic, caprylic, capric, lauric, sodium lauryl sulfate, isopropanol, ethanol

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 1996/009761 A1 (DIVERSEY CORPORATION) 04 April 1996 (04.04.1996) entire document	1-23
Y	US 2009/0004122 A1 (MODAK et al) 01 January 2009 (01.01.2009) entire document	1-23
Y	US 2010/0056416 A1 (SCHEUING et al) 04 March 2010 (04.03.2010) entire document	10-12
Y	US 6,071,961 A (WIDER) 06 June 2000 (06.06.2000) entire document	19-23
Y	US 6,019,905 A (WAGGONER) 01 February 2000 (01.02.2000) entire document	23
A	US 2010/0136148 A1 (SAINT VICTOR) 03 June 2010 (03.06.2010) entire document	1-23

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
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Date of the actual completion of the international search	Date of mailing of the international search report
30 October 2015	28 DEC 2015
Name and mailing address of the ISA/ Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Blaine Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

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