Title: A disinfectant composition comprising an effective amount of N-alkyl dimethyl benzyl ammonium chloride and N-alkyl dimethyl ethylbenzyl ammonium chloride 50/50 blend, Sodium Carbonate, Phytic Acid, Sodium Gluconate and at least one natural biocidal adjuvant selected from the group consisting of Circuma longa, Citrus paradisi, Citrus maxima, Citrus sinensis and/or combinations thereof.

Abstract: A disinfectant composition comprising an effective amount of N-alkyl dimethyl benzyl ammonium chloride and N-alkyl dimethyl ethylbenzyl ammonium chloride 50/50 blend, Sodium Carbonate, Phytic Acid, Sodium Gluconate and at least one natural biocidal adjuvant selected from the group consisting of Circuma longa, Citrus paradisi, Citrus maxima, Citrus sinensis and/or combinations thereof.
FDA COMPLIANT FOOD SURFACE SANITISER USING EXTRACTS OF CIRCUMA LONGA AND CITRUS PARADISI

[0001] CROSS REFERENCE TO RELATED APPLICATION

[0002] This application claims the benefit of U.S. Provisional Application Serial No. 62/169,025, filed June 1, 2015, the disclosure content of which is hereby incorporated by reference in its entirety.

[0003] FIELD OF THE INVENTION

[0004] The Invention relates to an aqueous disinfectant product which can be supplied either in a ready to use format or as a concentrate. It incorporates sustainable raw materials to potentiate and improve the performance of natural plant compounds, extracts and derivatives alone or in combination or with other chemical antimicrobial agents to disinfect hard surfaces in food business operations.

[0005] BACKGROUND OF THE INVENTION

[0006] Currently there is an ever increasing demand for foods and other products derived, in part, from plants or other natural sources. This demand is principally driven by consumer concerns that unwanted environmental consequences and unexpected side effects of synthetic chemicals. Accordingly, the use of products derived from plant and other natural sources is increasingly attractive to consumers.

[0007] Foodborne diseases affect 1 in 6 Americans (or 48 million people) annually causing 128,000 hospitalizations and 3,000 deaths. Furthermore, there are concerns that toxic chemicals are breeding resistant bacteria that are increasingly difficult to kill. The generation of resistant bacteria then relies upon stronger antibacterial compositions and/or increasing concentrations of the substances to effectively destroy the pathogens.

[0008] Certain patents have previously attempted to harness plant derived compounds for their antibacterial properties. For example, US 4,614,612 and US 7,258,883 each utilize
certain citrus based compounds in a cleansing or preservative based product. However, neither provide for an effective mechanism for control of pathogenic organisms as disclosed herein.

[0009] SUMMARY OF THE INVENTION

[0010] The invention comprises a blend of quaternary ammonium compounds, chelating agents, including but not confined to phytic acid or sodium gluconate, alongside materials with biocidal activity such as extracts of Citrus paradisi (GSE), Citrus maxima, Citrus sinensis and turmeric extract (Circuma longa extract), wherein the combination of products potentiates one another to provide a synergistic effect to the components as compared to their use alone.

[0011] In a preferred embodiment, the invention is a disinfectant composition complying with US and European requirements formulated from certain plant-derived components that can be supplied either as a concentrate or a ready to use formulation for sanitising food surfaces and fomites in healthcare to control nosocomial pathogens comprising at least one biocidal adjuvant from the group consisting of Circuma longa, Citrus paradisi, Citrus maxima, Citrus sinensis and/or combinations thereof.

[0012] In a further preferred embodiment, compositions as described herein are utilized wherein the composition is a preparation for sanitising food preparation surfaces that has improved rate of kill against pathogenic organisms when compared against base formulations compliant with 21CFR178 (b) (11) incorporated herein by reference in its entirety.

[0013] In further preferred embodiments, the compositions as described herein wherein when at 'in use' concentration does not exceed FDA requirements under 21 CFR 178.1010 that quaternary ammonium compounds exceed 200ppm.
In a further preferred embodiment a composition for sanitising food surfaces comprising an effective amount of N-alkyl dimethyl benzyl ammonium chloride and N-alkyl dimethyl ethylbenzyl ammonium chloride 50/50 blend, Sodium Carbonate, Phytic Acid, Sodium Gluconate, Grapefruit Seed Extract, and Turmeric Extract.

