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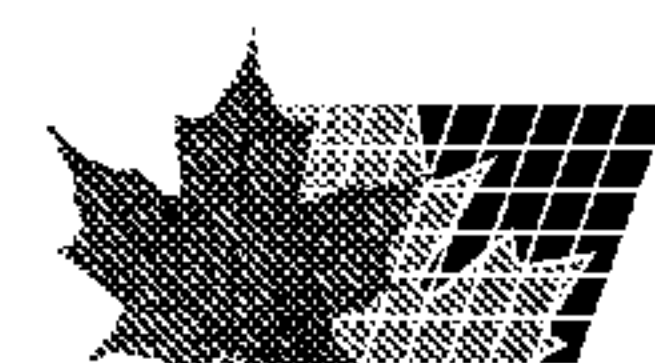
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(57) **Abrégé/Abstract:**

Disclosed is a solid particulate antiperspirant salt comprising a mixture (or complex) of an enhanced efficacy aluminum-zirconium chlorohydrate-amino acid and a neutralizing salt. The particulate antiperspirant salt, when measured as an aqueous solution at a concentration of 15% by weight at 25°C, has a pH greater than 4.5, preferably about 4.6 to about 5.3. Also disclosed is a topical antiperspirant composition comprising the aforementioned particulate antiperspirant salt and a method of reducing perspiration from human skin by applying the aforementioned antiperspirant composition. In addition, there is disclosed a method of preparing the aforementioned particulate antiperspirant salt.



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(54) Title: PARTICULATE ENHANCED EFFICACY ANTIPERSPIRANT SALT WITH RAISED PH

(57) Abstract: Disclosed is a solid particulate antiperspirant salt comprising a mixture (or complex) of an enhanced efficacy aluminum-zirconium chlorohydrate-amino acid and a neutralizing salt. The particulate antiperspirant salt, when measured as an aqueous solution at a concentration of 15% by weight at 25°C, has a pH greater than 4.5, preferably about 4.6 to about 5.3. Also disclosed is a topical antiperspirant composition comprising the aforementioned particulate antiperspirant salt and a method of reducing perspiration from human skin by applying the aforementioned antiperspirant composition. In addition, there is disclosed a method of preparing the aforementioned particulate antiperspirant salt.

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PARTICULATE ENHANCED EFFICACY
ANTIPERSPIRANT SALT WITH RAISED PH

Background of the Invention

[0001] The present invention relates to a solid particulate enhanced efficacy aluminum-zirconium antiperspirant salt with a pH greater than 4.5.

[0002] Enhanced efficacy aluminum-zirconium antiperspirant salts are well known. See, for example, US 4,775,528 (Callaghan) and US 4,871,525 (Giovanniello). The enhanced efficacy salts provide greater sweat reduction than conventional antiperspirant salts and are typically differentiated from conventional antiperspirant salts by reference to the various aluminum peaks that can be identified when the salt is analyzed by size exclusion chromatography, typically HPLC (high pressure liquid chromatography). A suitable chromatographic technique must be capable of resolving the Al into at least four distinct peaks (labeled peaks 2 (or 1+2), 3, 4 and 5), such as is shown in US 5,330,751. The enhanced efficacy salts have been described as having an increased peak 4 content or an increased peak 4 to peak 3 ratio compared to conventional salts. (In some cases, enhanced salts have been described as having increased "band III" content by some authors, depending on the chromatographic technique and nomenclature employed. Generally, bands I, II, III and IV of one system correspond to peaks 1+2 (band I), 3, 4 and 5 of the other system.) Typically, the enhanced efficacy salts (measured as 10% solutions) have an HPLC peak 4 to peak 3 area ratio of 0.5 or higher, preferably at least 0.7, with at least 70%, preferably at least 80%, of the aluminum contained in peaks 3 and 4. Thus, the enhanced salts will typically have a peak 4 content of at least 30% of the total aluminum contained in all the peaks (measured by peak area). In contrast, conventional non-enhanced antiperspirant salts have a negligible peak 4 content or a peak 4 to 3 area ratio less than 0.2, typically about 0.1.

[0003] Commercially available solid particulate enhanced efficacy aluminum-zirconium antiperspirant salts are fairly acidic, typically having a pH between about 3 and 4, more typically between about 3.5 and 3.8. Such acidic salts can be somewhat irritating to the skin and, in some cases, can
5 discolor fabric. Such acidic salts also typically have some undesirable odor and can be yellowish in color. In addition, when such salts are formulated into topical compositions, their acidity can cause degradation of other pH-sensitive cosmetic ingredients, such as fragrances, botanicals, etc., that a formulator might desire to include in a topical composition. Some attempts,
10 particularly with respect to non-enhanced salts, have been made to buffer or increase the pH moderately, for example, up to about 4.5, but any further pH increases were believed to reduce efficacy or to possibly cause salt precipitation during manufacture.

