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Sturgis et al.

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(54) **ANTIPERSPIRANT AND DEODORANT COMPOSITIONS**

(71) Applicant: **The Procter & Gamble Company**, Cincinnati, OH (US)

(72) Inventors: **David Arthur Sturgis**, Montgomery, OH (US); **Lindsey Michelle Britt**, West Chester, OH (US)

(73) Assignee: **The Procter & Gamble Company**, Cincinnati, OH (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 88 days.

This patent is subject to a terminal disclaimer.

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(51) **Int. Cl.**
A61K 8/92 (2006.01)
A61Q 15/00 (2006.01)
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CPC ***A61K 8/92*** (2013.01); ***A61K 8/0229*** (2013.01); ***A61K 8/0241*** (2013.01); ***A61K 8/19*** (2013.01);
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(58) **Field of Classification Search**
None
See application file for complete search history.

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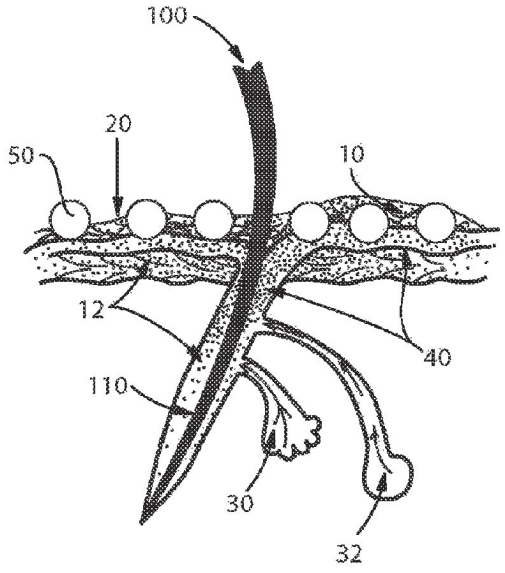
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Primary Examiner — Melissa S Mercier
(74) *Attorney, Agent, or Firm* — Kathleen Y. Carter

(57) **ABSTRACT**

A deodorant stick comprising at least 25% by weight liquid triglyceride; a primary antimicrobial having a water solubility of at most about 90 g/L at 25° C.; a fragrance composition comprising at least about 50% natural oils, essential oils, or a combination thereof; and a primary structurant with a melting point of at least 50° C.; said deodorant stick being free of an aluminum salt; and said deodorant stick having a hardness from about 70 mm*10 to about 140 mm*10, as measured by penetration with ASTM D-1321 needle.

19 Claims, 3 Drawing Sheets



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A61K 8/37	(2006.01)
A61K 8/49	(2006.01)
A61Q 17/00	(2006.01)

(52) **U.S. Cl.**

CPC ***A61K 8/37*** (2013.01); ***A61K 8/375*** (2013.01); ***A61K 8/4926*** (2013.01); ***A61K 8/732*** (2013.01); ***A61K 8/922*** (2013.01); ***A61Q 15/00*** (2013.01); *A61K 2800/30* (2013.01); *A61K 2800/34* (2013.01); *A61K 2800/74* (2013.01); *A61Q 17/005* (2013.01)

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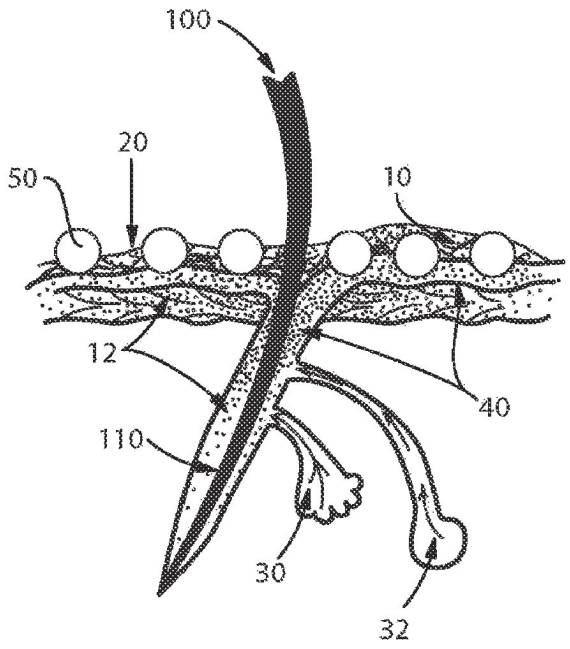


Fig. 1

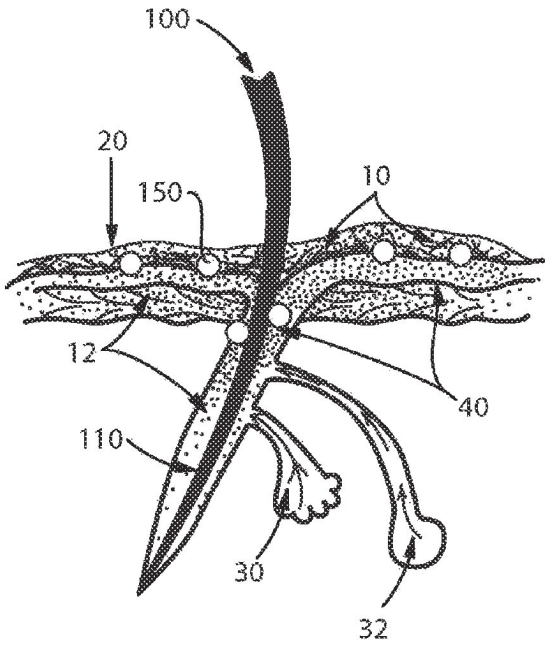


Fig. 2

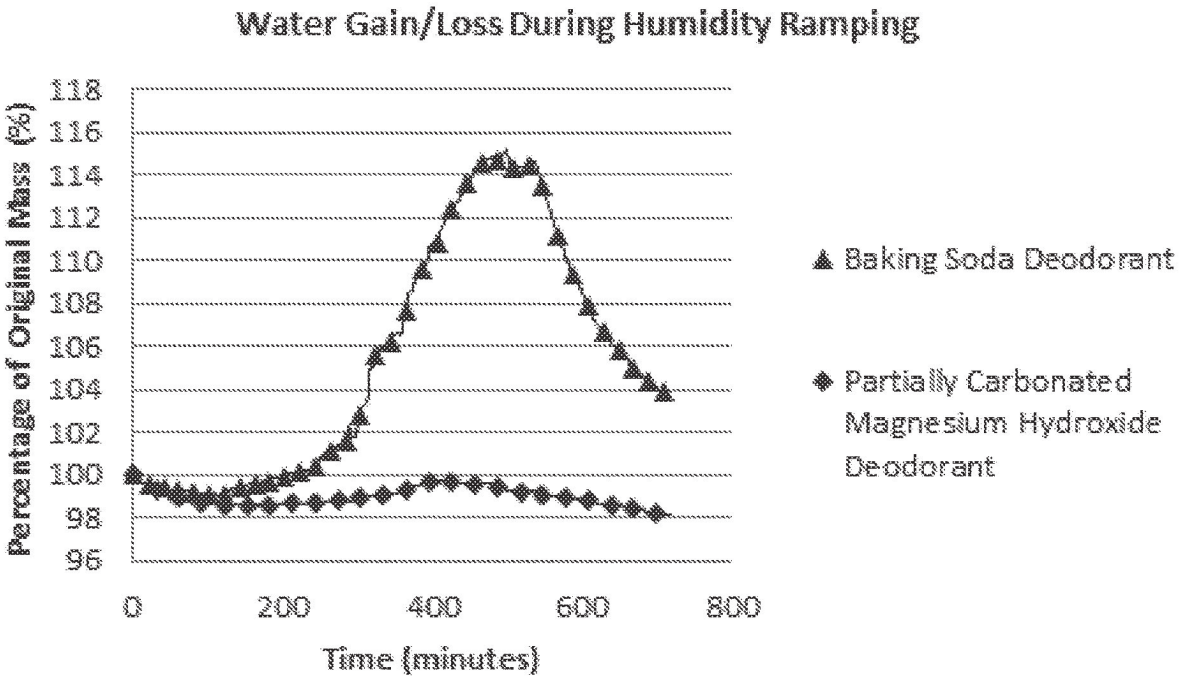

Water Gain/Loss During Humidity Ramping
Percentage of Original Mass (%)
118
116
114
112
110
108
106
104
102
100
98
96
0
200
400
600
800
Time (minutes)
Baking Soda Deodorant
Partially Carbonated Magnesium Hydroxide Deodorant

Fig. 3

ANTIPERSPIRANT AND DEODORANT COMPOSITIONS

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Application No. 62/527,180, filed Jun. 30, 2017, and of U.S. Provisional Application No. 62/647,111, filed Mar. 23, 2018, the substances of which are incorporated herein by reference.

FIELD OF THE INVENTION

The present disclosure relates to antiperspirant and deodorant compositions and methods relating thereto.

BACKGROUND OF THE INVENTION

Many antiperspirant and deodorants use actives that are astringent metallic salts, or in particular, aluminum salts. While aluminum is highly effective as an active, there is consumer interest in antiperspirants and deodorants that do not contain aluminum.

Consumers are also seeking more natural products complete with fragrances that are mostly natural or essential oil based. They are further seeking products with lower irritation than they have experienced with baking soda based products. The challenge with formulating with the natural and essential oil fragrances is that they can be less stable in the presence of heat and extreme pH (either high or low). And products formulated with baking soda, which has a relatively high pH and high water solubility, can increase irritation, even for consumers with moderate sweat rates. Highly water soluble alkaline powders contribute negatively towards natural or essential oil stability as well, especially in a hot process needed to melt waxes. And high water solubility powders can also lead to gritty products, as the water soluble powders can agglomerate when exposed to moisture released from powders during the hot batch process.

Thus, there is a continuing challenge to formulate a non-aluminum, natural fragrance deodorant that provides low irritation while maintaining sufficient odor protection.

Piroctone olamine is an anti-dandruff active used in shampoos, conditioners, and other treatments. Piroctone olamine can be an effective antimicrobial, but used alone as an active, it may not deliver the hoped for consumer performance. The inventors of the present invention have found, surprisingly, that the combination of piroctone olamine and other antimicrobials can provide significant antimicrobial activity against two of the most common underarm odor bacteria *C. mucofaciens* and *S. epidermidis*, which results in consumer odor protection on par or greater than some of the commonly used commercial deodorants available today.

Also to consider is that impurities can reduce the efficacy of piroctone olamine. Therefore, there is a need to develop products that mitigate this phenomenon and provide higher efficacy. The inventors of the present invention have found that select combinations of chelators and piroctone olamine, such as in an anhydrous formulation or in particular ratios, can provide significantly higher levels of anti-fungal activity than either material alone.