In a further preferred embodiment, the invention is directed to a disinfectant composition comprising an effective amount of N-alkyl dimethyl benzyl ammonium chloride and N-alkyl dimethyl ethylbenzyl ammonium chloride 50/50 blend, Sodium Carbonate, Phytic Acid, Sodium Gluconate and at least one natural biocidal adjuvant selected from the group consisting of *Circuma longa*, *Citrus paradisi*, *Citrus maxima*, *Citrus sinensis* and/or combinations thereof.

In a further embodiment, wherein the ammonium concentration of the composition does not exceed 200ppm. In a further embodiment wherein the adjuvants are food grade adjuvants.

In a further embodiment wherein the composition comprises *Circuma longa*, *Citrus paradisi*, *Citrus maxima*, and *Citrus sinensis*, in a buffer solution of 7.5 +/- 0.5.

In a further embodiment, a composition for sanitising food surfaces comprising an effective amount of N-alkyl dimethyl benzyl ammonium chloride and N-alkyl dimethyl ethylbenzyl ammonium chloride 50/50 blend, Sodium Carbonate, Phytic Acid, Sodium Gluconate, Grapefruit Seed Extract, and Turmeric Extract.

In a further embodiment, a concentrated disinfectant composition formulated from plant-derived components for sanitising food surfaces and fomites in healthcare to control nosocomial pathogens comprising at least one biocidal adjuvant from the group consisting of *Circuma longa*, *Citrus paradisi*, *Citrus maxima*, *Citrus sinensis* and/or combinations thereof, and an effective amount of a quaternary ammonium compound not to exceed 200 ppm.
[00020] In a further embodiment, a composition for sanitising food preparation surfaces that has improved rate of kill against pathogenic organisms when compared against formulations having less than 200 ppm quaternary ammonium as the anti-microbial agent comprising an effective amount of N-alkyl dimethyl benzyl ammonium chloride and N-alkyl dimethyl ethylbenzyl ammonium chloride 50/50 blend, Sodium Carbonate, Phytic Acid, Sodium Gluconate, Grapefruit Seed Extract, and Turmeric Extract.

[00021] In a further embodiment, a composition for sanitising food surfaces comprising an effective amount of N-alkyl dimethyl benzyl ammonium chloride and N-alkyl dimethyl ethylbenzyl ammonium chloride 50/50 blend, Sodium Carbonate, Phytic Acid, Sodium Gluconate, Grapefruit Seed Extract, and Turmeric Extract.

[00022] In a further embodiment, an aqueous disinfectant and hard surface cleaning composition effective for removal of Gram-negative organisms comprising effective levels of quaternary ammonium compound combined with at least one biocidal adjuvant from the group consisting of Circuma longa, Citrus paradisi, Citrus maxima, Citrus sinensis and/or combinations thereof, wherein said adjuvant is selected to boost the performance of the product such that it retains high levels of activity in both hard water areas and conditions with high soiling levels.

[00023] In a further embodiment, a disinfectant composition for treating Gram-negative bacteria that contains at least one biocidal adjuvant selected from the group consisting of Circuma longa, Citrus paradisi, Citrus maxima, Citrus sinensis, or mixtures thereof, and combined with one or more quaternary ammonium compounds, a carrier, and at least one chelating agent.

[00024] In a further embodiment, the disinfectant composition for treating Gram-negative bacteria, wherein the chelating agent is sodium gluconate.
In a further embodiment, the disinfectant composition for treating Gram-negative bacteria, wherein phytic acid is utilized as an anti-microbial agent and as a preservative.

In a further embodiment, the disinfectant composition for treating Gram-negative bacteria, wherein the quaternary ammonium compounds are N-alkyl dimethyl benzyl ammonium chloride and N-alkyl dimethyl ethylbenzyl ammonium chloride 50/50 blend.

In a further embodiment, the disinfectant composition for treating Gram-negative bacteria, wherein the carrier is appropriately formulated as a buffer solution of pH 7.5 +/- 0.5.