[0004] In US 4,369,173 (Causland), a non-enhanced aluminum-zirconium
15 chlorohydrate-glycine salt is buffered by encapsulating it in a hydrolyzed carbohydrate such as dextrin or maltrin. However, because the encapsulating material has a pH of about 5.2 or less (see col. 7, lines 1-2), none of the examples provide a salt with a pH above 4.0. (see Tables VII and VIII at col. 17). In US 6,749,841 (Joshi), a gel degradation inhibitor, such as
20 zinc glycinate, is added to an aqueous solution of a non-enhanced aluminum-zirconium chlorohydrate-glycine to increase the pH to 4.2–4.5. This aqueous solution is then mixed with an oil phase to form an emulsion gelled with a polysaccharide. In US 5,997,850 (Tang), a stabilized aluminum-zirconium chlorohydrate-glycine aqueous solution is provided with an increased glycine
25 (or amino acid) content to prevent polymerization of the Zr species. The glycine is added in an amount to provide a Zr:Gly weight ratio of 1:1.2–1:5. This antiperspirant solution is then mixed with an oil phase to form a gelled emulsion (see example 9).

[0005] In US 4,774,079 (Shin), non-enhanced antiperspirant compositions are disclosed that comprise a mixture of aluminum chloride, aluminum chlorohydrate and aluminum-zirconium polychlorohydrate complex. The antiperspirant composition is buffered to a pH in the range of 2.5–4.5,

5 preferably 2.8–3.8. All of the examples indicate a pH below 3.8. In US 4,017,599 (Rubino), non-enhanced aluminum-zirconium antiperspirant salts of various types are disclosed. Such salts include an alkali metal or alkaline earth metal salt of an amino acid, such as for example sodium glycinate or magnesium glycinate, to provide a pH of at least about 3.

10 Although this reference suggests a possible pH range of 3 to 5 (see col. 5, lines 9-13), none of the examples that provide pH data indicate a pH above 3.9, which is consistent with the general state of the antiperspirant art.

[0006] In US 5,643,558 (Provancal), there is disclosed a polyhydric alcohol solution (for example, a propylene glycol solution) of an enhanced efficacy

15 aluminum-zirconium chlorohydrate antiperspirant salt. This reference suggests that the pH of the polyhydric alcohol solution may be raised to about 4.1–5.0 by addition of an alkaline glycinate, such as sodium, potassium or zinc glycinate. In US 5,463,098 (Giovanniello) discloses a diol soluble aluminum-zirconium chlorohydrate-glycine antiperspirant salt. This salt is
20 prepared by forming an aqueous solution of the salt, to which has been added some propylene glycol and zinc glycinate, the latter to increase the pH to about 4.1–5.0, then spray drying. The dried salt is essentially a salt-diol adduct that may then be redissolved in propylene glycol (or other diols) for use in diol-based gel sticks.

25 **[0007]** It would be highly desirable to provide a solid particulate antiperspirant salt with a pH greater than 4.5. Such a salt would provide less irritation than current commercially available salts. Such a salt would also permit topical compositions to be formulated with pH-sensitive ingredients, particularly fragrance components that degrade in the highly

acidic environment of current commercially available salts. Thus, salts with a pH greater than 4.5 will allow the formulator to choose from a much wider variety of fragrance components and other pH sensitive components.

Summary of the Invention

5 [0008] The present invention embraces a solid particulate antiperspirant salt comprising a mixture (or complex) of an enhanced efficacy aluminum-zirconium chlorohydrate-amino acid and a neutralizing salt. The particulate anti-perspirant salt, when measured as an aqueous solution at a concentration of 15% by weight at 25°C, has a pH greater than 4.5, preferably
10 about 4.6 to about 5.3. The present invention also embraces a topical antiperspirant composition comprising the aforementioned particulate antiperspirant salt and a method of reducing perspiration from human skin by applying the afore-mentioned antiperspirant composition. In addition, the present invention includes a method of preparing the aforementioned
15 particulate antiperspirant salt.

Detailed Description of the Invention

[0009] The aluminum-zirconium salts of the present invention are of the enhanced efficacy type. By "enhanced efficacy" salt is meant an antiperspirant salt which, when reconstituted as a 10% aqueous solution (or
20 if already a solution, diluted with water to about 10% salt concentration in solution), produces an HPLC chromatogram wherein the Al is resolved into at least four distinct peaks (conveniently labeled peaks 2 (or 1+2), 3, 4 and 5), such as is shown in US 5,330,751,
wherein at least 70%, preferably at least 80%, of the aluminum is contained
25 in peaks 3 and 4, and wherein the ratio of the area under peak 4 to the area under peak 3 is at least 0.5, preferably at least 0.7, and more preferably at least 0.9 or higher. Most preferred are salts which exhibit an HPLC peak 4 to peak 3 area ratio of at least 0.7 when measured within two hours of preparation. Especially preferred are salts wherein at least 30%, more

preferably at least 40%, of the aluminum is contained in peak 4. The aluminum present in peaks 3 and 4 should be of the Al^c type, not Al^b , when analyzed by the ferron test. Enhanced efficacy aluminum chlorohydrate is referred to as "ACH" herein. Enhanced efficacy aluminum-zirconium chlorohydrate is referred to as "AZCH" herein.

[0010] The pH of a solid particulate antiperspirant salt is measured, in accordance with the United States Pharmacopeia (USP), by dissolving the salt in water to form an aqueous solution of 15% concentration by weight, then measuring the pH with a properly standardized pH meter at $25 \pm 2^\circ C$.

[0011] The term "anhydrous", as used herein, means that the composition is substantially free of free water (excluding any water of hydration normally associated with the antiperspirant salt). The term "substantially free", as used herein, means that a material contains less than about 1%, preferably less than 0.1%, and more preferably 0% by weight of the identified substance.

