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(54) LIQUID COMPOSITION FOR LIQUID HEATING-TYPE THERMAL FLAVOR INHALER

(57) The present invention relates to a liquid composition for a liquid heating-type flavor inhaler. A liquid composition for a liquid heating-type flavor inhaler of the present invention contains (1) propylene glycol and glycerol, (2) nicotine, (3) benzoic acid, and (4) one or more organic acids excluding benzoic acid. Another liquid composition for a liquid heating-type flavor inhaler of the present invention contains (1) propylene glycol and glycerol, (2) nicotine, and (4) one or more organic acids excluding benzoic acid.

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Description

TECHNICAL FIELD

[0001] The present invention relates to a liquid composition for a liquid heating-type flavor inhaler and a preparation method therefor. The present invention also relates to a liquid heating-type flavor inhaler including the liquid composition for a liquid heating-type flavor inhaler. The present invention further relates to a method of reducing the gunpowder-like odor of benzoic acid in a liquid composition for a liquid heating-type flavor inhaler.

BACKGROUND ART

[0002] A liquid heating-type flavor inhaler is a flavor inhaler that directly or indirectly heats, by an electric heat source or a chemical reaction-based heat source, a liquid composition for a liquid heating-type flavor inhaler to generate an aerosol and delivers the aerosol into the mouth through a mouthpiece member. A typical liquid composition for a liquid heating-type flavor inhaler (a liquid for electronic cigarettes (commonly called as e-liquid or e-juice)) comprises propylene glycol (PG), glycerol (GL), nicotine, and a flavor.

[0003] Japanese Unexamined Patent Application Publication (Translation of PCT Application) No. 2018-532377 describes a liquid formulation for e-vaping devices. The liquid formulation contains propylene glycol and substantially no amount of glycerol.

[0004] Japanese Unexamined Patent Application Publication (Translation of PCT Application) No. 2016-520061 describes a nicotine salt formulation for aerosol devices and methods therefor. The document specifies, for example, by the vapor pressure, melting point, or boiling point, an acid used to form a nicotine salt in the nicotine salt formulation.

[0005] It is said that the role of nicotine in e-liquids is to impart sensory impact during inhalation. Meanwhile, as the nicotine concentration in an e-liquid increases, inhalation accompanies more irritation to the mouth and throat (herein, referred to as "smoke flavor inhibition" in some cases). Consequently, a user often feels uncomfortable during inhalation of an aerosol. As a method of resolving these problems, products containing benzoic acid (BA) in an e-liquid have become widely used in recent years. The mechanism is that nicotine as a basic substance is neutralized with benzoic acid as an acidic substance to affect the gas-liquid equilibrium of nicotine during heating, thereby lowering smoke flavor inhibition caused by nicotine.

CITATION LIST

PATENT LITERATURE

[0006] PTL 1: Japanese Unexamined Patent Application Publication (Translation of PCT Application) No. 2018-532377
PTL 2: Japanese Unexamined Patent Application Publication (Translation of PCT Application) No. 2016-520061

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0007] The present inventors found problems that a product containing benzoic acid in an e-liquid for lowering smoke flavor inhibition caused by nicotine (nicotine impact) emits a smell peculiar to benzoic acid during heating (gunpowder-like; herein, referred to as "gunpowder-like odor" or "benzoic acid odor" in some cases), and the resulting benzoic acid odor interferes with the emission of a flavor in the e-liquid, thereby destroying smoking flavor. Moreover, benzoic acid has low solubility in PG and GL and hence requires a prolonged stirring step or heating step for the dissolution during production of e-liquids. For this reason, there are concerns about adverse effects on product quality, such as volatilization or deterioration of the components as well as effects on production efficiency.

[0008] The present inventors noticed that an e-liquid containing benzoic acid alone has such various problems with sensory characteristics, product quality, production efficiency, and so forth and conducted research to resolve these problems. Finally, the inventors arrived at the present invention through the development in view of the following.