In a further embodiment, the disinfectant composition for treating Gram-negative bacteria, wherein the composition has increased stability as compared to the compositions in their natural setting, wherein the disinfectant has a stability profile to effectuate anti-bacterial properties for a minimum of two-years.

In a further embodiment, use of the disinfectant composition for treating Gram-negative bacteria, wherein the disinfectant is effective against bacteria as it adsorbs to the cytoplasmic membrane in bacteria, or the plasma membrane in yeasts and the reaction with the membrane lipid or protein causes membrane disorganization leading to leakage of intracellular low-molecular-weight material, degradation of proteins and nucleic acids, and ultimately wall lysis caused by autolytic enzymes; and wherein this loss of structural organization and integrity of the membrane, together with other damaging effects to the bacterial cell, causes cell death.

In a further embodiment, the disinfectant composition for treating Gram-negative bacteria, wherein there is a synergistic effect of multiple biocidal components that provides a wide spectrum of biocidal activity and pH tolerance.
In a further embodiment, the disinfectant composition for treating Gram-negative bacteria, wherein the *Citrus spp.* extracts act as a wetting agent on organic soiling, thus enabling the biocidal activity to occur on dirty surfaces.

**Description of the Invention**

Food business operations require a product that performs to nationally-mandated standards to reduce levels of contaminating pathogens to minimum levels without leaving toxic residues which could be carried into the food chain. The Invention uses certain plant compounds, extracts and derivatives that have useful antimicrobial properties due to the role that has evolved for such substances in the plant’s own natural defense system. These plant derived compounds also have a very different toxicity profile compared to existing commonly used synthetic chemical antimicrobial compounds, such as aldehydes, anilides, biguanides, halogen-releasing agents, silver compounds, copper compounds, peroxysgens, phenols, bis-phenols and halophenols, among a group of antimicrobial compounds commonly used. While the synthetic chemicals are often effective in reducing microbial levels, sustained use of these compounds has many consumers concerned about generation of bacteria that are resistant to these compounds and thus generating a feed-back loop that requires greater concentrations of compounds and/or use of new and stronger anti-bacterial compositions to be effective.

The Invention described herein is an aqueous disinfectant and hard surface cleaning composition comprising effective levels of one or more quaternary ammonium compound combined with naturally-sourced adjuvants to boost the performance of the product such that it retains high levels of activity in both hard water areas and conditions with high soiling levels. In particular, the disinfectant composition is effective against Gram-negative organisms: a principal cause of food poisoning and foodborne intoxication including *Campylobacter, E. coli* and *Salmonella.*
In a preferred embodiment, the Invention is a disinfectant composition that contains at least one biocidal adjuvant selected from the group consisting of *Circuma longa, Citrus paradisi, Citrus maxima, Citrus sinensis* and/or mixtures thereof, and combined with one or more quaternary ammonium compounds, a carrier, and at least one chelating agent. In preferred embodiments, the chelating agents include sodium gluconate. In certain embodiments, phytic acid is utilized as an anti-microbial agent and as a preservative.

The biocidal anti-bacterial ingredients are potentiated with certain quaternary ammonium compounds to meet FDA and other relevant standards for commercial food preparation with synthetic but wholly biodegradable elements from sustainable sources. Indeed, as shown and described in the tests performed herein, the combination of components provides for a surprising improvement in the ability of the components to reduce the number of colony forming units when applied to a surface, when compared to a control or variants of the invention.

In suitable embodiments the composition further comprises a suitable surfactant. The surfactant is selected from the group consisting of anionic, cationic, and non-ionic surfactants. The surfactants in the composition, as well as the biocidal adjuvant and quaternary ammonium compounds are utilized to remove soiled materials from a surface. For example, dirt, bacteria, virus, biofilms and the like. Upon removal of these soiled materials, the debris are situated in the aqueous medium of the composition. Removal of the soiled materials is achieved through mechanical removal with a cloth or other material, and also through chelation of the soiled materials through the chelating agents of the composition. Accordingly, the chelating agent is effective for chelating and adhering to contaminants in solution and to prevent re-adsorption or re-adhesion of the contaminants to the surface.