The term "zirconium hydroxychloride", as used herein, is intended to embrace zirconium compositions of the formula $Zr(OH)_{4-b}Cl_b$ wherein b is about 0.8 to about 3.9, preferably about 1 to about 2, and is, thus, intended to embrace zirconium hydroxychloride and zirconyl oxychloride (sometimes written as $ZrOCl_2$).

[0012] The present invention is directed to a solid particulate antiperspirant salt comprising (or consisting essentially of, or consisting of) a mixture of an enhanced efficacy aluminum-zirconium chlorohydrate-amino acid and a neutralizing salt. This particulate antiperspirant salt, when measured as an aqueous solution at a concentration of 15% by weight, has a pH greater than 4.5 (e.g., up to about 5.5), preferably about 4.6 to about 5.3, more preferably about 4.8 to about 5.2. Preferably, the antiperspirant salt is substantially free of polyhydric alcohol (or diol) such as propylene glycol.

[0013] The enhanced efficacy aluminum-zirconium chlorohydrate-amino acid typically has the empirical formula $Al_nZr(OH)_{[3n+4-m(n+1)]}(Cl)_{[m(n+1)]}-AA_q$ 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 $M:Cl \cong 2.1-0.9$), preferably about 0.56 to about 0.83 (which corresponds to $M:Cl \cong 1.8-1.2$); 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.

[0014] The neutralizing salt typically will have a pH greater than 7 and will raise the pH of the aluminum-zirconium chlorohydrex salt with which it is mixed. Typically the neutralizing salt will be water soluble (which is preferred), although a neutralizing salt that is partially water soluble or that is water insoluble may be used in certain cases. For example, a partially soluble neutralizing salt that forms a colloidal suspension with aqueous aluminum-zirconium chlorohydrex may be used in the solution method (method 1) described *infra*, or an insoluble neutralizing salt may be used in the dry blend method (method 2) described *infra*. By “water soluble” is meant that the salt is substantially soluble in water (which is preferred) or it is soluble in an aqueous solution containing the aluminum-zirconium chlorohydrex salt.

[0015] The neutralizing salt may comprise a metal hydroxide or a salt (preferably a water soluble salt) of a strong base and an organic compound

containing an acid group (e.g., a carboxylic acid group). Examples of suitable metal hydroxides and/or strong bases include sodium, potassium, calcium, magnesium, strontium, zinc and aluminum hydroxide, with sodium and potassium hydroxide being preferred. Examples of suitable organic

5 compounds containing an acid group include weak acids such as acetic acid, ascorbic acid, benzoic acid, citric acid, gluconic acid, glycolic acid, lactic acid, etc., and the amino acids such as glycine, lysine, tyrosine, aminobutyric acid, etc. Thus, examples of suitable neutralizing salts include sodium hydroxide, sodium ascorbate, sodium benzoate, sodium citrate, sodium carbonate,

10 sodium bicarbonate, sodium glyconate, sodium lactate, sodium glycinate, sodium lysinate, sodium tyrosinate, as well as the corresponding potassium, calcium, magnesium, strontium, zinc and aluminum salts. Sodium glycinate and sodium hydroxide are preferred.

[0016] The amino acid used to form the neutralizing salt need not be the

15 same amino acid used in the aluminum-zirconium chlorohydrate, although it is preferred to use the same amino acid. Most preferably, the metal salt of an amino acid will be a metal glycinate. Typically the neutralizing salt will be derived from an alkali metal, such as sodium or potassium, or an alkaline earth metal, such as magnesium, calcium or strontium, although it may also

20 be derived from other metals, such as zinc, provided that the amino acid salt formed is water soluble. Thus, a more preferred neutralizing salt will be a metal salt of an amino acid selected from the group consisting of sodium glycinate, potassium glycinate, magnesium glycinate, calcium glycinate, strontium glycinate, zinc glycinate and mixtures thereof.

25 **[0017]** The solid particulate enhanced efficacy antiperspirant salt of the present invention may be prepared in accordance with the following methods.

[0018] Method 1 (solution mixing). To an aqueous solution of an enhanced efficacy aluminum-zirconium chlorohydrate salt will be added a water soluble neutralizing salt to form a final combined solution. This final combined

solution is then spray dried or vacuum dried to form a solid particulate antiperspirant salt. The amount of the water soluble neutralizing salt added prior to spray drying is that amount sufficient to provide the resulting solid particulate antiperspirant salt with a pH greater than 4.5, preferably about 4.6 to about 5.3, more preferably about 4.8 to about 5.2, when the salt is measured as an aqueous solution at a concentration of 15% by weight.

Generally, the pH of the final dried salt will be identical, or nearly identical, to the pH of the final combined solution (diluted to 15% by weight solids) and no further adjustments are necessary. However, since in some cases the pH of the dried salt may be slightly different from the pH of the final combined solution prior to drying, depending upon the process conditions and materials employed, it may be useful to prepare a sample of dried salt from a test aliquot of solution taken from the main batch, measure the pH of the dried salt, then adjust the pH of the main batch solution as required.