- to reduce the amount of benzoic acid to reduce benzoic acid odor
- to use other organic acids for making up for the amount of benzoic acid reduced while ensuring sensory characteristics and effects of lowering smoke flavor inhibition caused by nicotine at levels comparable to a product using benzoic acid alone
- to establish mixing procedures for efficiently formulating an e-liquid containing organic acids of the developed composition

[0009] The present inventors also found that smoke flavor inhibition caused by nicotine (nicotine impact) is lowered even when other organic acids alone are used without using benzoic acid in a liquid composition containing nicotine for a heating-type flavor inhaler, thereby arriving at the present invention concerning a liquid composition containing no benzoic acid.

SOLUTION TO PROBLEM

[0010] The present invention encompasses, but not limited to, the following embodiments.

[Embodiment 1] A liquid composition for a liquid heating-type flavor inhaler, containing

(1) propylene glycol and glycerol,
(2) nicotine,
(3) benzoic acid, and
(4) one or more organic acids excluding benzoic acid.

[Embodiment 2] The liquid composition according to Embodiment 1, where a mole ratio of (2) nicotine to the total of (3) benzoic acid and (4) one or more organic acids excluding benzoic acid falls within a range of 1:0.85 to 1:1.15.
[Embodiment 3] The liquid composition according to Embodiment 1 or 2 containing lactic acid as (4) one or more organic acids excluding benzoic acid.
[Embodiment 4] The liquid composition according to Embodiment 3 containing, in addition to lactic acid, any one selected from tartaric acid, fumaric acid, levulinic acid, malonic acid, acetic acid, adipic acid, citric acid, malic acid, pyruvic acid, sorbic acid, and mixtures thereof as (4) one or more organic acids excluding benzoic acid.
[Embodiment 5] The liquid composition according to Embodiment 3 containing, in addition to lactic acid, any one selected from tartaric acid, fumaric acid, levulinic acid, malonic acid, and mixtures thereof as (4) one or more organic acids excluding benzoic acid.
[Embodiment 6] The liquid composition according to Embodiment 3 containing, in addition to lactic acid, tartaric acid as (4) one or more organic acids excluding benzoic acid.
[Embodiment 7] The liquid composition according to any one of Embodiments 1 to 6, where a mole ratio of (2) nicotine to (3) benzoic acid falls within a range of 1:0.7 to 1:0.15.
[Embodiment 8] The liquid composition according to any one of Embodiments 1 to 7, where a mole ratio of (2) nicotine to (4) one or more organic acids excluding benzoic acid falls within a range of 1:0.9 to 1:0.3.
[Embodiment 9] The liquid composition according to any one of Embodiments 1 to 8, where (4) one or more organic acids excluding benzoic acid have solubility in glycerol of 0.32 mol/kg or more in molality.
[Embodiment 10] The liquid composition according to any one of Embodiments 1 to 9 containing substantially no water.
[Embodiment 11] The composition according to any one of Embodiments 1 to 10 further containing a flavor.
[Embodiment 12] A method of preparing a liquid composition for a liquid heating-type flavor inhaler, including steps of:

(i) preparing a solution (A) by dissolving nicotine and benzoic acid in propylene glycol;
(ii) preparing a solution (B) by dissolving lactic acid in glycerol;
(iii) preparing, as necessary, a solution (C) by dissolving one or more organic acids excluding benzoic acid and lactic acid in propylene glycol or glycerol; and
(iv) mixing solution (A), solution (B), and solution (C).

[Embodiment 13] A method of preparing a liquid composition for a liquid heating-type flavor inhaler, including steps of:

(i) preparing a solution (A) by dissolving nicotine and benzoic acid in propylene glycol; and
(v) dissolving glycerol, lactic acid, and, as necessary, one or more organic acids excluding benzoic acid and lactic acid in solution (A).

[Embodiment 14] The method according to Embodiment 12 or 13 further including adding a flavor in a step after step (i).
[Embodiment 15] A liquid heating-type flavor inhaler including the liquid composition according to any one of Embodiments 1 to 14.
[Embodiment 16] A method of reducing a gunpowder-like odor of benzoic acid in a liquid composition for a heating-type flavor inhaler,

where the liquid composition for a heating-type flavor inhaler contains (1) propylene glycol and glycerol, (2)

nicotine, and (3) benzoic acid,
the method including further incorporating (4) one or more organic acids excluding benzoic acid into the liquid composition for a heating-type flavor inhaler.