Furthermore, while antimicrobials in antiperspirants and deodorants are known to be able to reduce the microbes on the skin, microbes within hair follicles may still remain and contribute to malodor. The inventors of the present invention have found that piroctone olamine and other antimicrobial powders, if used at a size that can fit into a hair follicle, can deliver surprisingly superior antimicrobial activity.

By utilizing piroctone olamine in combination with appropriate antimicrobials, chelators, and/or at particular particle sizes, the present invention delivers compositions and products with superior antimicrobial performance.

SUMMARY OF THE INVENTION

A deodorant stick comprising at least 25% of a liquid triglyceride; a primary antimicrobial having a water solubility of at most about 90 g/L at 25° C.; a fragrance composition comprising at least about 50% natural oils, essential oils, or a combination thereof; and a primary structurant with a melting point of at least 50° C.; said deodorant stick being free of an aluminum salt; and said deodorant stick having a hardness from about 70 mm*10 to about 140 mm*10, as measured by penetration with ASTM D-1321 needle.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an illustration of a hair and hair follicle along with larger antimicrobial particles.

FIG. **2** is an illustration of a hair and hair follicle along with smaller antimicrobial particles.

FIG. **3** is a graph of the water gain/loss of two deodorant products.

DETAILED DESCRIPTION OF THE INVENTION

While the specification concludes with claims that particularly point out and distinctly claim the invention, it is believed the present invention will be better understood from the following description.

The present invention can comprise, consist of, or consist essentially of the essential elements and limitations of the invention described herein, as well any of the additional or optional ingredients, components, or limitations described herein.

All percentages, parts and ratios are based upon the total weight of the compositions of the present invention, unless otherwise specified. All such weights as they pertain to listed ingredients are based on the active level and, therefore do not include carriers or by-products that may be included in commercially available materials.

The components and/or steps, including those which may optionally be added, of the various embodiments of the present invention, are described in detail below.

All documents cited are, in relevant part, incorporated herein by reference; the citation of any document is not to be construed as an admission that it is prior art with respect to the present invention.

All ratios are weight ratios unless specifically stated otherwise.

All temperatures are in degrees Celsius, unless specifically stated otherwise.

Except as otherwise noted, all amounts including quantities, percentages, portions, and proportions, are understood to be modified by the word "about", and amounts are not intended to indicate significant digits.

Except as otherwise noted, the articles "a", "an", and "the" mean "one or more".

Herein, "comprising" means that other steps and other ingredients which do not affect the end result can be added.

This term encompasses the terms "consisting of" and "consisting essentially of". The compositions and methods/processes of the present invention can comprise, consist of, and consist essentially of the essential elements and limitations of the invention described herein, as well as any of the additional or optional ingredients, components, steps, or limitations described herein.

Herein, "effective" means an amount of a subject active high enough to provide a significant positive modification of the condition to be treated. An effective amount of the subject active will vary with the particular condition being treated, the severity of the condition, the duration of the treatment, the nature of concurrent treatment, and like factors.

The term "anhydrous" as used herein means substantially free of added or free water. From a formulation standpoint, this means that the anhydrous antiperspirant or deodorant stick compositions of the present invention contain less than about 1%, and more specifically zero percent, by weight of free or added water, other than the water of hydration typically associated with the particulate antiperspirant or deodorant active prior to formulation.

The term "ambient conditions" as used herein refers to surrounding conditions under about one atmosphere of pressure, at about 50% relative humidity, and at about 25° C., unless otherwise specified. All values, amounts, and measurements described herein are obtained under ambient conditions unless otherwise specified.

The term "majority" refers to greater than about 51% of the stated component or parameter.

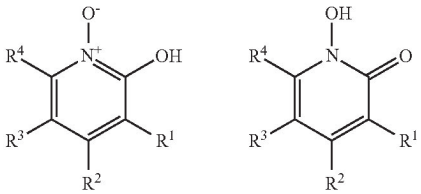
The term "polarity" as used herein is defined by the Hansen Solubility Parameter for solubility.

"Substantially free of" refers to about 2% or less, about 1% or less, or about 0.1% or less of a stated ingredient. "Free of" refers to no detectable amount of the stated ingredient or thing.

The term "volatile" as used herein refers to those materials that have a measurable vapor pressure at 25° C. Such vapor pressures typically range from about 0.01 millimeters of Mercury (mm Hg) to about 6 mmHg, more typically from about 0.02 mmHg to about 1.5 mmHg; and have an average boiling point at one (1) atmosphere of pressure of less than about 250° C., more typically less than about 235° C. Conversely, the term "non-volatile" refers to those materials that are not "volatile" as defined herein.

A. 2-Pyridinol-N-Oxide Materials

2-Pyridinol-N-oxide materials suitable for use in this invention include a substituted or unsubstituted 2-pyridinol-N-oxide material or a salt thereof. Included within the scope of this invention are tautomers of this material, e.g., 1-hydroxy-2(1H)-pyridinone. The substituted or unsubstituted 2-pyridinol-N-oxide material and its corresponding tautomeric form, 1-hydroxy-2(1H)-pyridinone, are shown below:



where R^1, R^2, R^3, R^4 groups are independently selected from the group consisting of H, Cl, Br, I, F, NO, NO_2, and $(CH_2)_nG$, where each G is independently selected from the group consisting of $(O)_mSO_3M^3$, $(O)_mCO_2M^3$, $(O)_mC(O)(R^5)$, $(O)_mC(O)N(R^5R^6)$, $(O)_mCN$, $(O)_m(R^5)$, and $N(R^5R^6)$, where m is 0 or 1, n is an integer from 0 to 4, R^5 and R^6 are independently selected from the group consisting of H and a substituted or unsubstituted C_1-C_{12} organic group, and M^3 is selected from the group consisting of H, a substituted or unsubstituted C_1-C_{12} organic group, $^+N(R^7R^8R^9R^{10})$, and $1/q\ M'^{q+}$ where M' is selected from the group consisting of an alkali metal of charge q and an alkaline earth metal of charge q, where R^7, R^8, R^9, and R^{10} are independently selected from the group consisting of H and a substituted or unsubstituted C_1-C_{12} organic group, and where any pair of vicinal groups, R^1 and R^2, R^2 and R^3, R^3 and R^4 may be taken together to form another five- or six-membered aromatic or aliphatic ring optionally substituted with one or more groups selected from the group consisting of Cl, Br, I, F, NO, NO_2, CN, $(CH_2)_nG$, and mixtures thereof. Suitable organic groups include $(C_1$-$C_{12})$alkyl, $(C_2$-$C_{12})$alkenyl, and $(C_2$-$C_{12})$alkynyl. The organic group may optionally be substituted and suitable substituent groups include a hydroxyl group, a carboxyl group, and an amino group. 2-pyridinol-N-oxide is also known, for example, as 2-hydroxypyridine-N-oxide, 2-pyridinol-1-oxide, or 2-hydroxypyridine-1-oxide.

In certain aspects, the 2-pyridinol-N-oxide material is a 2-pyridinol-N-oxide material or tautomer thereof according to the formula(s) above, where R^1, R^2, R^3, R^4 are independently selected from the group consisting of H, Cl, and $(CH_2)_nG$, where G is independently selected from the group consisting of $(O)_mSO_3M^3$, $(O)_mCO_2M^3$, $(O)_mC(O)(R^5)$, $(O)_mCN$, and $(O)_m(R^5)$, where m is 0 or 1. In other aspects, the 2-pyridinol-N-oxide material is a 2-pyridinol-N-oxide material according to the formula above, where R^1, R^2, R^3, R^4 are independently selected from the group consisting of H, SO_3M^3, and CO_2M^3. In still other aspects, R', R^2, R^3, R^4 are independently selected from the group consisting of H, SO_3M^3, and CO_2M^3, where no more than one R', R^2, R^3, R^4 is SO_3M^3 or CO_2M^3.

In certain aspects, the 2-pyridinol-N-oxide material is the salt of a substituted or unsubstituted 2-pyridinol-N-oxide material. In these aspects, the hydrogen of the hydroxyl group of the 2-pyridinol-N-oxide material may be substituted with a suitable charge-balancing cation. In these aspects, non-limiting examples of the hydrogen-substituting cation include Na^+, Li^+, K^+, ½ Mg^{2+}, or ½ Ca^{2+}, substituted ammonium, such as C_1-C_6 alkanolammnonium, mono-ethanolamine (MEA), tri-ethanolamine (TEA), di-ethanolamine (DEA), or any mixture thereof. In some aspects, in solution, the cation may be dissociated from the 2-pyridinol-N-oxide or the 1-hydroxy-2(1H)-pyridinone anion.

In certain aspects, the 2-pyridinol-N-oxide material is of a substituted or unsubstituted 2-pyridinol-N-oxide material. Salts for use herein include those formed from the polyvalent metals barium, bismuth, strontium, copper, zinc, cadmium, zirconium and mixtures thereof.

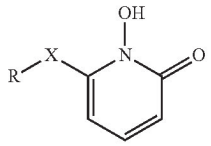
In some aspects, the 2-pyridinol-N-oxide material is selected from the group consisting of: 6-hydroxy-3-pyridinesulfonic acid, 1-oxide (CAS 191672-18-1); 2-hydroxypyridine-1-oxide (CAS 13161-30-3); 2-hydroxy-4-pyridinecarboxylic acid, 1-oxide (CAS 13602-64-7); 5-ethoxy-2-pyridinol, 2-acetate, 1-oxide (CAS 51984-49-7); 1-(3-hydroxy-2-oxido-4-isoquinolinyl)-ethanone (CAS 65417-65-4); 6-hydroxy-3-pyridinecarboxylic acid, 1-oxide (CAS 90037-89-1); 2-methoxy-4-quinolinecarbonitrile, 1-oxide