[0019] Method 1(a). In a preferred embodiment of method 1, the starting solution is a 30%–55% aqueous solution of enhanced efficacy aluminum-zirconium chlorohydrate or chlorohydrate-amino acid (e.g., -gly). This solution can be made by mixing 30-55% enhanced efficacy aluminum chlorohydrate (ACH') with an appropriate amount (to achieve the desired Al:Zr molar ratio) of aqueous zirconium hydroxychloride (25–50%) with glycine (preferred) or without glycine. To this solution is added a neutralizing salt (e.g., sodium hydroxide or sodium glycinate or a mixture thereof), preferably as an aqueous solution of about 10% to about 90%, more preferably about 30% to about 70%, concentration by weight. The neutralizing salt is added to the antiperspirant salt solution with mechanical dispersion, such as homogenization, to assist in solubilizing and maintaining all the components in solution. Heat optionally may be applied during homogenization. After combining these components, the final combined solution is spray dried (preferred) or vacuum dried to form the dried particulate salt, which may then be pulverized or micronized to the desired particle size (e.g., <10 μ m).

[0020] Method 1(b). In a second embodiment of method 1, the starting solution is a 10%–20% aqueous solution of enhanced efficacy aluminum chlorohydrate (ACH'), to which is added (i) an appropriate amount (to achieve the desired Al:Zr molar ratio) of aqueous zirconium hydroxychloride (25–45%)
5 with glycine (preferred) or without glycine and (ii) a neutralizing salt (e.g., sodium hydroxide or sodium glycinate or a mixture thereof), preferably as an aqueous solution of about 10% to about 90%, more preferably about 30% to about 70%, concentration by weight. This combined solution is concentrated in a vacuum evaporator to about 35%–55% concentration, then spray dried
10 (preferred) or vacuum dried to form the dried particulate salt, which may then be pulverized or micronized to the desired particle size.

[0021] In method 1(b), solution (i) – the zirconium solution – and solution (ii) – the aqueous neutralizing salt solution – may be added in any order or simultaneously, or solutions (i) and (ii) may be first combined together. It is
15 highly preferred, however, that the zirconium solution is first mixed with the aluminum chlorohydrate solution to form an aluminum-zirconium chlorohydrate solution, followed by the addition of aqueous neutralizing salt solution to raise the pH. Typically, the zirconium component will also include amino acid, such as glycine, to prevent polymerization of the zirconium
20 species. Thus, upon addition of the zirconium (with amino acid) component to the enhanced efficacy aluminum chlorohydrate solution, an aqueous solution of the enhanced efficacy aluminum-zirconium chlorohydrate-amino acid is produced.

[0022] Method 2 (dry blending). An intimate mixture of a particulate
25 enhanced efficacy aluminum-zirconium chlorohydrate salt and an appropriate amount of a particulate neutralizing salt is pulverized or micronized to a desired particle size (e.g., <10µm). The appropriate amount of neutralizing salt is that amount which will provide the final particulate salt blend with the desired pH within the range of the present invention.

[0023] The solid particulate antiperspirant salts of the present invention may be formulated into anhydrous topical antiperspirant compositions in any of the currently known forms, for example as a cream, a gel, a soft-solid, or a solid stick. Accordingly, a topical antiperspirant composition will include a
5 perspiration reducing effective amount of an antiperspirant salt of the present invention suspended in a dermatologically acceptable anhydrous carrier, particularly a carrier comprising a silicone (e.g., cyclomethicone, dimethicone, etc.), typically at a concentration of about 6% to about 22% (USP) antiperspirant active by weight. Such a topical composition is
10 particularly advantageous when it additionally includes a pH sensitive ingredient, such as a fragrance. By “pH sensitive” ingredient is meant that the ingredient, when included in an acidic composition, such as a conventional antiperspirant composition, will degrade somewhat during storage (particularly storage at 45°C for three months) as evidenced by
15 unacceptable odor or color of the composition, or by some other unacceptable characteristic of the composition, such as, for example, degradation in hardness or gel strength.

[0024] The anhydrous carrier may comprise any of the ingredients commonly utilized in the formulation of topical antiperspirant compositions.
20 Advantageously, the carrier will comprise one or more volatile silicones, which evaporate quickly and provide a dry feel. The volatile silicones include the cyclic polydimethylsiloxanes, also known as cyclomethicones, which have from about three to about seven silicon atoms, and the linear polydimethylsiloxanes, also known as dimethicones, which have from about 2
25 to about 8 silicon atoms. The linear volatile silicones generally have viscosities of less than 5 cst, while the cyclic volatile silicones have viscosities under 10 cst. Mixtures of volatile silicones may be advantageously employed. When included in the carrier, the volatile silicones are typically present in an amount of about 10% to 90%, more typically about 20% to 70%, by weight.

[0025] The carrier may optionally include a liquid non-volatile emollient to improve emolliency and application aesthetics (e.g., reduced tackiness, slower dry-down, reduced drag and reduced whitening). The non-volatile emollient may be generally included in an amount of about 0% to about 25%, preferably about 2% to about 20%, more preferably about 5% to about 15%, by weight. Preferably the amount of non-volatile emollient will be less than about one-half the amount of volatile silicone present in the composition, and more preferably will be less than about one-third the amount of volatile silicone. Generally, the amount of non-volatile emollient should be kept to a minimum so as not to adversely affect efficacy.