[Embodiment 17] The method according to Embodiment 16 including incorporating lactic acid as (4) one or more organic acids excluding benzoic acid.
[Embodiment 18] The method according to Embodiment 17 including incorporating, in addition to lactic acid, any one selected from tartaric acid, fumaric acid, levulinic acid, malonic acid, acetic acid, adipic acid, citric acid, malic acid, pyruvic acid, sorbic acid, and mixtures thereof as (4) one or more organic acids excluding benzoic acid.
[Embodiment 19] A liquid composition for a liquid heating-type flavor inhaler, containing

(1) propylene glycol and glycerol,
(2) nicotine, and
(4) one or more organic acids excluding benzoic acid.

[Embodiment 20] The liquid composition according to Embodiment 19, where a mole ratio of (2) nicotine to (4) one or more organic acids excluding benzoic acid falls within a range of 1:0.85 to 1:1.15.
[Embodiment 21] The liquid composition according to Embodiment 19 or 20 containing lactic acid as (4) one or more organic acids excluding benzoic acid.
[Embodiment 22] The liquid composition according to Embodiment 21 containing, in addition to lactic acid, any one selected from tartaric acid, fumaric acid, levulinic acid, malonic acid, acetic acid, adipic acid, citric acid, malic acid, pyruvic acid, sorbic acid, and mixtures thereof as (4) one or more organic acids excluding benzoic acid.
[Embodiment 23] The liquid composition according to any one of Embodiments 19 to 22, where (4) one or more organic acids excluding benzoic acid have solubility in glycerol of 0.32 mol/kg or more in molality.
[Embodiment 24] A method of preparing a liquid composition for a liquid heating-type flavor inhaler, including steps of:

(i') preparing a solution (B) by dissolving lactic acid in glycerol;
(ii') preparing, as necessary, a solution (C) by dissolving one or more organic acids excluding benzoic acid and lactic acid in propylene glycol or glycerol; and
(iii') mixing nicotine, solution (B), and solution (C).

[Embodiment 25] The method according to Embodiment 24 further including adding a flavor.
[Embodiment 26] A liquid heating-type flavor inhaler including the liquid composition according to any one of Embodiments 19 to 25.

ADVANTAGEOUS EFFECTS OF INVENTION

[0011] A liquid composition (I) for a liquid heating-type flavor inhaler of the present invention has excellent features of reduced smoke flavor inhibition caused by nicotine due to a mixture of benzoic acid and other organic acids as well as reduced gunpowder-like odor of benzoic acid to be generated during heating.
[0012] Moreover, a method of preparing the above-mentioned liquid composition includes dissolving benzoic acid first in propylene glycol in the presence of nicotine and then mixing with glycerol. This makes it possible to efficiently prepare, in a short time without heating treatment, a liquid composition for a liquid heating-type flavor inhaler containing benzoic acid, which is difficult to dissolve in glycerol.
[0013] A liquid composition (II) for a liquid heating-type flavor inhaler of the present invention effectively reduces smoke flavor inhibition caused by nicotine solely by organic acids excluding benzoic acid without using benzoic acid. Since the liquid composition does not use benzoic acid, a preparation method therefor does not require a step of dissolving benzoic acid first in propylene glycol in the presence of nicotine. Nicotine may appropriately be mixed into, for example, after dissolving organic acids to be used in propylene glycol or glycerol.

DESCRIPTION OF EMBODIMENTS

[0014] The present invention encompasses, in a non-limiting manner, the following embodiments.

1. Liquid Composition (I) for Liquid Heating-type Flavor Inhaler

[0015] The present invention relates to a liquid composition for a liquid heating-type flavor inhaler.
[0016] In an embodiment, a liquid composition for a liquid heating-type flavor inhaler contains

(1) propylene glycol and glycerol,
(2) nicotine,
(3) benzoic acid, and
(4) one or more organic acids excluding benzoic acid.