(CAS 379722-76-6); 2-pyridinecarboxylic acid, 6-hydroxy-, 1-oxide (CAS 1094194-45-2); 3-pyridinecarboxylic acid, 2-hydroxy-, 1-oxide (CAS 408538-43-2); 2-pyridinol, 3-nitro-, 1-oxide (CAS 282102-08-3); 3-pyridinepropanenitrile, 2-hydroxy-, 1-oxide (193605-60-6); 3-pyridineethanol, 2-hydroxy-, 3-acetate, 1-oxide (CAS 193605-56-0); 2-pyridinol, 4-bromo-, 1-oxide (CAS 170875-41-9); 2-pyridinol, 4,6-dibromo-, 2-acetate, 1-oxide (CAS 170875-40-8); 2-pyridinol, 4,6-dibromo, 1-oxide (CAS 170875-38-4); 2-pyridinol, 4-(2-aminoethyl)-, 1-oxide (CAS 154403-93-7); 2-pyridinol, 5-(2-aminoethyl)-, 1-oxide (CAS 154403-92-6); 3-pyridinepropanoic acid, α-amino-6-hydroxy-, 1-oxide (CAS 134419-61-7); 2-pyridinol, 3,5-dimethyl, 1-oxide (CAS 102074-62-4); 2-pyridinol, 3-methyl-, 1-oxide (CAS 99969-07-0); 2-pyridinol, 3,5-dinitro, 1-oxide (CAS 98136-47-1); 2-pyridinol, 3,5-dibromo-, 1-oxide (CAS 98136-29-9); 2-pyridinol, 4-methyl-6-(2-methylpropyl)-, 1-oxide (CAS 91408-77-4); 2-pyridinol, 3-bromo-4, 6-dimethyl-, 1-oxide (CAS 91408-76-3); 2-pyridinol, 4,5,6-trimethyl-, 1-oxide (CAS 91408-75-2); 2-pyridinol, 6-heptyl-4-methyl-, 1-oxide (CAS 91408-73-0); 2-pyridinol, 6-(cyclohexylmethyl)-4-methyl-, 1-oxide (CAS 91408-72-9); 2-pyridinol, 6-bromo-, 1-oxide (CAS 89284-00-4); 2-pyridinol, 5-bromo-, 1-oxide (CAS 89283-99-8); 2-pyridinol, 3,5-dichloro-4,6-difluoro-, 1-oxide (CAS 33693-37-7); 2-pyridinol, 3,4,5,6-tetrachloro-, 1-oxide (CAS 32835-63-5); 2-pyridinol, 6-methyl-, 1-oxide (CAS 14420-62-3); 2-pyridinol, 5-nitro-, 1-oxide (CAS 14396-03-3); 2-pyridinol, 4-methyl-5-nitro-, 1-oxide (CAS 13602-77-2); 2-pyridinol, 4-chloro-5-nitro-, 1-oxide (CAS 13602-73-8); 2-pyridinol, 4-chloro-, 1-oxide (CAS 13602-65-8); 2-pyridinol, 4-nitro-, 1-oxide (CAS 13602-63-6); and 2-pyridinol, 4-methyl-, 1-oxide (CAS 1952-64-3), and mixtures thereof. These materials are commercially available from, for example, Sigma-Aldrich (St. Louis, Mo.) and/or Aces Pharma (Branford, Conn.).

In certain aspects, the 2-pyridinol-N-oxide material is a 2-pyridinol-N-oxide material selected from the group consisting of: 2-hydroxypyridine-1-oxide; 3-pyridinecarboxylic acid, 2-hydroxy-, 1-oxide; 6-hydroxy-3-pyridinecarboxylic acid, 1-oxide; 2-hydroxy-4-pyridinecarboxylic acid, 1-oxide; 2-pyridinecarboxylic acid, 6-hydroxy-, 1-oxide; 6-hydroxy-3-pyridinesulfonic acid, 1-oxide; and mixtures thereof.

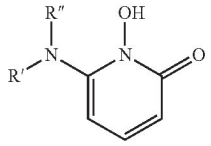
In certain aspects, the 2-pyridinol-N-oxide material is a 1-Hydroxy-2(1H)-pyridinone material selected from the group consisting of: 1-Hydroxy-2(1H)-pyridinone (CAS 822-89-9); 1,6-dihydro-1-hydroxy-6-oxo-3-Pyridinecarboxylic acid (CAS 677763-18-7); 1,2-dihydro-1-hydroxy-2-oxo-4-Pyridinecarboxylic acid (CAS 119736-22-0); 1,6-dihydro-1-hydroxy-6-oxo-2-Pyridinecarboxylic acid (CAS 94781-89-2); 1-hydroxy-4-methyl-6-(2,4,4-trimethylpentyl)-2(1H)-Pyridinone (CAS 50650-76-5); 6-(cyclohexylmethyl)-1-hydroxy-4-methyl-2(1H)-Pyridinone (CAS 29342-10-7); 1-hydroxy-4,6-dimethyl-2(1H)-Pyridinone (CAS 29342-02-7); 1-Hydroxy-4-methyl-6-(2,4,4-trimethylpentyl)-2-pyridone monoethanolamine (CAS 68890-66-4); 1-hydroxy-6-(octyloxy)-2(1H)-Pyridinone (CAS 162912-64-3); 1-Hydroxy-4-methyl-6-cyclohexyl-2-pyridinone ethanolamine salt (CAS 41621-49-2); 1-Hydroxy-4-methyl-6-cyclohexyl-2-pyridinone (CAS 29342-05-0); 6-ethoxy-1, 2-dihydro-1-hydroxy-2-oxo-4-Pyridinecarboxylic acid, methyl ester (CAS 36979-78-9); 1-hydroxy-5-nitro-2(1H)-Pyridinone (CAS 45939-70-6); and mixtures thereof. These materials are commercially available from, for example, Sigma-Aldrich (St. Louis, Mo.), Princeton Building Blocks (Monmouth Junction, N.J.), 3B Scientific Corporation (Libertyville, Ill.), SynFine Research (Richmond Hill, ON), Ryan Scientific, Inc. (Mt. Pleasant, S.C.), and/or Aces Pharma (Branford, Conn.).

In certain aspects, the 2-pyridinol-N-oxide material is a 2-pyridinol-N-oxide material or tautomer thereof according to the formula(s) below:



where X is an oxygen or sulfur moiety and R is a substituted or unsubstituted hydrocarbon group having between 1 and 20 carbon atoms. Materials of this class can be synthesized following the procedure disclosed in U.S. Pat. No. 5,675,013.

In certain aspects, the 2-pyridinol-N-oxide material is a 2-pyridinol-N-oxide material or tautomer thereof according to the formula(s) below:



Wherein R' and R" are independently either hydrogen or a substituted or unsubstituted hydrocarbon group having between 1 and 20 carbon atoms. Materials of this class can be synthesized following the procedure disclosed in U.S. Pat. No. 5,675,013. In certain aspects, the 2-pyridinol-N-oxide material is 1-Hydroxy-4-methyl-6-(2,4,4-trimethylpentyl)-2-pyridone monoethanolamine salt.

The amount of 2-pyridinol-N-oxide (which may throughout this disclosure sometimes be referred to as piroctone olamine) in antiperspirant or deodorant formulations of the present invention may be from about 0.04% to about 1.0% by weight, in some embodiments from about 0.05% to about 0.6% by weight, and in some embodiments from about 0.05% to about 0.5% by weight.

B. Chelators

In the present invention, iron chelators may have, but are not limited to, the following characteristics:

1. An affinity for iron ions in either the ferrous (iron II) or ferric (III) forms;

2. Materials of Description 1 (above) that have a denticity of four or higher (denticity is the number of groups of a molecule that bind to the iron);

3. Chemical descriptions that are a subset of Description 2:

   a. Either natural or synthetic materials;

   b. Materials of the following chemical classes:

   i. Aminophosphates

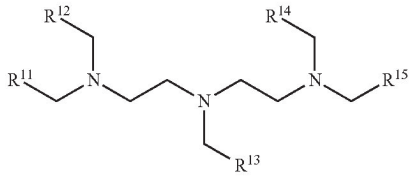
   ii Aminocarboxylates

   iii. Hydroxamic acids

   and molecules representing combinations of these chemical classes.

In an embodiment of the present invention, an iron chelator may be present from the following groups:

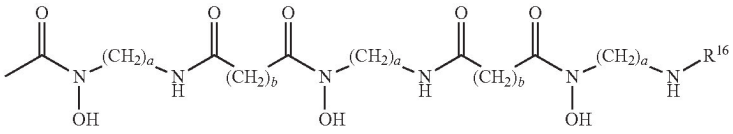
(1) Iron chelators represented by the following structure:



where R^{11}, R^{12R}, R^{13}, R^{14}, R^{15} are independently selected from the group consisting of $M^1M^2PO_3$, CO_2M^1, and mixtures thereof

where M^1 and M^2 is H, a metal salt (such as Na, K, Ca, Mg, Al, etc.) or ammonium salt.

(2) Iron chelators represented by the following structure:



where a is an integer from 2 to 7 wherein any of the CH_2 groups in this unit may be substituted with alkyl or aryl units that may contain heteroatoms (S, N, O, Cl, F, Br or I)

where b is an integer from 1 to 7 wherein any of the CH_2 groups in this unit may be substituted with alkyl or aryl units that may contain heteroatoms (S, N, O, Cl, F, Br or I)

where R^{16} is H or $(CH_2)_n$, where n in an integer from 1 to 6 or is a CH_2 linker unit that may be further substituted at any CH_2 group in the chain with alkyl or aryl units that may contain heteroatoms (S, N, O, Cl, F, Br, or I).

Specific and/or additional chelators in the present invention may include, but are not limited to, diethylenetriaminepentaacetic acid (DTPA), diethylenetriaminepentakis (methylenephosphonic acid) (DTPMP), desferrioxamine, their salts and combinations thereof, EDTA, DPTA, EDDS, enterobactin, desferrioxamine, HBED, and combinations thereof.

While piroctone olamine can be an effective antimicrobial for an antiperspirant or deodorant, the presence of iron and other impurities may reduce piroctone olamine's effectiveness. As such, the inventors of the present invention have found that including a chelant to bond with iron, for example, can reduce the occurence of piroctone olamine itself bonding with the iron, essentially freeing the piroctone olamine to be effective against bacteria.

This is particularly true in anhydrous formulations. In an aqueous formulation comprising piroctone olamine and a chelant, the chelant can improve piroctone olamine's efficacy because the chelant should have more affinity for the iron than the piroctone olamine has affinity for the iron. In addition, in an anhydrous formulation, with little or no water, the water solubility of the materials comes into play when sweat meets the formulation. Piroctone olamine typically has a lower water solubility than a chelant, meaning that in an anhydrous formulation, the chelant's higher water solubility results in the chelant more quickly getting into solution and bonding with iron, ie., before the piroctone olamine gets into solution. This further advantage only exists in an anhydrous formulation, as in an aqueous formulation, everything is fully in solution from the beginning.

Table 1 below shows the intrinsic water solubility independent of pH (Log WS_o) of piroctone olamine and EDTA as an example. The lower Log WS_o of piroctone olamine indicates that it will get into solution more slowly than a chelant such as EDTA, and the chelant will have more of an opportunity to bond with iron than the piroctone olamine will.

TABLE 1

CAS Number	Name	LogWS_o
6153824	Piroctone olamine	−3.22
6153825	EDTA	−1.4

Furthermore, the inventors of the present invention have found that the ratio of chelant to piroctone olamine may be important. In some embodiments, the improved efficacy of a chelant with piroctone olamine can be seen when the ratio of chelant to piroctone is at least about 4:1, in some embodiments at least 6:1, and in some embodiments, at least 8:1. The amount of chelant, by weight of composition, may be from about 0.05% to about 4%.