[0026] When present, the non-volatile emollient will typically have a viscosity of about 5 to about 1000 cst, preferably about 10 to 500 cst. Examples of non-volatile emollients include the non-volatile silicones, typically polyalkylsiloxanes such as dimethicone (e.g. DC 200) and polyalkylarylsiloxanes such as phenyltrimethicone (e.g. DC 556), paraffinic hydrocarbons such as mineral oil and hydrogenated polyisobutene, aliphatic alcohols such as octyldodecanol, fatty alcohol esters such as C₁₂₋₁₅ alcohols benzoate and myristyl octanoate, fatty acid esters such as isopropyl palmitate, myristyl myristate and octyl isononanoate, dicarboxylic acid esters such as diisopropyl sebacate, polyethylene glycols and polypropylene glycols such as PEG-40 and PPG-20, polyethylene and/or polypropylene glycol ethers of C₄₋₂₀ alcohols such as PPG-10 butanediol, PPG-14 butyl ether, PPG-5-Buteth-7, PPG-3-Myreth-3, and Steareth-20, and polyethylene and/or polypropylene glycol esters of C₄₋₂₀ acids such as PEG-8 Distearate and PEG-10 Dioleate. Preferred emollients include the ethoxylated and propoxylated ethers and esters of C₄₋₂₀ alcohols and acids. Of course, more than one emollient may be used.

[0027] The carrier may include waxes such as fatty alcohols, for example, stearyl alcohol, cetyl alcohol, and myristyl alcohol, fatty amides, for example,

Stearamide MEA and Lauramide DEA, hydrogenated castor oil (castor wax), silicone wax and polyethylene homopolymer, gelling agents such as 12-hydroxystearic acid (including esters and amides thereof) and glyceryl tribehenate, N-acyl amino acid amides such as N-lauroyl-L-glutamic acid-di-
5 n-butyl amide and alkyl amides such as 2-dodecyl-N,N'-dibutylsuccinamide, thickeners such as silicone latex or silicone elastomer, suspending agents such as clays (e.g. quaternium-18 hectorite) and silicas, and fillers such as talc, polyolefins and modified corn starch.

[0028] Naturally, of course, the antiperspirant composition will also ideally
10 include a fragrance. Because topical compositions formulated with the antiperspirant salts of the present invention are less acidic than prior art compositions, many pH sensitive fragrance components may be included that could not be used in compositions containing conventional antiperspirant salts.

15 **[0029]** The foregoing list of materials is by way of example only and is not intended to be a comprehensive list of all potential materials that may be useful in an antiperspirant composition. Obviously, the skilled worker may select materials that provide the desired application and aesthetic characteristics of the particular form of antiperspirant composition to be
20 produced.

[0030] The present invention also embraces a method of inhibiting or reducing perspiration by topically applying an effective amount of an anhydrous antiperspirant composition as described herein to the skin of a human, preferably to the axilla, where such reduction in perspiration is
25 desired. An effective amount is that amount which provides at least a 20% sweat reduction, preferably at least a 40% sweat reduction, when tested in accordance with a standard hot room thermal efficacy protocol, and most preferably that amount which reduces perspiration to a degree that is noticeable by the user. Typically, the amount of antiperspirant composition

applied will range from about 0.1 gram to about 1.0 gram per axilla depending on the formulation or such amount as will deliver about 0.01 to about 0.25 gram of antiperspirant active per axilla.

[0031] The present invention may be further illustrated by the following examples in which the parts and percentages are by weight, unless otherwise indicated. In these examples, the abbreviation ACH' means enhanced efficacy 5/6 basic aluminum chlorohydrate with an Al:Cl ratio of about 1.95 and having an HPLC peak 4 to peak 3 area ratio of at least 0.7 with at least 80% of the aluminum contained in peaks 3 and 4. The ACH' is made by diluting ACH with water to form a solution of about 10% concentration, heating the dilute ACH solution at about 85°C for about 16 hours, then rapidly concentrating the ACH' by vacuum evaporation (for example, using a falling film evaporator) to a concentration of about 40% USP active and cooling to room temperature. The ACH' should preferably be used shortly after preparation in order to insure that it has the desired high peak 4 to peak 3 ratio.

Example 1

[0032] (Method 1(a)) To 1760g freshly prepared ACH' (41% USP) is added 440g zirconium hydroxychloride/glycine (ZHC/gly) solution (17.5% Zr; Zr:Cl $\cong$ 0.7; Zr:Gly $\cong$ 1.0) and 400g water while mixing at 8000 rpm (IKA T25 Basic disperser) to form an aqueous enhanced efficacy aluminum-zirconium pentachlorohydrate-gly solution. After mixing this solution for ten minutes, 169g sodium glycinate solution (50%) is slowly added (over about 30 sec.) to form a final combined solution while maintaining the agitation at 8000 rpm. The agitation speed is increased to 20,000 rpm and maintained for ten minutes, then the final combined solution is spray dried (Niro Bowen spray drier; inlet/outlet temp. = 175°/105°C; feed rate 170 ml/min) to produce a solid particulate antiperspirant salt. This salt is further pulverized (Hosokawa 100 AFG/50) to an average particle size of 5µm. The solid particulate

aluminum-zirconium pentachlorohydrate-gly antiperspirant salt (Al:Zr = 9.78:1; M:Cl = 1.67:1), when dissolved in water at 15% by weight, has a pH of 4.86.