In certain preferred embodiments, sodium carbonate is relied upon as a pH regulator to modify the pH of the composition. Other suitable strong and weak bases may be
appropriately utilized to modify the pH according to accepted protocols. In appropriate embodiments, the sodium carbonate or other weak base is utilized in conjunction with an appropriate corresponding weak acid, or salt thereof to form an appropriate buffer solution. The buffer solution is preferably a pH 7.5 +/- 0.5 buffer solution.

Therefore, in particular embodiments, the composition is appropriately formulated in a buffer solution. A buffer is used to maintain pH of about 7.5 +/- 0.5. Preferably the composition provides for a generally neutral pH in a buffer solution so that the pH of the composition can be generally maintained upon contact with environments of a different pH.

In certain embodiments, the composition comprises phytic acid. Phytic acid is a saturated cyclic acid C6H18O24P6 which can function as a preservative in certain embodiments and also has certain anti-microbial properties. Phytic acid also provides certain chelating properties of some components.

In certain preferred embodiments, the composition comprises a chelating agent such as sodium gluconate. Other suitable chelating agents may be advantageous exchanged in certain embodiments. An appropriate blend of chelating agents is appropriate in further embodiments, wherein the chelating agents are receptive to different pathogens or materials to be cleansed, such as grease, oils, bacteria, viruses, dirt, grime, and the like. Accordingly, an appropriate mixture of chelating agents comprises chelating compounds suitable for binding to a variety of materials to be bound.

The disinfectant composition, once combined, results in a product that has increased stability as compared to the compositions in their natural setting. The disinfectant composition has a stability profile to effectuate anti-bacterial properties for a minimum of two-years, based on the addition of appropriate buffers and stability promoting agents.
[00043] The disinfectant is effective against bacteria as it adsorbs to the cytoplasmic membrane in bacteria, or the plasma membrane in yeasts and the reaction with the membrane lipid or protein causes membrane disorganization leading to leakage of intracellular low-molecular-weight material, degradation of proteins and nucleic acids, and ultimately wall lysis caused by autolytic enzymes. This loss of structural organization and integrity of the membrane, together with other damaging effects to the bacterial cell, causes cell death.

[00044] A particular advantage of the composition is the synergistic effect of multiple biocidal components provides a wide spectrum of biocidal activity and pH tolerance. The Citrus spp. Extracts act as a wetting agent on organic soiling, thus enabling the biocidal activity to occur on dirty surfaces. As the wetting agents and biocidal activity remove dirt, grime, grease, bacteria and biofilms from a surface, these materials are mechanically removed from the surface using a cloth, sponge or other wiping agent. However, the materials are further removed via one or more chelating agents disposed of within said composition.

[00045] In certain preferred embodiments, the composition comprises (1) N-alkyl dimethyl benzyl ammonium chloride and N-alkyl dimethyl ethylbenzyl ammonium chloride 50/50 blend; (2) Sodium Carbonate; (3) Phytic Acid; (4) Sodium Gluconate; (5) extract of Circuma longa; (6) extract of Citrus paradisi; (7) extract of Citrus maxima; and (8) extract of Citrus sinensis.

[00046] In preferred embodiments, the composition comprises the following concentrations in PPM in a ready to use formulation:

[00047] N-alkyl dimethyl benzyl ammonium chloride and N-alkyl dimethyl ethylbenzyl ammonium chloride 50/50 blend - 100-200 ppm

[00048] Sodium Carbonate - 25-50 ppm

[00049] Phytic Acid - 50 - 200 ppm
Sodium Gluconate - 50 - 200 ppm
extract of Circuma longa - 25 - 100 ppm
extract of Citrus paradis - 25 - 100 ppm
extract of Citrus maxima - 25 - 100 ppm
extract of Citrus sinensis - 25 - 100 ppm.

In preferred embodiments, the composition may be concentrated for later dilution. An appropriate concentration is about 100X to 1000X of the concentrations of the ready to use formulation.

In preferred embodiments the compositions described herein may be advantageously utilized for methods of treating a surface wherein said composition is effective for treating Gram-negative bacteria. In further embodiments, the compositions are suitable for use in reducing the number of colony forming units of Gram-negative bacteria.