C. Water Solubility

The present inventors have discovered that the water solubilities of certain components in the solid stick antiperspirant or deodorant have great importance. Some deodorant ingredients will bring in moisture to the batch, which can solvate these components to different extents when the water evaporates and subsequently recondenses as free water in the batch. Certain batch processing conditions (such as a closed top on the tank) could more effectively trap this water in the tank, where it is then free to interact with components of the batch. For example, highly water soluble alkaline powders can contribute negatively towards natural and essential oil stability when dissolved. This is because many natural and essential oils contain a broad range of perfume chemicals, many of which can undergo degradation reactions when exposed to extreme pH or heat. This is why many natural and essential oils have shorter shelf lives than many commercial synthetic chemicals or perfumes. And certain antimicrobials may cause irritation due to high water solubility. Further, high water solubility can lead to grittier products as the more water soluble powders can agglomerate when exposed to moisture released from powders during the heat of manufacture.

To demonstrate this concept, the present inventors made two batches of deodorant product following the same formula, where baking soda (high water solubility) was the active ingredient. The fragrance contained 6-8% natural vanilla. Batch A was made similarly to the inventive formulas herein. Batch B had 3% water added into the batch during cooling to simulate moisture that could evaporate and recondense in a tank under certain process conditions. The

differences in Batch B were almost immediately obvious. The color of the batch became a deep brown during a brief hold time of 15 minutes.

As previously explained, it is believed that the water solvates the baking soda since it is so highly water soluble, and the resulting high pH solution degrades fragrance (particularly the more susceptible natural vanilla). The resulting byproducts change the color and odor of the batch.

Color and odor were observed to be adversely affected by the excess water. The color difference was very visually obvious. The odor differences were confirmed with an odor panel, in which the comparison of Batch A (control) vs. Batch B failed with a grade of 2.7 (below 3 is a failure). Thus, embodiments of the present invention may include an antimicrobial with a low water solubility. An antimicrobial with a low water solubility may be, in some embodiments, an antimicrobial with a water solubility of at most 90 g/L at 25° C., in other embodiments at most 75 g/L at 25° C., or in still other embodiments at most 50 g/L at 25° C.

Materials with a water solubility above 90 g/L @25° C. include but are not limited to: potassium carbonate, potassium bicarbonate, sodium carbonate, sodium sesquicarbonate, triethyl citrate, and baking soda. Materials with a water solubility below 90 g/L @25° C. include but are not limited to: beryllium carbonate, magnesium carbonate, calcium carbonate, magnesium hydroxide, magnesium hydroxide and magnesium carbonate hydroxide, partially carbonated magnesium hydroxide, piroctone olamine, hexamidine, zinc carbonate, thymol, polyvinyl formate, salycilic acid, phenoxyethanol, eugenol, linolenic acid, dimethyl succinate, citral, and triethyl citrate. Each of beryllium carbonate, magnesium carbonate, calcium carbonate, magnesium hydroxide, magnesium hydroxide and magnesium carbonate hydroxide, partially carbonated magnesium hydroxide, piroctone olamine, hexamidine, zinc carbonate, thymol, polyvinyl formate, salycilic acid, phenoxyethanol, eugenol, linolenic acid, dimethyl succinate, and citral have a water solubility below 75 g/L @25° C., below 50 g/L @25° C., below 1 g/L @25° C., and below 0.2 g/L @25° C.

As FIG. **3** shows, when samples of a deodorant product containing partially carbonated magnesium hydroxide (low water solubility) and a deodorant product containing baking soda (high water solubility) were put through a humidity ramp from 0% relative humidity (RH) to 100% RH and back to 0% RH, the baking soda deodorant gained and lost more water weight than the partially carbonated magnesium hydroxide deodorant. Absorbing more water puts the product at risk of grittiness and perfume instability.

For example, the data below shows one product difference when using high vs. low water solubility powders. Product A, with a low water solubility antimicrobial powder, demonstrated better perfume stability than Product B, which had a high water solubility antimicrobial powder:

Product A	
	Cardamom Ginger Control = Product A, Day 0
Day 1	3.7
Day 2	3.3
Day 3	3.3

Product B	
	Cardamom Ginger Control = Product A, Day 0
Day 0	3.7
Day 1	2.7
Day 2	2.7
Day 3	2.7

Odor grading was completed on a solid stick deodorant containing a low water solubility powder of magnesium hydroxide & magnesium carbonate hydroxide (Product A), as well as a solid stick deodorant containing a high water solubility powder of baking soda (Product B). Both products had the same level of a fragrance, which was composed entirely of natural and essential oils. Jars containing samples of the products were heated at 73° C. for 1, 2, and 3 days as part of a rapid stability program. All odor grades were made for the heated jars in comparison to a control, which was an unheated jar of product A. The grades evaluate scent character and intensity changes. If at any time point there is an average odor grade score below a 3, the product is considered an odor grade failure. The product containing the high water solubility powder failed odor grading, while the product with the low water solubility passed odor grading. This serves as an example of how natural and essential oil blends would be more susceptible to degradation and less stability when used with high water solubility powders.

D. Additional Antimicrobials

The present invention may include one or more antimicrobial compositions. For example, antimicrobials may include, without being limited to, piroctone olamine, hexamidine, magnesium carbonate, zinc carbonate, thymol, magnesium hydroxide, dead sea salt, magnesium hydroxide and magnesium carbonate hydroxide, partially carbonated magnesium hydroxide, calcium carbonate, polyvinyl formate, salycilic acid, niacinamide, phenoxyethanol, eugenol, linolenic acid, dimethyl succinate, citral, triethyl citrate, sepiwhite, baking soda, partially carbonated magnesium hydroxide, magnesium carbonate hydroxide, cinnamon essential oil, cinnamon bark essential oil, cinnamic aldehyde, and combinations thereof.

In general, the total amount of antimicrobial used in the present invention may be from about 0.1% to about 30%, by weight, of the deodorant. Some antimicrobials may be used in amounts as low as about 0.1%, by weight of the deodorant, such as if using piroctone olamine or hexamidine as the primary antimicrobial, while others could be as high as about 25%, such as if using magnesium hydroxide or magnesium hydroxide and magnesium carbonate hydroxide as the primary antimicrobial (primary antimicrobial being the antimicrobial present in the composition in the highest amount). In the latter cases, baking soda might still be used at a lower level, such as from about 0.1% to about 6%, as a secondary antimicrobial, or not at all.

Any of the antimicrobials of the present invention may be used as powders. It is believed that antimicrobial powders may provide a better deposition and have more longevity on the skin than antimicrobials delivered in a different form. In addition, it is believed that antimicrobial powders of a certain average particle size, typically from about 1 micron to about 5 microns, may provide a significant increase in antimicrobial efficacy.

Many antimicrobials can be effective at minimizing the skin surface bacteria. However, as a leave-on product where odor may not occur until later, even hours after application, antiperspirant and deodorant antimicrobials are needed that will be effective for long periods of time. So while antiperspirant and deodorant antimicrobials may be effective immediately upon application on the skin, it is believed that odor comes back quickly because the bacteria living around the hair follicle can quickly repopulate the skin surface bacteria. Historical approaches using high skin penetrating liquid antimicrobials to affect this region (for example, hexanediol) can cause irritation. Therefore, the present invention is able to target methods and mechanisms that can more effectively deliver antimicrobials not only to the skin surface, but to the bacteria in and around the hair follicle. While not wanting to be bound to the theory, the inventors of the present invention believe that powders, specifically powders with an average particle size of less than about 10 microns, in some cases from about 1 micron to about 5 microns, are more efficient at getting into the hair follicle where the bacteria live and repopulate the skin surface.

As shown in FIGS. **1** and **2**, a hair 100 is partly above the skin surface and partly below the skin surface in the hair follicle 110. The antimicrobial particles, 50 and 150, upon application, may be on the surface of the skin at the skin secretion/air/sweat interface 20 and where there is bacteria 10. As shown in FIGS. **1** and **2**, the sebaceous gland 30 and the apocrine gland 32 in the skin have secretions that are in the hair follicle 110. Bacteria 12 and odor precursors 40 are embedded in the secretions. In FIG. **1**, the larger antimicrobial particles 50 are too big to fit into the hair follicle, leaving the secretions inside the hair follicle untouched. The antimicrobial particles 50 come in contact with bacteria only on the surface of the skin. In FIG. **2**, however, the antimicrobial particles 50 are sized to fit within the hair follicle and deliver antimicrobial activity not only to the surface of the skin, but also directly and immediately to the hair follicle secretions 12 and 40. Having the antimicrobial particles be in the range of about 1 to about 10 microns, in some embodiments about 1 to about 5 microns, provides better odor protection later in the day hours after application of the antiperspirant or deodorant when other good antimicrobial materials and other sizes of antimicrobial materials are not as effective against this rebound in bacteria population from the follicle.

E. Antimicrobial Activity

Table 2 below shows the raw material microbial inhibition concentration data tested against two key underarm bacteria strains. As can be seen, the first three listed antimicrobials, lupamin, hexamidine, and piroctone olamine, perform particularly well against the bacteria as raw materials. Also performing well as raw materials are phenoxyethanol, eugenol, linolenic acid, dimethyl succinate, citral, triethyl citrate, and sepiwhite. Also performing moderately well against the bacteria as raw materials were magnesium carbonate and magnesium hydroxide and calcium carbonate.

TABLE 2

Antimicrobial	*C. mucofaciens*	*S. epidermidis*
Lupamin	<2 ppm	4 ppm
Hexamidine 36 mg/ml H2O	<2 ppm	7 ppm
100 mg/ml piroctone olamine in H2O	<5 ppm	10 ppm
100% Phenoxyethanol	400 ppm	800 ppm %
Eugenol 99% ETOH	773 ppm	773 ppm
Linolenic Acid 70% ETOH	1093 ppm	1093 ppm
Dimethyl Succinate 98% ETOH	1531 ppm	3062 ppm
Citral 96% ETOH	1500 ppm	1500 ppm
100% Triethyl citrate	1600 ppm	1600 ppm
Sepiwhite 40 mg/ml H2O ins	2000 ppm	1000 ppm
Magnesium Carbonate & Magnesium Hydroxide 50 mg/ml H2O ins	>2500 ppm	>2500 ppm
Ca Carbonate 50 mg/ml H2O ins	>2500 ppm	>2500 ppm
Linoleic acid 100% ETOH	3125 ppm	3125 ppm
Conarom B (beta Bio) 100% ETOH	3125 ppm	3125 ppm
Hexyl Decanol 97% ETOH	6062 ppm	3031 ppm
Ajowan oil 50% ETOH	12500 ppm	6300 ppm
Oregano oil 50% ETOH	12500 ppm	6300 ppm
100% Ethylhexyl glycerin	12500 ppm	12500 ppm
Mineral oil 50% in ETOH	12500 ppm	>50000 ppm
ACH 50% in H2O	25000 ppm	25000 ppm
NaCl 250 mg/ml H2O	>25000 ppm	>25000 ppm
Farnesol 95% ETOH	47500 ppm	5937 ppm
Phytol 97% ETOH	>49000 ppm	>49000 ppm
Nerolidol 98% ETOH	>49000 ppm	>49000 ppm
CaCl 500 mg/ml H2O	>50000 ppm	>50000 ppm
Isopropyl Myristate 98% ETOH	>59000 ppm	>59000 ppm

While numerous antimicrobials exhibit efficacy against two main bacteria strains that antiperspirants and deodorants try to address, due to regulatory and safety reasons, there are sometimes limits as to how much of a particular antimicrobial may be put into an antiperspirant or deodorant formula. Therefore, there is a need for multiple antimicrobials to work together in a formula to deliver enough long-term odor protection. The inventors of the present invention believe that piroctone olamine may be an ideal antimicrobial to combine with other antimicrobials.