[0017] A non-combustion flavor inhaler is a flavor inhaler that enables inhalation of a flavor without involving combustion. Such non-combustion flavor inhalers include: heating-type flavor inhalers equipped with an electric heat source or a chemical reaction-based heat source; and non-heating flavor inhalers without heat source.

[0018] A "liquid heating-type flavor inhaler," as a form of non-combustion flavor inhalers, is a flavor inhaler that has a cartridge for holding a liquid composition (aerosol source) containing nicotine, heats directly or indirectly the aerosol source (liquid) by an electric heat source or a chemical reaction-based heat source to generate an aerosol containing nicotine and a flavor, and delivers the aerosol into the mouth through a mouthpiece member.

[0019] In an embodiment of a liquid heating-type flavor inhaler, a porous or fibrous body impregnated with an aerosol source of a liquid, such as glycerol or propylene glycol, or a mixed solution thereof is electrically heated to generate a gas of mixed vapor and particulate substance, and the gas is then mixed into air drawn through the flavor inhaler. A consumer generally inhales the resulting mixed gas by drawing at the end of the flavor inhaler (mouth side end, filter end, or mouthpiece end).

[0020] In an embodiment of a liquid composition for a liquid heating-type flavor inhaler, (2) nicotine, (3) benzoic acid, and (4) one or more organic acids excluding benzoic acid are dissolved in solvents of propylene glycol and glycerol. Herein, a liquid composition for a liquid heating-type flavor inhaler is referred to as "e-liquid" in some cases. In a non-limiting manner, benzoic acid reduces smoke flavor inhibition caused by nicotine, and other organic acids reduce the gunpowder-like odor of benzoic acid.

[0021] In an embodiment of the liquid composition for a liquid heating-type flavor inhaler, a mole ratio of (2) nicotine to the total of (3) benzoic acid and (4) one or more organic acids excluding benzoic acid falls within a range of 3:0.1 to 0.1:3, 2:0.5 to 0.5:2, or 1:0.85 to 1:1.15. In a preferable embodiment, a mole ratio of (2) nicotine to the total of (3) benzoic acid and (4) one or more organic acids excluding benzoic acid falls within a range of 1:0.85 to 1:1.15.

[0022] In an embodiment, a liquid composition for a liquid heating-type flavor inhaler contains (4) one or more organic acids excluding benzoic acid. Here, "organic acids" are a collective term for acids of organic compounds. The majority of organic acids are carboxylic acids having a carboxyl group or sulfonic acids having a sulfo group. The types of (4) organic acids excluding benzoic acid to be used for a liquid composition of the present invention are not particularly limited. The number of (4) organic acids excluding benzoic acid is also not particularly limited, and two or more (4) organic acids excluding benzoic acid may be contained. In a non-limiting embodiment, (4) organic acids excluding benzoic acid include lactic acid.

[0023] Further, in an embodiment, the liquid composition for a liquid heating-type flavor inhaler may contain, in addition to lactic acid, any one selected from tartaric acid, fumaric acid, levulinic acid, malonic acid, acetic acid, adipic acid, citric acid, malic acid, pyruvic acid, sorbic acid, and mixtures thereof as (4) one or more organic acids excluding benzoic acid. In a non-limiting manner, the liquid composition may contain, in addition to lactic acid, any one selected from tartaric acid, fumaric acid, levulinic acid, malonic acid, and mixtures thereof as (4) one or more organic acids excluding benzoic acid. In a non-limiting manner, the liquid composition may contain, in addition to lactic acid, tartaric acid as (4) one or more organic acids excluding benzoic acid. Organic acids contained in a liquid composition for a liquid heating-type flavor inhaler are preferably organic acids, for which safety to organisms has been recognized, such as those approved as food additives.

[0024] In the liquid composition for a liquid heating-type flavor inhaler, a mole ratio of lactic acid to organic acids excluding lactic acid, both of which are (4) organic acids excluding benzoic acid, is not particularly limited. In an embodiment, a mole ratio of lactic acid to organic acids excluding lactic acid is 10:1 to 1:2, 5:1 to 1:1, or 4:1 to 2:1. In an embodiment, a mole ratio of lactic acid to organic acids excluding lactic acid is about 3:1.