In other embodiments, it is apparent that the composition is suitable for application to food surfaces, wherein application and use of the composition on the surfaces is effective in reducing colony forming units of certain bacteria and other microbes, wherein such use is appropriate for food surfaces because all components of the composition are generally regarded as safe (GRAS) for use around foods.

Advantageous effects of the Invention

Combinations of selected adjuvants were tested in a base formulation compliant to 21CFR178 (b) (11) as defined by the FDA which allows for any adjuvant to be added as long as it is Generally Regarded As Safe (GRAS) and also requires that 'in use' concentrations must be diluted such that concentration of quaternary ammonium in the sanitiser solution is <=200ppm.

The bactericidal activity is evaluated using the following strains:

*Pseudomonas aeruginosa* ATCC 15442 *Staphylococcus aureus* ATCC 6538 *Enterococcus*
In order to prepare the working culture of bacterial strains, subculture from the stock culture by streaking onto TSA agar and incubate overnight. Make a second subculture and incubate as earlier. The second subculture is the working culture.

Bacterial test suspensions are prepared by taking 10 ml of diluent (Tryptone NaCl solution) in a 100 ml flask with 5g of glass beads. From the working culture a loop full of bacterial cells is transferred into the diluent and suspended. Flask is shaken 3 minutes using a mechanical shaker. The number of cells in the suspension is adjusted to $1.5 \times 10^8$ cfu/ml to $5 \times 10^8$ cfu/ml using a diluent by turbidimetry.

Product test solutions shall be prepared at three different concentrations to include at least two concentrations in the active range. (In this case dilutions ended at the ppm active values in the table).

Dilution-neutralization method is the method of choice. Prior to testing all reagents are equilibrated to the test temperature of 20°C using the water bath.

Pipette 8 ml of the test products in to container of suitable capacity and add 1 ml of water. Add 1 ml bacterial suspension containing $1.5 \times 10^8$ cfu/ml to $5 \times 10^8$ cfu/ml and 1 ml of interfering substance (0.3/3g/l BSA) after incubating these two 2 minutes.

Immediately start the stopwatch, mix and place the container in the water bath at 20°C. The activity of the product shall be determined for a contact time chosen from one of the following: 1min, 5min, 15min, 30min, 45min, 60min.

At the chosen contact time, pipette 1 ml of the test mixture into a tube containing 8ml neutralizer (30g/l polysorbate 80 + 3g/l lecithine) and 1 ml of water. Mix and incubate in the water bath for 5 minutes. After neutralization take a 1 ml sample in duplicate and transfer on TSA plates. Incubate the plates in 36°C for 24 hours.
[00067] Count the plates and determine the number of colony forming units for each plate. Results For each test organism record the number of cfu/ml in the bactericidal test suspension (N) and after the test procedure for bactericidal activity of the product (N_a).

[00068] Reduction in viability = (N x 10^1) / N_a

[00069] The results of the tests for each of the ready to use solutions are provided below in the following tables:

<table>
<thead>
<tr>
<th>WATER TO 100%</th>
<th>Concentration of actives in ready to use solution (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N-alkyl dimethyl benzyl ammonium chloride and N-alkyl dimethyl ethylbenzyl ammonium chloride 50/50 blend</td>
<td>200 150 150 150 150 150</td>
</tr>
<tr>
<td>Sodium Carbonate</td>
<td>34 34 34 34 34 34</td>
</tr>
<tr>
<td>Phytic Acid</td>
<td>80 80 80 80 80</td>
</tr>
<tr>
<td>Sodium Gluconate</td>
<td>80 80 80 80 80</td>
</tr>
<tr>
<td>Grapefruit Seed Extract</td>
<td>40 40 40 40</td>
</tr>
<tr>
<td>Turmeric Extract</td>
<td>40 40 40 40</td>
</tr>
</tbody>
</table>

**Log reduction in five minutes, 'clean' conditions:** 0.3 g l⁻¹ bovine albumin (final concentration)

| Staphylococcus aureus ATCC 6538                        | 4.11 4.9 4.75 5.3 5.2 5.8 |
| Pseudomonas aeruginosa ATCC 15442                      | 2.08 3 2.8 4.8 4.7 5.4 |
| Escherichia coli ATCC 10536                            | 4.48 5.3 5.5 5.6 5.7 5.8 |
| Enterococcus hirae ATCC 10541                          | 5.15 5.5 5.6 5.6 5.5 5.7 |