Table 3 is a summary of in-use consumer data for Inventive Formulas 1-4 shown in Table 4 along with a comparative deodorant that is a currently marketed aluminum-free product with a high water solubility active (baking soda). As seen in Table 3, the inventive formulas produce a consumer-accepted deodorant that works on par with the high water solubility deodorant. And as discussed herein, the use of the low water solubility actives can provide additional perfume stability and aesthetic benefits that deodorants with high water solubility actives cannot. Consumer data test method: Phase 1 was four days of soap washing only (no underarm product use). Both phase 2 and 3 included once per day application of test products for eight days. The desired dose was 0.9 g. Subjects were asked to complete twice daily self-assessed odor evaluations and once daily discomfort evaluation.

TABLE 3

	Keeping Underarms from Malodor (% who answered Excellent or Very Good)	Keeping Underarms from Malodor (% who answered Fair or Poor or Very Good)
Males (n = 33-47)		
Comparative Deodorant	84	16
Inventive Formula #1	86	14
Inventive Formula #2	84	16
Inventive Formula #3	82	18
Inventive Formula #4	68	32

TABLE 3-continued

	Keeping Underarms from Malodor (% who answered Excellent or Very Good)	Keeping Underarms from Malodor (% who answered Fair or Poor or Very Good)
Females (n = 55-73)		
Comparative Deodorant	73	27
Inventive Formula #1	70	30
Inventive Formula #2	71	29
Inventive Formula #3	72	28
Inventive Formula #4	66	34

TABLE 4

F. Examples

	Inventive Formula #1	Inventive Formula #2	Inventive Formula #3	Inventive Formula #4	Inventive Formula #5
Hardness (Penetration mm * 10)	90	100	110	115	110
Caprylic/Capric Triglyceride	53.5	57.58	64.3	60.5	63.8
Starch	20	14.27	15.6	20	15.6
Zinc Carbonate		2			
Silica Silylate		0.5			
Ozokerite	10	9	9.6	9	10.1
Magnesium hydroxide and magnesium carbonate hydroxide	8	8	8	8	8
Cyclodextrin	6	6			
Thymol		0.05			
Hexamidine		0.1			
Piroctone Olamine	0.5	0.5	0.5	0.5	0.5
Fragrance	2	2	2	2	2
Total	100	100	100	100	100

G. Iron Affinity—log K_1

The strength of the association between a ligand and metal, in this case iron, can be termed iron affinity. A high iron binding affinity is required for chelators to effectively compete with iron salt impurities that reduce the efficacy of 2-pyridinol-N-oxide materials.

Affinity between a metal (M) and ligand (L) can be measured by the stepwise association constant, K_1 which describes the following equilibrium:

$$M + L \rightleftharpoons ML; K_1 = \frac{[ML]}{[M][L]}$$

The affinity constant is conveniently expressed as the logarithm (log K_1) and the larger the magnitude of this number, the stronger the association between the metal (iron ions in this case) and ligand.

TABLE 5

Iron Binding Affinities of Chelators

Chelator	Log K_1[a]
Desferrioxamine	31
Diethylenetriaminepentaacetic acid (DTPA)	28
Diethylenetriaminepentakis(methylenephosphonic acid) (DTPMP)	23
Methylglycine diacetic acid (MGDA)	16
Citric Acid	11

[a]NIST Standard Reference Database 46: Critically Selected Stability Constants of Metal Complexes.

In an embodiment of the present invention, the antiperspirant or deodorant composition may contain an iron chelator which has a log K_1 greater than about 16. In a further embodiment, the antiperspirant or deodorant composition may contain an iron chelator which has a log K_1 greater than about 20.

Antiperspirant/Deodorant Composition

The antiperspirant and/or deodorant compositions (for simplicity sometimes referred to as either antiperspirant or deodorant compositions) as described herein can contain a primary structurant, an antiperspirant active, a perfume, and additional chassis ingredient(s). The antiperspirant or deodorant composition may further comprise other optional ingredient(s). The compositions can be in the form of a solid stick. The compositions may be free of dipropylene glycol, added water, castor wax, or any combination thereof. The antiperspirant composition may be anhydrous. The antiperspirant composition may be free of added water.

As consumers seek more natural ingredients in their antiperspirants and deodorants, one approach to formulation is to use emollients derived from natural oils. Emollients derived from natural oils are derived from plant sources, such as palm oil or coconut oil. One example of an emollient derived from natural oils may be a liquid triglyceride, defined as a triglyceride that is liquid at 25° C. Thus, products that hope to emphasize natural ingredients may have a significant amount of a liquid triglyceride, for example. Derived directly from plant sources, liquid triglyc-

erides are often short chains. Longer chain triglycerides may be used as structurants in deodorant or antiperspirant sticks, but the triglycerides of the present invention are liquid at room temperature (25° C.) and tend to be shorter chains. An example may be caprylic/capric triglyceride.

Hardness

Providing a deodorant stick having at least 25% of a liquid triglyceride and structurants that have a melting point greater than about 50° C. can result in a deodorant stick with a hardness from about 70 mm*10 to about 140 mm*10. Such a deodorant stick is able to comprise consumer-perceived natural ingredients, while offering a pleasant consumer experience in terms of its hardness.

In general, the greater amount of liquid in the formulation, the softer the deodorant stick may be. The more solids in the formulation leads to greater hardness. Because achieving a sufficient softness in a deodorant stick with natural ingredients can be a challenge, it can be beneficial to formulate with higher amounts of liquids such as liquid triglyceride.

Rather than using waxes or other high melting structurants, embodiments may comprise levels of liquid triglycerides such as at least about 25% by weight of the composition, and in some embodiments, at least about 30%, at least about 40%, at least about 50%, at least about 55% of the composition, or at least about 60% by weight of the composition. In some embodiments, the amount of liquid triglyceride may be from about 25% to about 50%, from about 30% to about 50%, from about 35% to about 60%, from about 40% to about 50%, from about 40% to about 60%, from about 50% to about 60%, from about 40% to about 70%, from about 50% to about 70%, or from about 60% to about 70%, by weight, of the composition. The level of liquid triglyceride as referred to herein may be the sum total of one or more types of liquid triglyceride in a particular deodorant stick.

The deodorant compositions of the present invention may have a product or stick hardness from about 70 mm*10 to about 140 mm*10, as measured by penetration with ASTM D-1321 needle (see Hardness test method below). In some embodiments, the product hardness may be from about 75 to about 125 mm*10, or from about 80 to about 120 mm*10, from about 80 to about 140 mm*10, or from about 90 to about 110 mm*10.

Primary Structurants

The antiperspirant and deodorant compositions of the present invention comprise a suitable concentration of a primary structurant to help provide the compositions with the desired viscosity, rheology, texture and/or product hardness, or to otherwise help suspend any dispersed solids or liquids within the composition. A primary structurant may be the structurant that appears in the product in the highest amount (liquid triglycerides are not considered a structurant in this context). In some embodiments, the primary structurant may have a melting point of at least about 50° C., or from about 50° C. to 70° C., or from about 50° C. to about 80° C., or from about 70° C. to about 80° C.

The term "solid structurant" as used herein means any material known or otherwise effective in providing suspending, gelling, viscosifying, solidifying, and/or thickening properties to the composition or which otherwise provide structure to the final product form. These solid structurants include gelling agents, and polymeric or non-polymeric or inorganic thickening or viscosifying agents. Such materials will typically be solids under ambient conditions and include organic solids, crystalline or other gellants, inorganic particulates such as clays or silicas, or combinations thereof.

The concentration and type of solid structurant selected for use in the antiperspirant and deodorant compositions will vary depending upon the desired product hardness, rheology, and/or other related product characteristics. For most structurants suitable for use herein, the total structurant concentration ranges from about 5% to about 35%, more typically from about 10% to about 30%, or from about 7% to about 20%, by weight of the composition.

Non-limiting examples of suitable primary structurants include stearyl alcohol and other fatty alcohols; hydrogenated castor wax (e.g., Castorwax MP80, Castor Wax, etc.); hydrocarbon waxes include paraffin wax, beeswax, carnauba, candelilla, spermaceti wax, ozokerite, ceresin, bayberry, synthetic waxes such as Fisher-Tropsch waxes, and microcrystalline wax; polyethylenes with molecular weight of 200 to 1000 daltons; solid triglycerides; behenyl alcohol, or combinations thereof. The deodorant stick may further comprise one or more structural elements selected from the group consisting of waxes, natural oils, coconut oil, fractionated coconut oil, jojoba seed oil, olive oil, soybean oil, sunflower oil, and combinations thereof.

Other non-limiting examples of primary structurants suitable for use herein are described in U.S. Pat. No. 5,976,514 (Guskey et al.) and U.S. Pat. No. 5,891,424 (Bretzler et al.), the descriptions of which are incorporated herein by reference.

Additional Structurant

The antiperspirant or deodorant composition can further comprise one or more of an additional, or secondary, structurant. The additional structurant may be present in an amount from 1% to about 10%, by weight of the composition. The additional structurant(s) will be present at an amount less than the primary structurant.

Non-limiting examples of suitable additional structurants include stearyl alcohol and other fatty alcohols; hydrogenated castor wax (e.g., Castorwax MP80, Castor Wax, etc.); hydrocarbon waxes include paraffin wax, beeswax, carnauba, candelilla, spermaceti wax, ozokerite, ceresin, bayberry, synthetic waxes such as Fisher-Tropsch waxes, and microcrystalline wax; polyethylenes with molecular weight of 200 to 1000 daltons; and solid triglycerides; behenyl alcohol, or combinations thereof.

Other non-limiting examples of additional structurants suitable for use herein are described in U.S. Pat. No. 5,976,514 (Guskey et al.) and U.S. Pat. No. 5,891,424 (Bretzler et al.).