Examples 2 to 6

5 **[0033]** The procedure of Example 1 is repeated, but the amounts of ACH', ZHC/gly, and sodium glycinate are altered to provide the following solid particulate antiperspirant salts (M:Cl ratio is adjusted as desired by addition of HCl as necessary and/or by using a ZHC with a higher or lower Zr:Cl ratio as necessary and/or by adjusting with AlCl_3 or with 2/3, 3/4 or 5/6 basic
10 aluminum chlorohydrate):

Ex. 2: aluminum-zirconium tetrachlorohydrate-gly (Al:Zr = 3.6:1;
 M:Cl = 1.39:1; pH = 4.6)

Ex. 3: aluminum-zirconium trichlorohydrate-gly (Al:Zr = 3.6:1;
 M:Cl = 1.51:1; pH = 4.7)

15 Ex. 4: aluminum-zirconium octachlorohydrate-gly (Al:Zr = 9.6:1;
 M:Cl = 1.26:1; pH = 4.9)

Ex. 5: aluminum-zirconium tetrachlorohydrate-gly (Al:Zr = 3.6:1;
 M:Cl = 1.41:1; pH = 5.1)

Ex. 6: aluminum-zirconium pentachlorohydrate-gly (Al:Zr = 9.17:1;
20 M:Cl = 1.65:1; pH = 5.0)

[0034] The enhanced efficacy antiperspirant salts of Examples 1 to 6 look whiter and smell cleaner (i.e., no off-odor) than conventional enhanced efficacy antiperspirant salts without any significant difference in antiperspirant efficacy. Topical compositions containing these salts have no
25 odor to interfere with added fragrances and provide greater fragrance stability.

Example 7

[0035] The procedure of Example 1 is repeated, but with 1749g ACH', 451g ZHC/gly, 400g water and 56.5g sodium hydroxide (in place of sodium glycinate) to produce a solid particulate pentachlorohydrex-gly (Al:Zr =
5 9.34:1; M:Cl = 1.67:1) that, when dissolved in water at 15% by weight, has a pH of 4.61.

Examples 8 to 17

[0036] The procedure of Example 1 is repeated, but the aqueous sodium glycinate is replaced by an appropriate amount of the following neutralizing
10 salt solutions: potassium glycinate, magnesium glycinate, calcium glycinate, strontium glycinate, zinc glycinate, sodium alanate, sodium valinate, sodium serinate, sodium leucinate and sodium carbonate.

Example 18

[0037] (Method 1(b)) To 1749g freshly prepared ACH' (10% USP) is added
15 113g zirconium hydroxychloride/glycine (ZHC/gly) solution (17.5% Zr; Zr:Cl $\cong$ 0.7; Zr:Gly $\cong$ 1.0) while mixing with a conventional laboratory agitator. To this solution is added 51.4g sodium glycinate solution (50%) with continuous mixing. This solution is evaporated to about 45% concentration, then spray dried and pulverized to produce a solid particulate pentachlorohydrex-gly
20 (Al:Zr = 9.6:1; M:Cl = 1.67:1) that, when dissolved in water at 15% by weight, has a pH of 5.3.

Example 19

[0038] (Method 2) A mixture of 8165g of particulate enhanced efficacy aluminum-zirconium pentachlorohydrex-gly and 907g of particulate calcium
25 carbonate is pulverized to a particle size of 5.5 μ m. This antiperspirant salt, when dissolved in water at 15% by weight, has a pH of 4.86.

Examples 20 to 21

[0039] Two solid stick antiperspirant compositions are prepared having the following formulation: :

	<u>Ingredient</u>	<u>Weight Percent</u>
5	Cyclomethicone (DC 245)	41.8
	AZCH'-gly	23.0*
	Stearyl alcohol	17.8
	PPG-14 butyl ether	11.0
	Hydrogenated castor wax	2.8
10	Myristyl myristate	1.9
	Silica (R972 & A300)	0.9
	Fragrance	0.8

* Salt of Ex. 6 (pH 5.0) at approximately 18% USP active

- 15 Each composition includes a fragrance – namely, pettigrain or ionone alpha – generally considered unstable under the acidic conditions present in a conventional antiperspirant solid stick. Each composition has acceptable odor and color – i.e., the fragrance is stable – when stored for three months at 45°C. This suggests that the palette of fragrances available for inclusion in
- 20 topical compositions of the present invention is substantially greater than for conventional antiperspirant compositions.

WHAT IS CLAIMED IS:

1. A solid particulate antiperspirant salt comprising a mixture of an enhanced efficacy aluminum-zirconium chlorohydrate-amino acid and a neutralizing salt, wherein the antiperspirant salt, when measured as an aqueous solution at a concentration of 15% by weight, has a pH greater than 4.5, and wherein the antiperspirant salt is substantially free of polyhydric alcohol.
2. The antiperspirant salt of claim 1 wherein the enhanced efficacy aluminum-zirconium chlorohydrate-amino acid is aluminum-zirconium chlorohydrate-glycine.
3. The antiperspirant salt of claim 1 or 2 wherein the neutralizing salt is a salt of a metal hydroxide and an organic compound containing an acid group.
4. The antiperspirant salt of claim 1 or 2 wherein the neutralizing salt is derived from an alkali or alkaline earth metal hydroxide.
5. The antiperspirant salt of claim 1 or 2 wherein the neutralizing salt is an alkali or alkaline earth metal salt of an amino acid.
6. The antiperspirant salt of claim 2 wherein the neutralizing salt is an alkali or alkaline earth metal salt of glycine.
7. The antiperspirant salt of claim 2 wherein the neutralizing salt is selected from the group consisting of sodium glycinate, potassium glycinate, magnesium glycinate, calcium glycinate, strontium glycinate, zinc glycinate and mixtures thereof.
8. The antiperspirant salt of claim 1 or 2 wherein the neutralizing salt is selected from the group consisting of sodium hydroxide, sodium ascorbate, sodium benzoate, sodium citrate, sodium carbonate, sodium bicarbonate, sodium glyconate, sodium lactate, sodium glycinate, sodium lysinate, sodium tyrosinate, potassium ascorbate, potassium benzoate, potassium citrate, potassium carbonate, potassium bicarbonate, potassium glyconate,