[0025] For preparing as a liquid composition, "organic acids excluding benzoic acid" are preferably organic acids soluble in glycerol and/or propylene glycol. In a non-limiting embodiment, organic acids excluding benzoic acid have solubility in glycerol of 0.32 mol/kg or more in molality. Lactic acid has properties of relatively satisfactory solubility in glycerol and propylene glycol compared with benzoic acid and other organic acids. Among other organic acids, for example, there exist those having a higher dissolution rate in propylene glycol than in glycerol, such as tartaric acid and malic acid (Example 8).

[0026] In an embodiment of the liquid composition for a liquid heating-type flavor inhaler, a mole ratio of (2) nicotine to (3) benzoic acid falls within a range of 1:0.9 to 1:0.1 or 1:0.7 to 1:0.15. In a preferable embodiment of the liquid composition for a liquid heating-type flavor inhaler, a mole ratio of (3) benzoic acid to (2) nicotine is 60% or less.

[0027] In an embodiment of the liquid composition for a liquid heating-type flavor inhaler, a mole ratio of (2) nicotine to (4) organic acids excluding benzoic acid falls within a range of 2:1 to 1:0.1 or 1:0.9 to 1:0.3. In an embodiment of the liquid composition for a liquid heating-type flavor inhaler, a mole ratio of (2) nicotine to (4) organic acids excluding benzoic

acid falls within a range of 1:0.9 to 1:0.3.

[0028] In a non-limiting manner, a ratio of propylene glycol to glycerol is 1:1 to 1:3, more preferably 1:1 to 1:2.5, and further preferably 1:about 2.4.

[0029] In an embodiment, the liquid composition for a liquid heating-type flavor inhaler has a water content of 10 weight% or less, 5 weight% or less, 3 weight% or less, or 1.5 weight% or less. In an embodiment, the liquid composition for a liquid heating-type flavor inhaler contains substantially no water. The expression of"...contains substantially no water" means that "water" is not added in the steps of preparing the liquid composition.

[0030] The liquid composition for a liquid heating-type flavor inhaler may further contain, in addition to components (1) to (4), other components for an aerosol source of the liquid heating-type flavor inhaler. In an embodiment, the liquid composition contains a flavor.

2. Method (I) of Preparing Liquid Composition for Liquid Heating-type Flavor Inhaler

[0031] The present invention relates to a method of preparing a liquid composition for a liquid heating-type flavor inhaler.

[0032] In an embodiment, a method of preparing a liquid composition for a liquid heating-type flavor inhaler includes steps of:

(i) preparing a solution (A) by dissolving nicotine and benzoic acid in propylene glycol;
(ii) preparing a solution (B) by dissolving lactic acid in glycerol;
(iii) preparing, as necessary, a solution (C) by dissolving one or more organic acids excluding benzoic acid and lactic acid in propylene glycol or glycerol; and
(iv) mixing solution (A), solution (B), and solution (C).

[0033] The matters concerning a liquid composition for a liquid heating-type flavor inhaler are as described in "1. Liquid Composition for Liquid Heating-type Flavor Inhaler."

[0034] Benzoic acid has properties of being less soluble in glycerol. Meanwhile, lactic acid has properties of relatively satisfactory solubility in glycerol and propylene glycol compared with benzoic acid and other organic acids. Among other organic acids, for example, there exist those having a higher dissolution rate in propylene glycol than in glycerol, such as tartaric acid and malic acid. The preparation method of the present invention includes: first dissolving nicotine and benzoic acid in propylene glycol (solution (A)) (step (i)); separately dissolving lactic acid in glycerol (solution (B)) (step (ii)); further dissolving, as necessary, one or more organic acids excluding benzoic acid and lactic acid in propylene glycol or glycerol (solution (C)) (step (iii)); and after dissolving the respective organic acids, mixing solution (A), solution (B), and solution (C). This procedure makes it possible to prepare efficiently in a short time even a liquid composition for a liquid heating-type flavor inhaler containing benzoic acid, which is less soluble in glycerol.