Antiperspirant Active

The antiperspirant stick compositions of the present invention can comprise a particulate antiperspirant active suitable for application to human skin. The concentration of antiperspirant active in the composition should be sufficient to provide the desired perspiration wetness and odor control from the antiperspirant stick formulation selected.

The antiperspirant stick compositions of the present invention comprise an antiperspirant active at concentrations of from about 0.5% to about 60%, and more specifically from about 5% to about 35%, by weight of the composition. These weight percentages are calculated on an anhydrous metal salt basis exclusive of water and any complexing agents such as, for example, glycine, and glycine salts. The antiperspirant active as formulated in the composition can be in the form of dispersed particulate solids having an average particle size or equivalent diameter of less than about 100 microns, more specifically less than about 20 microns, and even more specifically less than about 10 microns.

The antiperspirant active for use in the anhydrous antiperspirant compositions of the present invention may include any compound, composition or other material having antiperspirant activity. More specifically, the antiperspirant actives may include any of the antimicrobial discussed above, or may also include astringent metallic salts, especially inorganic and organic salts of aluminum, zirconium and zinc, as well as mixtures thereof. Even more specifically, the antiperspirant actives may include aluminum-containing and/or zirconium-containing salts or materials, such as, for example, aluminum halides, aluminum chlorohydrate, aluminum hydroxyhalides, zirconyl oxyhalides, zirconyl hydroxyhalides, and mixtures thereof.

Aluminum salts for use in the anhydrous antiperspirant stick compositions include those that conform to the formula:

$$Al_2(OH)_aCl_b.xH_2O,$$

wherein a is from about 2 to about 5;
the sum of a and b is about 6;
x is from about 1 to about 6; and
a, b, and x may have non-integer values.

More specifically, aluminum chlorohydroxides referred to as "⅚ basic chlorohydroxide" may be used, wherein a=5, and "⅔ basic chlorohydroxide", wherein a=4.

Processes for preparing aluminum salts are disclosed in U.S. Pat. No. 3,887,692, Gilman, issued Jun. 3, 1975; U.S. Pat. No. 3,904,741, Jones et al., issued Sep. 9, 1975; U.S. Pat. No. 4,359,456, Gosling et al., issued Nov. 16, 1982; and British Patent Specification 2,048,229, Fitzgerald et al., published Dec. 10, 1980, the disclosures of which are incorporated herein by reference for the purpose of describing processes for preparing aluminum salts.

Mixtures of aluminum salts are described in British Patent Specification 1,347,950, Shin et al., published Feb. 27, 1974, which description is also incorporated herein by reference.

Zirconium salts for use in the anhydrous antiperspirant stick compositions include those which conform to the formula:

$$ZrO(OH)_{2-a}Cl_a.xH_2O,$$

wherein a is from about 1.5 to about 1.87;
x is from about 1 to about 7; and
a and x may both have non-integer values.

These zirconium salts are described in Belgian Patent 825,146, Schmitz, issued Aug. 4, 1975, which description is incorporated herein by reference. Zirconium salts that additionally contain aluminum and glycine, commonly known as "ZAG complexes," are believed to be especially beneficial. These ZAG complexes contain aluminum chlorohydroxide and zirconyl hydroxy chloride conforming to the above-described formulas. Such ZAG complexes are described in U.S. Pat. No. 3,792,068, Luedders et al., issued Feb. 12, 1974; Great Britain Patent Application 2,144,992, Callaghan et al., published Mar. 20, 1985; and U.S. Pat. No. 4,120,948, Shelton, issued Oct. 17, 1978, disclosures of which are incorporated herein by reference for the limited purpose of describing ZAG complexes.

Also suitable for use herein are enhanced efficacy aluminum-zirconium chlorohydrex-amino acid which typically has the empirical formula $Al_nZr(OH)_{[3n+4-m(n+1)]}(Cl)_{[m(n+1)]}\text{-}AA_q$ where n is 2.0 to 10.0, preferably 3.0 to 8.0; m is about 0.48 to about 1.11 (which corresponds to M:Cl approximately equal to 2.1-0.9), preferably about 0.56 to about 0.83 (which corresponds to M:Cl approximately equal to 1.8-1.2); q is about 0.8 to about 4.0, preferably about 1.0 to 2.0; and AA is an amino acid such as glycine, alanine, valine, serine, leucine, isoleucine, β-alanine, cysteine, β-amino-n-butyric acid, or γ-amino-n-butyric acid, preferably glycine. These salts also generally have some water of hydration associated with them, typically on the order of 1 to 5 moles per mole of salt (typically, about 1% to about 16%, more typically about 4% to about 13% by weight). These salts are generally referred to as aluminum-zirconium trichlorohydrex or tetrachlorohydrex when the Al:Zr ratio is between 2 and 6 and as aluminum-zirconium pentachlorohydrex or octachlorohydrex when the Al:Zr ratio is between 6 and 10. The term "aluminum-zirconium chlorohydrex" is intended to embrace all of these forms. The preferred aluminum-zirconium salt is aluminum-zirconium chlorohydrex-glycine. Additional examples of suitable high efficacy antiperspirant actives can include Aluminum Zirconium Pentachlorohydrex Glycine, Aluminum Zirconium Octachlorohydrex Glycine, or a combination thereof. These high efficacy actives are more fully described in U.S. App. Pub. No. 2007/0003499 by Shen et al. filed Jun. 30, 2005.

Perfume

Perfumes or fragrances are often a combination of many raw materials, known as perfume raw materials. Any perfume or fragrance suitable for use in an antiperspirant or deodorant composition may be used herein, including, but not limited to, natural or essential oils. In some embodiments, the composition may be free of, or substantially free of a synthetic fragrance. A synthetic fragrance is one mostly derived through chemical synthesis where the starting material is no longer intact, but is converted to the new fragrance chemical. In some embodiments, the deodorant or antiperspirant may comprise a fragrance composition comprising at least about 50% of natural oils, essential oils, or a combination thereof.

A natural or essential oil fragrance is a result of natural sources wherein the fragrance material is not altered (chemically modified) but extracted from its natural source. These sources can include, but are not limited to, bark, flowers, blossoms, fruits, leaves, resins, roots, bulbs, and seeds. Natural or essential oils go through an extraction process instead of chemical synthesis. Extraction processes include, but are not limited to, maceration, solvent extraction, distillation, expression of a fruit peel, or effleurage.

Additional Chassis Ingredients

Emollient

As discussed, an effective and consumer-preferred emollient may be a liquid triglyceride. In some embodiments, additional emollients may be used, such as plant oils (generally used at less than 10%) including olive oil, coconut oil, sunflower seed oil, jojoba seed oil, avocado oil, canola oil, and corn oil. Additional emollients including mineral oil; shea butter; PPG-14 butyl ether; isopropyl myristate; petrolatum; butyl stearate; cetyl octanoate; butyl myristate; myristyl myristate; C12-15 alkylbenzoate (e.g., Finsolv™); octyldodecanol; isostearyl isostearate; octododecyl benzoate; isostearyl lactate; isostearyl palmitate; isobutyl stearate; dimethicone, and any mixtures thereof.

Solvent

The antiperspirant and deodorant compositions of the present invention may have a liquid triglyceride or natural oils as a solvent.

Also, non-volatile organic fluids may be present, for example, in an amount of about 15% or less, by weight of the composition.

Non-limiting examples of nonvolatile organic fluids include mineral oil, PPG-14 butyl ether, isopropyl myristate, petrolatum, butyl stearate, cetyl octanoate, butyl myristate, myristyl myristate, C12-15 alkylbenzoate (e.g., Finsolv™), octyldodecanol, isostearyl isostearate, octododecyl benzoate, isostearyl lactate, isostearyl palmitate, and isobutyl stearate.

Other Optional Ingredients

The anhydrous compositions of the present invention may further comprise any optional material that is known for use

in antiperspirant and deodorant compositions or other personal care products, or which is otherwise suitable for topical application to human skin.

One example of an optional ingredient is a scent expression material. Scent expression or release technology may be employed with some or all of the fragrance materials to define a desired scent expression prior to use and during use of the products. Such scent expression or release technology can include cyclodextrin complexing material, like beta cyclodextrin. Other materials, such as, for example, starch-based matrices or microcapsules may be employed to "hold" fragrance materials prior to exposure to bodily-secretions (e.g., perspiration). The encapsulating material may have release mechanisms other than via a solvent; for example, the encapsulating material may be frangible, and as such, rupture or fracture with applied shear and/or normal forces encountered during application and while wearing. A microcapsule may be made from many materials, one example is polyacrylates.

Another example of optional materials are clay mineral powders such as talc, mica, sericite, silica, magnesium silicate, synthetic fluorphlogopite, calcium silicate, aluminum silicate, bentonite and montomorillonite; pearl pigments such as alumina, barium sulfate, calcium secondary phosphate, calcium carbonate, titanium oxide, finely divided titanium oxide, zirconium oxide, zinc oxide, hydroxy apatite, iron oxide, iron titrate, ultramarine blue, Prussian blue, chromium oxide, chromium hydroxide, cobalt oxide, cobalt titanate, titanium oxide coated mica; organic powders such as polyester, polyethylene, polystyrene, methyl methacrylate resin, cellulose, 12-nylon, 6-nylon, styrene-acrylic acid copolymers, poly propylene, vinyl chloride polymer, tetrafluoroethylene polymer, boron nitride, fish scale guanine, laked tar color dyes, laked natural color dyes; and combinations thereof.

Talc, if used at higher levels can produce a significant amount of white residue which has been found to be a consumer negative for product acceptance. Therefore it is best to limit the composition to less than 10%, less than about 8%, less than about 6%, or less than about 3%, by weight of the composition.

Nonlimiting examples of other optional materials include emulsifiers, distributing agents, antimicrobials, pharmaceutical or other topical active, preservatives, surfactants, and so forth. Examples of such optional materials are described in U.S. Pat. No. 4,049,792 (Elsnau); U.S. Pat. No. 5,019,375 (Tanner et al.); and U.S. Pat. No. 5,429,816 (Hofrichter et al.); which descriptions are incorporated herein by reference.

Method of Making

The antiperspirant and deodorant stick products of the present invention may be made by mixing all the components of the products in an open-top or vented tank. Many powders come with bound moisture, especially naturally high moisture powders like starches. In a mostly anhydrous process with waxes, melting the waxes above their melt point can release this bound water as the batch temperature increases. In a closed tank process this water vapor will condense in the tank and drip back into the batch as water. This water can interact with the most water soluble ingredients in the batch to have negative effects on the product, including releasing the pH of any antimicrobial ingredient, which can then degrade any perfume ingredients in the batch. Additionally, the condensed water can interfere with the wax and produce a stick softer than intended.