**Log reduction in five minutes, 'dirty' conditions :** 3.0 g l⁻¹ bovine albumin (final concentration)
In the studies performed to compare several variations of a disinfectant as well as control applications both chelating agents were tried, along with the Grapefruit Seed Extract and Turmeric extract. In this format, the Invention passed standard protocol European Norm 1276, which tests disinfectants and antiseptics according to a quantitative suspension test for the evaluation of bactericidal activity of chemical disinfectants and antiseptics used in food, industrial, domestic, and institutional areas in both clean and dirty conditions. This is a required standard test for disinfection in food service and health care.

The results point to the fact that a more than 5 log decrease is identified in both clean and dirty conditions when using a composition comprising a 50/50 blend of quaternary ammonium compounds, sodium carbonate, phytic acid, sodium gluconate, and an extract of Grapefruit seed and turmeric. No other composition tested, provided for such effective results in either the clean or the dirty conditions.

Methods and Materials

n-alkyl dimethyl benzyl ammonium chloride and n-alkyl dimethyl ethylbenzyl ammonium chloride 50/50 blend was sourced from The Stepan Company via the local UK distributor Surfachem, as the commercial blend BTC 2125M
Sodium Carbonate was sourced from Aldrich Sigma

Phytic Acid was sourced from Soliance, via the UK distributor EV1CD

Sodium Gluconate was sourced from Surfachem UK

Grapefruit Seed extract (Unifect GSE liquid) was sourced from Unifect UK

Turmeric Extract (Floviva Turmeric extract PF) was sourced from Protecbotanica UK

Citrus senesis

Citrus maxima
Claims

1. A disinfectant composition comprising an effective amount of N-alkyl dimethyl benzyl ammonium chloride and N-alkyl dimethyl ethylbenzyl ammonium chloride 50/50 blend, Sodium Carbonate, Phytic Acid, Sodium Gluconate and at least one natural biocidal adjuvant selected from the group consisting of Circuma longa, Citrus paradisi, Citrus maxima, Citrus sinensis and/or combinations thereof.

2. The composition of claim 1 wherein the ammonium concentration does not exceed 200ppm.

3. The composition of claim 1 further comprising food grade adjuvants.

4. The composition of claim 1 comprising Circuma longa and Citrus paradisi.

5. The composition of claim 1 comprising Circuma longa, Citrus paradisi, and Citrus maxima.

6. The composition of claim 1 comprising Circuma longa, Citrus paradisi, Citrus maxima, and Citrus sinensis, in a buffer solution of 7.5 +/- 0.5.

7. A composition for sanitising food surfaces comprising an effective amount of N-alkyl dimethyl benzyl ammonium chloride and N-alkyl dimethyl ethylbenzyl ammonium chloride 50/50 blend, Sodium Carbonate, Phytic Acid, Sodium Gluconate, Grapefruit Seed Extract, and Turmeric Extract.

8. A concentrated disinfectant composition formulated from plant-derived components for sanitising food surfaces and fomites in healthcare to control nosocomial pathogens comprising at least one biocidal adjuvant from the group consisting of Circuma longa, Citrus paradisi, Citrus maxima, Citrus sinensis and/or combinations thereof, and an effective amount of a quaternary ammonium compound not to exceed 200 ppm.

9. A composition for sanitising food preparation surfaces that has improved rate of kill against pathogenic organisms when compared against formulations having less
than 200 ppm quaternary ammonium as the anti-microbial agent comprising an effective amount of N-alkyl dimethyl benzyl ammonium chloride and N-alkyl dimethyl ethylbenzyl ammonium chloride 50/50 blend, Sodium Carbonate, Phytic Acid, Sodium Gluconate, Grapefruit Seed Extract, and Turmeric Extract.