potassium lactate, potassium glycinate, potassium lysinate, potassium tyrosinate, calcium ascorbate, calcium benzoate, calcium citrate, calcium carbonate, calcium bicarbonate, calcium glyconate, calcium lactate, calcium glycinate, calcium lysinate, calcium tyrosinate, magnesium ascorbate, magnesium benzoate, magnesium citrate, magnesium carbonate, magnesium bicarbonate, magnesium glyconate, magnesium lactate, magnesium glycinate, magnesium lysinate, magnesium tyrosinate, strontium ascorbate, strontium benzoate, strontium citrate, strontium carbonate, strontium bicarbonate, strontium glyconate, strontium lactate, strontium glycinate, strontium lysinate, strontium tyrosinate, zinc ascorbate, zinc benzoate, zinc citrate, zinc carbonate, zinc bicarbonate, zinc glyconate, zinc lactate, zinc lysinate, zinc tyrosinate, and mixtures of two or more of these.

9. The antiperspirant salt of claim 2 wherein the neutralizing salt is selected from the group consisting of sodium hydroxide, sodium glycinate and mixtures thereof.

10. The antiperspirant salt of any one of claims 1 to 9 wherein the antiperspirant salt has a pH of about 4.6 to about 5.3.

11. The antiperspirant salt of any one of claims 1 to 9 wherein the antiperspirant salt has a pH of about 4.8 to about 5.2.

12. The antiperspirant salt of claim 1 consisting essentially of a spray-dried mixture of an enhanced efficacy aluminum-zirconium chlorohydrate-glycine and a water soluble neutralizing salt, wherein the antiperspirant salt, when measured as an aqueous solution at a concentration of 15% by weight, has a pH of about 4.6 to about 5.3.

13. The antiperspirant salt of claim 12 wherein the neutralizing salt is selected from the group consisting of sodium hydroxide, sodium ascorbate, sodium benzoate, sodium citrate, sodium carbonate, sodium bicarbonate, sodium glyconate, sodium lactate, sodium glycinate, sodium lysinate, sodium tyrosinate, potassium ascorbate, potassium benzoate, potassium citrate, potassium carbonate, potassium bicarbonate, potassium glyconate, potassium lactate, potassium glycinate, potassium lysinate, potassium tyrosinate, calcium ascorbate, calcium benzoate, calcium citrate, calcium carbonate, calcium bicarbonate, calcium glyconate,

calcium lactate, calcium glycinate, calcium lysinate, calcium tyrosinate, magnesium ascorbate, magnesium benzoate, magnesium citrate, magnesium carbonate, magnesium bicarbonate, magnesium glyconate, magnesium lactate, magnesium glycinate, magnesium lysinate, magnesium tyrosinate, strontium ascorbate, strontium benzoate, strontium citrate, strontium carbonate, strontium bicarbonate, strontium glyconate, strontium lactate, strontium glycinate, strontium lysinate, strontium tyrosinate, zinc ascorbate, zinc benzoate, zinc citrate, zinc carbonate, zinc bicarbonate, zinc glyconate, zinc lactate, zinc lysinate, zinc tyrosinate, and mixtures of two or more of these.

10 14. A topical antiperspirant composition comprising a perspiration reducing effective amount of an antiperspirant salt according to any one of claims 1 to 13, suspended in an anhydrous carrier.

15 15. The antiperspirant composition of claim 14 in the form of a cream, gel, soft-solid, or solid stick.

16. The antiperspirant composition of claim 14 or 15 additionally comprising a pH sensitive ingredient.

20 17. The antiperspirant composition of claim 16 wherein the pH sensitive ingredient is a fragrance.

18. A method of reducing perspiration from human skin comprising applying to human skin a topical antiperspirant composition according to claim 14.

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19. A method of preparing a solid particulate antiperspirant salt according to claim 1, which method comprises providing an aqueous solution of an enhanced efficacy aluminum-zirconium chlorohydrate, adding to this solution a water soluble neutralizing salt to form a final combined solution, then spray drying the final combined solution to form the solid particulate antiperspirant salt, wherein the amount of the water soluble neutralizing salt added prior to spray drying is sufficient to provide the resulting solid particulate antiperspirant salt with a pH greater than 4.5, when the salt is measured as an aqueous solution at a

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concentration of 15% by weight.