The present invention reduces the risk of these negative consequences by minimizing the water solubility of the primary antimicrobial ingredients. The ideal process remedy for this behavior is to produce the batches in one of four ways:

1. An open tank system where the water vapor can leave the batch tank to reduce or eliminate condensation.
2. A vented closed tank to also remove water vapor during the batch process.
3. A dual phase process where the moisture containing powders can be put into the cold phase separate from the wax phase which is heated. These two phases are then mixed before filling.
4. A low residence time batch process for a closed system, where the product has less than 3 hours residence time above 50° C. to reduce the rate of reaction from the moisture.

A method of making a deodorant composition or stick may comprise the steps of combining any of the herein described deodorant or antiperspirant composition components in an open tank system or a vented closed tank. The components may be mixed, heated, and then cooled into a stick product. In some embodiments, the deodorant components may comprise at least about 50% of a liquid triglyceride, by weight of the composition, and an antimicrobial in an open tank system, heating the components, mixing the components, and cooling the components.

H. Test Methods

1. Tier 1 Anaerobic MIC Assay

The data in Table 2 above was generated with the following test method. The purpose of this assay is to determine if a compound or formulation has an antimicrobial effect in vitro.

It is understood that when not specifically noted in this procedure:

a) All materials, reagents and equipment required for this procedure are of appropriate design and condition of cleanliness and/or sterility as determined by their intended use.

b) The operator has been trained in aseptic technique and has been qualified to perform the procedure and accurately interpret the results.

c) All media required for this procedure was manufactured by a reputable commercial source egg. Difco, Merck etc. and has been stored and prepared as per manufacturer's instructions.

d) All routine laboratory controls, including but not limited to, media function and growth promotion tests, verification of sterility and use of positive and negative controls are being conducted.

Procedure: (All procedures performed in anaerobic chamber except where noted)

1. Apparatus

Incubator at 37° C.; 20-200 ul 12 channel pipette; 5-50 ul 12 channel pipette; 1250 ul 8 channel Thermo Scientific Matrix pipette; 96 well plate shaker (located in incubator); Beckman Coulter deep well cap mat #267005; Beckman Coulter deep 96 well plates #267007; Falcon 96 well tissue culture plates #353072; Vortexer; Culture tubes/caps Disposable sterile gloves; Sterile petri dishes; Standard microbiological lab equipment (sterile pipettes, syringes, tips, loops, etc.); Glass bottles/flasks for media; Autoclave; Parafilm; Spectrophotometer.

2. Media

0.9% or 0.85% saline solution

BHI agar supplemented with 1% Tween 80

BHI media supplemented with 1% Tween 80

3. Microbial Strains

Staphylococcus epidermidis (clinical isolate)

Corynebacterium mucofaciens (clinical isolate)

4. Test Procedure

Inoculum Preparation

Prior to testing streak organisms for isolation on BHI with 1% Tween 80 plates, wrap with parafilm and place in 37° C. incubator. When isolated colonies appear remove one representative colony from each plate and place each in 5 ml of BHI with 1% Tween 80 media. Incubate at 37° C. with shaking overnight. Inoculate 20 ml BHI with 1% Tween 80 (per 96 deep well plate to be tested) with 20 ul of the overnight culture (1-1000 dilution).

Master Plate Preparation

Compounds/formulations to be tested are diluted across a 96 deep well plate as shown below (for a 1% stock solution). 800 ul of 0.85% saline is added to wells A1 and B1 (as these will be the negative and positive control respectively). 800 ul each 1% stock solution+ positive control are added to wells Cl through H1.400 ul 0.85% saline are added to all other wells. 400 ul is then removed from #1 well added to the #2 well and mixed. This is then continued across the plate resulting in a 50% dilution between wells across the plate (this can be easily accomplished with an automatic 8 channel Matrix pipette set to withdraw, dispense and mix).

	1	2	3	4	5	6
A	800 ul saline	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl
B	800 ul saline	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl
C	800 ul + control	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl
D	800 ul compond 1	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl
E	800 ul compond 2	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl
F	800 ul compond 3	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl
G	800 ul compond 4	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl
H	800 ul compond 5	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl

	7	8	9	10	11	12
A	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl
B	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl
C	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl
D	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl
E	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl
F	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl
G	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl
H	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl	400 ul NaCl

	1	2	3	4	5	6
A	Media Blank	Media Blank	Media Blank	Media Blank	Media Blank	Media Blank
B	Pos	Pos	Pos	Pos	Pos	Pos
C	0.1	0.05	0.025	0.0125	0.00625	0.003125
D	0.1	0.05	0.025	0.0125	0.00625	0.003125
E	0.1	0.05	0.025	0.0125	0.00625	0.003125
F	0.1	0.05	0.025	0.0125	0.00625	0.003125
G	0.1	0.05	0.025	0.0125	0.00625	0.003125
H	0.1	0.05	0.025	0.0125	0.00625	0.003125

	7	8	9	10	11	12
A	Media Blank	Media Blank	Media Blank	Media Blank	Media Blank	Media Blank
B	Pos	Pos	Pos	Pos	Pos	Pos
C	0.0015625	0.00078125	0.000390625	0.000195313	9.76563E−05	4.88281E−05
D	0.0015625	0.00078125	0.000390625	0.000195313	9.76563E−05	4.88281E−05
E	0.0015625	0.00078125	0.000390625	0.000195313	9.76563E−05	4.88281E−05
F	0.0015625	0.00078125	0.000390625	0.000195313	9.76563E−05	4.88281E−05
G	0.0015625	0.00078125	0.000390625	0.000195313	9.76563E−05	4.88281E−05
H	0.0015625	0.00078125	0.000390625	0.000195313	9.76563E−05	4.88281E−05

Test Plate Preparation

In row A of a 96 deep well plate pipette 180 ul of sterile BHI with 1% Tween 80 as a negative growth control. All other wells receive 180 ul of inoculum. From the master plate introduce 20 ul to the corresponding row in the test plate using an 8-channel pipette. Loaded plates are placed on a plate shaker in the 37° C. incubator and incubated overnight. The next day read the O.D. 600 on a plate reader. The MIC is the last well from the right that has no bacterial growth.

Hardness—Penetration Measurement for Antiperspirant and Deodorant Finished Products

The penetration test is a physical test method that provides a measure of the firmness of waxy solids and extremely thick creams and pastes with penetration values not greater than 250 when using a needle for D1321. The method is based on the American Society for Testing and Materials Methods D-5, D1321 and D217 and DIN 51 579 and is suitable for all solid antiperspirant and deodorant products.

A needle or polished cone of precisely specified dimensions and weight is mounted on the bottom of a vertical rod in the test apparatus. The sample is prepared as specified in the method and positioned under the rod. The apparatus is adjusted so that the point of the needle or cone is just touching the top surface of the sample. Consistent positioning of the rod is critical to the measured penetration value. The rod is then released and allowed to travel downward, driven only by the weight of the needle (or cone) and the rod. Penetration is the tenths of a millimeter travelled following release.

APPARATUS	SUGGESTED TYPE (OR EQUIVALENT)
Penetrometer with Timer (see attached drawings Attachment 1 and Attachment 2)	Penetrometer Suitable For ASTM D-5 and D-1321 methods; Examples: Precision or Humboldt Universal Penetrometer (Humboldt Manufacturing, Schiller Park, IL USA) or Penetrometer Model PNR10 or PNR12 (Petrolab USA or PetroTest GmbH).
Penetration Needles	ANTIPERSPIRANT or DEODORANT SOLIDS can use: Needles as specified for ASTM Method D-5, NIST Certified, Fisher Scientific #01-512. Needles as specified for ASTM Method D 1321/DIN 51 579, Officially certified, Taper-Tipped needle, No. H-1310, Humboldt Mfg.

General Instructions—All Penetrometers—Keep the instrument and needles/probes clean at all times, free from dust and grime. When not in use, store needles in a suitable container to avoid damage. Periodic calibration should confirm:

Electronic Timer is correctly set. Verify against an independent stopwatch if unsure.

Shaft falls without visible signs of frictional resistance.

Ensure the total weight of the shaft and needle is 50±0.2 grams when the shaft is in free fall. Note: for modern, automated or digital systems this may be performed automatically and confirmed through annual calibration.

At time of use confirm:

Electronic Timer is correctly set to 5.0 seconds.

The appropriate needle is installed and is clean, straight and without obvious defects (visual inspection)

The penetrometer is level and the shaft is clean, straight and falls freely (visual inspection)

Once level, avoid shifting the position of the unit to maintain level.

Sample Preparation and Measurement

1. On a deodorant or antiperspirant stick that has cooled ambiently to a temperature between 22° C. and 26° C. for at least 24 hours, slice off top ½ inch of product to achieve a flat surface with a wire cutter drawn across the upper lip of the canister.

2. For the first sample to be tested, lubricate the needle by gently wiping with a lint-free tissue coated with a small amount of the product to be tested. This small amount is typically taken from the shaved top.

3. Place the canister in the appropriate location for the measurement. Locate the sample so the needle will penetrate the product 9-11 mm from the inside of the canister wall on the long axis.

4. Using the coarse and fine adjustments, align the height of the penetrometer mechanism head so that the point of the penetrating needle is just touching the surface of the sample. A weak light at the side of the penetrometer which casts a shadow of the needle on the surface of the sample may be helpful in determining this contact. When a light area on the sample cannot be seen at the end of the tip of the needle's shadow, the needle height over the sample is correctly adjusted. The light should not be strong enough to heat or melt the sample surface. The needle should be just close enough to scratch the sample surface.

5. Perform the penetration measurement at this location by releasing the needle. Record the result.

6. Repeat Steps 2 through 4 at the other test point, i.e., at the other point 9-11 mm inside of the canister wall on the long axis.

To report results, units for penetration are tenths of a millimeter (1/10 mm=100 microns). For example, a result of 80 units is 80 mm*10 or 8 mm. Report the average results of at least 4 total measurements from 2 different sticks. Report the average result of the measurements to the nearest tenth of a millimeter.