10. A composition for sanitising food surfaces comprising an effective amount of N-alkyl dimethyl benzyl ammonium chloride and N-alkyl dimethyl ethylbenzyl ammonium chloride 50/50 blend, Sodium Carbonate, Phytic Acid, Sodium Gluconate, Grapefruit Seed Extract, and Turmeric Extract.

11. An aqueous disinfectant and hard surface cleaning composition effective for removal of Gram-negative organisms comprising effective levels of quaternary ammonium compound combined with at least one biocidal adjuvant from the group consisting of *Circuma longa*, *Citrus paradisi*, *Citrus maxima*, *Citrus sinensis* and/or combinations thereof, wherein said adjuvant is selected to boost the performance of the product such that it retains high levels of activity in both hard water areas and conditions with high soiling levels.

12. A disinfectant composition for treating Gram-negative bacteria that contains at least one biocidal adjuvant selected from the group consisting of *Circuma longa*, *Citrus paradisi*, *Citrus maxima*, *Citrus sinensis*, or mixtures thereof, and combined with one or more quaternary ammonium compounds, a carrier, and at least one chelating agent.

13. The composition of claim 12 wherein the chelating agent is sodium gluconate.

14. The composition of claim 12 wherein phytic acid is utilized as an anti-microbial agent and as a preservative.
15. The composition of claim 12 wherein the quaternary ammonium compounds are N-alkyl dimethyl benzyl ammonium chloride and N-alkyl dimethyl ethylbenzyl ammonium chloride 50/50 blend

16. The composition of claim 12 wherein the carrier is appropriately formulated as a buffer solution of pH 7.5 +/- 0.5.

17. The composition of claim 12 wherein the composition has increased stability as compared to the compositions in their natural setting, wherein the disinfectant has a stability profile to effectuate anti-bacterial properties for a minimum of two-years.

18. The use of the composition of claim 12 wherein the disinfectant is effective against bacteria as it adsorbs to the cytoplasmic membrane in bacteria, or the plasma membrane in yeasts and the reaction with the membrane lipid or protein causes membrane disorganization leading to leakage of intracellular low-molecular-weight material, degradation of proteins and nucleic acids, and ultimately wall lysis caused by autolytic enzymes; and wherein this loss of structural organization and integrity of the membrane, together with other damaging effects to the bacterial cell, causes cell death.

19. The composition of claim 12 wherein there is a synergistic effect of multiple biocidal components that provides a wide spectrum of biocidal activity and pH tolerance.

20. The composition of claim 12 wherein the Citrus spp. extracts act as a wetting agent on organic soiling, thus enabling the biocidal activity to occur on dirty surfaces.
### A. CLASSIFICATION OF SUBJECT MATTER

AOIN 33/12(2006.01)1, AOIN 65/48(2009.01)1, A01N 65/36(2009.01)1, A01N 25/02(2006.01)1

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)

- A01N 33/12; A01N 65/48; C02F 1/461; A01N 65/00; A01P 1/00; A01N 31/00; A01N 59/00; A01N 43/16; A01N 65/36; A01N 25/02

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

- Korean utility models and applications for utility models
- Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & keywords: disinfectant composition, N-alkyl dimethyl benzyl ammonium chloride, N-alkyl dimethyl ethylbenzyl ammonium chloride, sodium carbonate, phytic acid, sodium gluconate, circuma longa, citrus paradisi, citrus maxima, citrus sinensis, grapefruit, turmeric

### C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
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<td>US 2013-0316027 (CHAKRABORTTY et al.) 28 November 2013</td>
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<td>See paragraph [0025] and claim 1.</td>
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<td>X</td>
<td>WO 2011-002929 (THE TRUSTEES OF COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK) 06 January 2011</td>
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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
  - "E" earlier application or patent but published on or after the international filing date
  - "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
  - "O" document referring to an oral disclosure, use, exhibition or other means
  - "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search: 12 September 2016 (12.09.2016)

Date of mailing of the international search report: 12 September 2016 (12.09.2016)

Name and mailing address of the ISA/KR International Application Division

Korean Intellectual Property Office

189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea

Facsimile No. +82-42-481-8578

Authorized officer

KIM, Seung Beom

Telephone No. +82-42-481-3371

Form PCT/ISA/210 (second sheet) (January 2015)
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