[0035] In an embodiment, when one or more organic acids excluding benzoic acid are acids readily soluble in glycerol and propylene glycol, such as lactic acid alone, for example, glycerol and such organic acids may be added directly to prepared solution (A) without preparing solution (B) separately from solution (A). In an embodiment, a method of preparing a liquid composition for a liquid heating-type flavor inhaler includes steps of:

(i) preparing a solution (A) by dissolving nicotine and benzoic acid in propylene glycol; and
(v) dissolving glycerol, lactic acid, and, as necessary, one or more organic acids excluding benzoic acid and lactic acid in solution (A).

[0036] In a non-limiting manner, the method of preparing a liquid composition for a liquid heating-type flavor inhaler further includes adding a flavor in a step after step (i). Through addition of a flavor after preparing solution (A) by dissolving nicotine and benzoic acid in propylene glycol in step (i), it is possible to shorten stirring time after the addition of a flavor, thereby preventing or reducing the loss of flavor components. The addition of components, such as a flavor, may be performed before, simultaneously with, or after step (iv) of mixing solution (A), solution (B), and solution (C) or step (v) of dissolving glycerol, lactic acid, and so forth in solution (A) provided that the addition is performed after step (i).

3. Liquid Heating-type Flavor Inhaler (I)

[0037] The present invention relates to a liquid heating-type flavor inhaler. The liquid heating-type flavor inhaler includes a liquid composition for a liquid heating-type flavor inhaler of the present invention.

[0038] The matters concerning a liquid composition for a liquid heating-type flavor inhaler as well as a liquid heating-type flavor inhaler are as described in "1. Liquid Composition for Liquid Heating-type Flavor Inhaler."

4. Method of Reducing Gunpowder-like Odor of Benzoic acid in Liquid Composition for Liquid Heating-type Flavor Inhaler

[0039] The present invention relates to a method of reducing a gunpowder-like odor of benzoic acid in a liquid composition for a liquid heating-type flavor inhaler.

[0040] The method of reducing a gunpowder-like odor of benzoic acid in a liquid composition for a liquid heating-type flavor inhaler,

where the liquid composition for a liquid heating-type flavor inhaler contains (1) propylene glycol and glycerol, (2) nicotine, and (3) benzoic acid,
includes further incorporating (4) one or more organic acids excluding benzoic acid into the liquid composition for a liquid heating-type flavor inhaler.

[0041] The method may include incorporating lactic acid as (4) one or more organic acids excluding benzoic acid.

[0042] In an embodiment of the method of reducing a gunpowder-like odor of benzoic acid in a liquid composition for a liquid heating-type flavor inhaler, the matters concerning a liquid composition for a liquid heating-type flavor inhaler as well as a heating-type flavor inhaler are as described in "1. Liquid Composition for Liquid Heating-type Flavor Inhaler."

[0043] In the method of reducing a gunpowder-like odor of benzoic acid in a liquid composition for a liquid heating-type flavor inhaler, it is important to incorporate (4) one or more organic acids excluding benzoic acid into the liquid composition for a liquid heating-type flavor inhaler. Here, the order of incorporating (1) propylene glycol and glycerol, (2) nicotine, (3) benzoic acid, and (4) one or more organic acids excluding benzoic acid into the liquid composition for a heating-type flavor inhaler is not particularly limited.

[0044] In an embodiment, a liquid composition for a liquid heating-type flavor inhaler may be prepared in accordance with the method described in "2. Method of Preparing Liquid Composition for Liquid Heating-type Flavor Inhaler." In an embodiment, a method of preparing a liquid composition for a liquid heating-type flavor inhaler includes steps of:

(i) preparing a solution (A) by dissolving nicotine and benzoic acid in propylene glycol;
(ii) preparing a solution (B) by dissolving lactic acid in glycerol;
(iii) preparing, as necessary, a solution (C) by dissolving one or more organic acids excluding benzoic acid and lactic acid in propylene glycol or glycerol; and
(iv) mixing solution (A), solution (B), and solution (C).