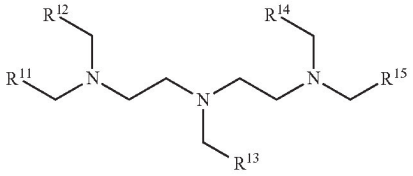
H. Additional Examples/Combinations

A. A deodorant stick comprising:

a) from about 0.1% to about 10% of a substituted or unsubstituted 2-pyridinol-N-oxide material;

b) from about 0.01% to about 15% of an iron chelator selected from the group consisting of:

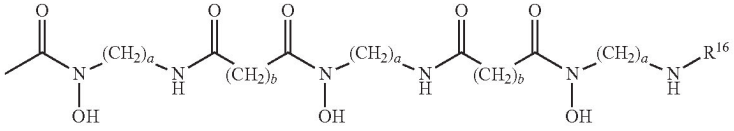
(1) Iron chelators represented by the following structure:



where R^{10}, R^{11}, R^{12}, R^{13}, R^{14} are selected from the group consisting of $M^1M^2PO_3$, CO_2M^1, and mixtures thereof.

where M^1 and M^2 are independently selected from the group consisting of H, a metal salt and an ammonium salt;

(2) Iron chelators represented by the following structure:



where a is an integer from 2 to 7 wherein any of the CH_2 groups in this unit may be substituted with alkyl or aryl units that may contain heteroatoms (S, N, O, Cl, Fe, Br or I)

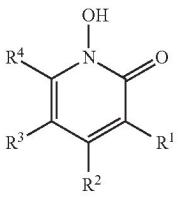
where b is an integer from 1 to 7 wherein any of the CH_2 groups in this unit may be substituted with alkyl or aryl units that may contain heteroatoms (S, N, O, Cl, Fe, Br or I)

where R^{16} is H or $(CH_2)_n$, where n in an integer from 1 to 6 or is a CH_2 linker unit that may be further substituted at any CH_2 group in the chain with alkyl or aryl units that may contain heteroatoms (S, N, O, Cl, F, Br, or I).

B. The deodorant stick according to Paragraph A, wherein the iron chelator has a log K_1 greater than about 16.

C. The deodorant stick according to Paragraph A-B, wherein the iron chelator has a log K_1 greater than about 20.

D. The deodorant stick according to Paragraph A-C, where the substituted or unsubstituted 2-pyridinol-N-oxide material comprises the molecular structure:



wherein R^1, R^2, R^3, R^4 are independently selected from the group consisting of H, Cl, Br, I, F, NO, NO_2, $(CH_2)_nG$, and mixtures thereof, wherein each G is independently selected from the group consisting of $(O)_mSO_3M^3$, $(O)_mCO_2M^3$, $(O)_mC(O)(R^5)$, $(O)_mC(O)N(R^5R^6)$, $(O)_mCN$, $(O)_m(R^5)$, $N(R^5R^6)$, and mixtures thereof,

wherein m is 0 or 1,

and wherein n is an integer from 0 to 4,

and wherein R^5 and R^6 are independently selected from the group consisting of H

and a substituted or unsubstituted C1-C12 organic group, and

wherein M^3 is selected from the group consisting of H, a substituted or unsubstituted C_1-C_{12} organic group, $^+N(R^7R^8R^9R^{10})$, and 1/q M' q+ wherein M' is selected from the group consisting of an alkali metal of charge q and an alkaline earth metal of charge q, where R7, R8, R9, and R10 are independently selected from the group consisting of H and a substituted or unsubstituted C_1-C_{12} organic group, and wherein any pair of vicinal groups, R^1 and R^2, R^2 and R^3, R^3 and R^4, may be taken together to form another five- or six-membered aromatic or aliphatic ring optionally substituted with one or more groups selected from the group consisting of Cl, Br, I, F, NO, NO_2, CN, $(CH_2)_nG$, and mixtures thereof.

E. The deodorant stick according to Paragraph A-D, wherein R^1, R^2, R^3, R^4 are selected from the group consisting of H, Cl, and $(CH_2)_nG$, wherein G is selected from the group consisting of $(O)_mSO_3M^3$, $(O)_mCO_2M^3$, $(O)_mC(O)(R^5)$, $(O)_mCN$, and $(O)_m(R^5)$, wherein m is 0 or 1.

F. The deodorant stick according to Paragraph A-E, wherein said substituted or unsubstituted 2-pyridinol-N-oxide material is 1-hydroxy-4-methyl-6-(2,4,4-trimethylpentyl)-2-pyridone monoethanolamine salt.

G. The deodorant stick according to Paragraph A-F, wherein the iron chelator is diethylenetriaminepentaacetic acid (DTPA).

H. The deodorant stick according to Paragraph A-G, wherein the iron chelator is Diethylenetriaminepentakis (methylenephosphonic acid) (DTPMP).

I. The deodorant stick according to Paragraph A-H, wherein the iron chelator is Desferrioxamine.

J. The deodorant stick according to Paragraph A-I, wherein the substituted or unsubstituted 2-pyridinol N-oxide material is from about 0.3% to about 3%.

K. The deodorant stick according to Paragraph A-J, the substituted or unsubstituted 2-pyridinol N-oxide material is from about 0.5% to about 2%.

L. The deodorant stick according to Paragraph A-K, wherein the iron chelator is from about 0.3% to about 6%.

M. The deodorant stick according to Paragraph A-L, wherein the iron chelator is from about 0.5% to about 4%.

N) Use of the deodorant stick according to Paragraph A-M, for treating underarm skin.

O) Use of the deodorant stick according to Paragraph A-M, for boosting the anti-bacterial performance.

P) Use according to Paragraph O, for treating cosmetically underarm skin against *C. mucofaciens* and/or *S. epidermidis*

Q) Use according to Paragraph O or P, wherein the deodorant stick comprises from 0.1% to 10%, preferably from 0.3% to 3%, more preferably from 0.5% to 2% of 1-hydroxy-4-methyl-6-(2,4,4-trimethylpentyl)-2-pyridone monoethanolamine salt and from 0.01% to 15%, preferably from 0.3% to 6%, more preferably from 0.5% to 4% of an iron chelator which is selected from the group consisting of diethylenetriaminepentaacetic acid (DTPA), Diethylenetriaminepentakis (methylenephosphonic acid) (DTPMP), Desferrioxamine, and mixtures thereof.

R) The personal care composition according to Paragraph A-M for use in a method of treating bacterial agents onto underarm skin.

S) The personal care composition according to Paragraph A-M, for use in a method of inhibiting the growth *C. mucofaciens* and/or *S. epidermidis* onto underarm skin.

The devices, apparatuses, methods, components, and/or compositions of the present invention can include, consist essentially of, or consist of, the components of the present invention as well as other ingredients described herein. As used herein, "consisting essentially of" means that the devices, apparatuses, methods, components, and/or compositions may include additional ingredients, but only if the additional ingredients do not materially alter the basic and novel characteristics of the claimed devices, apparatuses, methods, components, and/or compositions.

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

While particular embodiments of the present invention have been illustrated and described, it would be obvious to those skilled in the art that various other changes and modifications can be made without departing from the spirit and scope of the invention. It is therefore intended to cover in the appended claims all such changes and modifications that are within the scope of this invention.

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

It should be understood that every maximum numerical limitation given throughout this specification will include every lower numerical limitation, as if such lower numerical limitations were expressly written herein. Every minimum numerical limitation given throughout this specification will include every higher numerical limitation, as if such higher numerical limitations were expressly written herein. Every numerical range given throughout this specification will include every narrower numerical range that falls within such broader numerical range, as if such narrower numerical ranges were all expressly written herein.

What is claimed is:

1. A deodorant stick comprising:

a. at least 25% by weight liquid triglyceride;

b. a primary antimicrobial having a water solubility of at most about 90 g/L at 25° C.;

c. a fragrance composition comprising at least about 50% by weight of natural oils, essential oils, or a combination thereof; and

d. a primary structurant with a melting point of at least 50° C.;

said deodorant stick being free of an aluminum salt; and

said deodorant stick having a hardness from about 70 mm*10 to about 140 mm*10, as measured by penetration with ASTM D-1321 needle.

2. The deodorant stick of claim **1**, wherein the primary antimicrobial is selected from the group consisting of beryllium carbonate, magnesium carbonate, calcium carbonate, magnesium hydroxide, magnesium carbonate hydroxide, magnesium hydroxide and magnesium carbonate hydroxide, partially carbonated magnesium hydroxide, and piroctone olamine.

3. The deodorant stick of claim **1**, further comprising at least one additional antimicrobial different from the primary antimicrobial, selected from the group consisting of beryllium carbonate, magnesium carbonate, calcium carbonate, magnesium hydroxide, magnesium hydroxide and magnesium carbonate hydroxide, partially carbonated magnesium hydroxide, piroctone olamine, potassium carbonate, potassium bicarbonate, sodium carbonate, sodium sesquicarbonate, baking soda, hexamidine, zinc carbonate, thymol, polyvinyl formate, salycilic acid, niacinamide, magnesium carbonate hydroxide, cinnamon essential oil, cinnamon bark essential oil, cinnamic aldehyde, and combinations thereof.

4. The deodorant stick of claim **1**, wherein the primary antimicrobial is a powder.

5. The deodorant stick of claim **1**, wherein the deodorant stick is substantially free of baking soda.

6. The deodorant stick of claim **1**, wherein the deodorant stick is substantially free of a synthetic fragrance.

7. The deodorant stick of claim **1**, wherein the deodorant stick has a hardness from about 90 mm*10 to about 110 mm*10, as measured by penetration with ASTM D-1321 needle.

8. The deodorant stick of claim **1**, wherein the deodorant comprises piroctone olamine and magnesium hydroxide and magnesium carbonate hydroxide.

9. The deodorant stick of claim **1**, wherein the primary structurant has a melting point from 50° C. to 80° C.

10. The deodorant stick of claim **1**, comprising at least about 40% by weight liquid triglyceride.

11. The deodorant stick of claim **1**, comprising at least about 50% by weight liquid triglyceride.

12. The deodorant stick of claim **1**, wherein the primary antimicrobial has a water solubility of at most about 50 g/L at 25° C.

13. The deodorant stick of claim **3**, wherein all antimicrobials have a water solubility of at most about 90 g/L at 25° C.

14. A deodorant stick comprising:

a. at least 50% by weight liquid triglyceride;

b. a primary antimicrobial having a water solubility of at most about 90 g/L at 25° C.;

c. a fragrance composition comprising at least about 50% of natural oils, essential oils, or a combination thereof; and

d. a primary structurant with a melting point of at least 50° C.

15. The deodorant stick of claim **14**, comprising at least about 60% by weight liquid triglyceride.

16. A deodorant stick comprising:

a. at least 60% by weight liquid triglyceride;

b. at least one antimicrobial;

c. a fragrance composition comprising at least about 50% by weight of natural oils, essential oils, or a combination thereof; and

said deodorant stick being free of an aluminum salt.

17. The deodorant stick of claim **16**, further comprising a primary structurant having a melting point from about 50° C. to about 80° C.

18. A deodorant stick comprising:

a. at least 50% by weight of a liquid triglyceride;

b. a primary antimicrobial having a water solubility of at most about 90 g/L at 25° C.; and

said deodorant stick having a hardness from about 70 mm*10 to about 140 mm*10, as measured by penetration with ASTM D-1321 needle.

19. The deodorant stick of claim **18**, comprising at least about 60% by weight of a liquid triglyceride.

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