20. A method of preparing a solid particulate antiperspirant salt according to claim 1,
which method comprises providing an aqueous solution of an enhanced efficacy aluminum
5 chlorohydrate, adding to this solution (a) zirconium hydroxychloride in an amount to provide
an Al:Zr mole ratio of 2:1 to 10:1 and (b) a water soluble neutralizing salt to form a final
combined solution, then spray drying the final combined solution to form the solid particulate
antiperspirant salt, wherein the amount of the water soluble neutralizing salt added prior to
10 spray drying is sufficient to provide the resulting solid particulate antiperspirant salt with a
pH greater than 4.5, when the salt is measured as an aqueous solution at a concentration of
15% by weight.

21. The method of claim 20 wherein the zirconium hydroxychloride is added in the form
of an aqueous zirconium hydroxychloride solution and wherein the neutralizing salt is added
15 as an aqueous neutralizing salt solution.

22. The method of claim 21 wherein the neutralizing salt is selected from the group
consisting of sodium hydroxide, sodium ascorbate, sodium benzoate, sodium citrate, sodium
carbonate, sodium bicarbonate, sodium glyconate, sodium lactate, sodium glycinate, sodium
20 lysinate, sodium tyrosinate, potassium ascorbate, potassium benzoate, potassium citrate,
potassium carbonate, potassium bicarbonate, potassium glyconate, potassium lactate,
potassium glycinate, potassium lysinate, potassium tyrosinate, calcium ascorbate, calcium
benzoate, calcium citrate, calcium carbonate, calcium bicarbonate, calcium glyconate,
calcium lactate, calcium glycinate, calcium lysinate, calcium tyrosinate, magnesium
25 ascorbate, magnesium benzoate, magnesium citrate, magnesium carbonate, magnesium
bicarbonate, magnesium glyconate, magnesium lactate, magnesium glycinate, magnesium
lysinate, magnesium tyrosinate, strontium ascorbate, strontium benzoate, strontium citrate,
strontium carbonate, strontium bicarbonate, strontium glyconate, strontium lactate, strontium
glycinate, strontium lysinate, strontium tyrosinate, zinc ascorbate, zinc benzoate, zinc citrate,
30 zinc carbonate, zinc bicarbonate, zinc glyconate, zinc lactate, zinc lysinate, zinc tyrosinate,
and mixtures of two or more of these.

23. The method of any one of claims 21 and 22 wherein the neutralizing salt is selected from the group consisting of sodium hydroxide, sodium glycinate and mixtures thereof.

24. The method of any one of claims 21 to 23 wherein the amount of the water soluble neutralizing salt added prior to spray drying is sufficient to provide the resulting solid particulate antiperspirant salt with a pH of about 4.6 to about 5.3.

25. The method of any one of claims 21 to 24 wherein the amount of the water soluble neutralizing salt added prior to spray drying is sufficient to provide the resulting solid particulate antiperspirant salt with a pH of about 4.8 to about 5.2.

26. The method of any one of claims 21 to 25 wherein the zirconium hydroxychloride solution is added to the aluminum chlorohydrate solution prior to the addition of the neutralizing salt solution.

27. The method of claim 26 wherein the zirconium hydroxychloride solution further includes glycine.

28. A method of preparing a solid particulate antiperspirant salt according to claim 1, which method comprises mixing a particulate enhanced efficacy aluminum-zirconium chlorohydrate and an appropriate amount of a particulate neutralizing salt to form a mixture, then pulverizing or micronizing the mixture to form a particulate salt with a desired particle size, wherein the appropriate amount of neutralizing salt is that amount which will provide the particulate salt with a pH greater than 4.5, when the salt is measured as an aqueous solution at a concentration of 15% by weight.

29. The method of claim 28 wherein the neutralizing salt is selected from the group consisting of sodium hydroxide, sodium ascorbate, sodium benzoate, sodium citrate, sodium carbonate, sodium bicarbonate, sodium glyconate, sodium lactate, sodium glycinate, sodium lysinate, sodium tyrosinate, potassium ascorbate, potassium benzoate, potassium citrate, potassium carbonate, potassium bicarbonate, potassium glyconate, potassium lactate, potassium glycinate, potassium lysinate, potassium tyrosinate, calcium ascorbate, calcium

benzoate, calcium citrate, calcium carbonate, calcium bicarbonate, calcium glyconate, calcium lactate, calcium glycinate, calcium lysinate, calcium tyrosinate, magnesium ascorbate, magnesium benzoate, magnesium citrate, magnesium carbonate, magnesium bicarbonate, magnesium glyconate, magnesium lactate, magnesium glycinate, magnesium lysinate, magnesium tyrosinate, strontium ascorbate, strontium benzoate, strontium citrate, strontium carbonate, strontium bicarbonate, strontium glyconate, strontium lactate, strontium glycinate, strontium lysinate, strontium tyrosinate, zinc ascorbate, zinc benzoate, zinc citrate, zinc carbonate, zinc bicarbonate, zinc glyconate, zinc lactate, zinc lysinate, zinc tyrosinate, and mixtures of two or more of these.

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30. Use of a solid particulate antiperspirant salt comprising a mixture of an enhanced efficacy aluminum-zirconium chlorohydrate-amino acid and a neutralizing salt, for the manufacturing of an antiperspirant composition, wherein the antiperspirant salt, when measured as an aqueous solution at a concentration of 15% by weight, has a pH greater than 4.5, and wherein the antiperspirant salt is substantially free of polyhydric alcohol.

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