[0045] In an embodiment, a method of preparing a liquid composition for a liquid heating-type flavor inhaler includes steps of:

(i) preparing a solution (A) by dissolving nicotine and benzoic acid in propylene glycol; and
(v) dissolving glycerol, lactic acid, and, as necessary, one or more organic acids excluding benzoic acid and lactic acid in solution (A).

[0046] The expression of "reducing a gunpowder-like odor of benzoic acid" means that a weaker gunpowder-like odor of benzoic acid is sensed compared with a case in which (4) organic acids excluding benzoic acid are not contained. In a non-limiting embodiment, this means that the gunpowder-like odor of benzoic acid is reduced when benzoic acid odor is determined as "weak" at a significance level of 1% or a significance level of 5% in a χ^2 test (Pearson's χ^2 test) or a binomial test, for example.

5. Liquid Composition (II) for Liquid Heating-type Flavor Inhaler

[0047] The present invention relates to a liquid composition for a liquid heating-type flavor inhaler.

[0048] In an embodiment, a liquid composition for a liquid heating-type flavor inhaler contains

(1) propylene glycol and glycerol,
(2) nicotine, and
(4) one or more organic acids excluding benzoic acid.

[0049] The matters concerning "non-combustion flavor inhaler" are as described in "1. Liquid Composition (I) for Liquid Heating-type Flavor Inhaler."

[0050] As demonstrated in Example 6 of the present specification, a plurality of organic acids were found to exhibit effects of lowering smoke flavor inhibition caused by nicotine (nicotine impact) that are comparable to benzoic acid. Among the organic acids tested in this Example, lactic acid attained particularly strong effects. For this reason, a liquid

composition (II) for a liquid heating-type flavor inhaler is an embodiment (solely) containing, as organic acids, organic acids excluding benzoic acid without containing benzoic acid.

[0051] In an embodiment of the liquid composition for a liquid heating-type flavor inhaler, (2) nicotine and (4) one or more organic acids excluding benzoic acid are dissolved in solvents of propylene glycol and glycerol.

[0052] In an embodiment of the liquid composition for a liquid heating-type flavor inhaler, a mole ratio of (2) nicotine to (4) one or more organic acids excluding benzoic acid falls within a range of 3:0.1 to 0.1:3, 2:0.5 to 0.5:2, or 1:0.85 to 1:1.15. In a preferable embodiment, a mole ratio of (2) nicotine to (4) one or more organic acids excluding benzoic acid falls within a range of 1:0.85 to 1:1.15.

[0053] In an embodiment, the liquid composition for a liquid heating-type flavor inhaler contains (4) one or more organic acids excluding benzoic acid. Here, "organic acids" are a collective term for acids of organic compounds. The majority of organic acids are carboxylic acids having a carboxyl group or sulfonic acids having a sulfo group. The types of (4) organic acids excluding benzoic acid to be used for the liquid composition of the present invention are not particularly limited. The number of (4) organic acids excluding benzoic acid is also not particularly limited, and two or more (4) organic acids excluding benzoic acid may be contained. In a non-limiting embodiment, (4) organic acids excluding benzoic acid include lactic acid.

[0054] By adding, in addition to lactic acid, other organic acids as (4) organic acids excluding benzoic acid, it is possible to reduce slightly negative sensory elements attributed to lactic acid (slight acidic odor, slight oiliness). In a non-limiting embodiment, any one selected from tartaric acid, fumaric acid, levulinic acid, malonic acid, acetic acid, adipic acid, citric acid, malic acid, pyruvic acid, sorbic acid, and mixtures thereof may be contained in addition to lactic acid as (4) organic acids excluding benzoic acid.

[0055] In a non-limiting embodiment, organic acids excluding benzoic acid have solubility in glycerol of 0.32 mol/kg or more in molality.

[0056] The matters concerning "(4) organic acids excluding benzoic acid" are as described in "1. Liquid Composition for Liquid Heating-type Flavor Inhaler" unless otherwise mentioned particularly in this section.

[0057] In a non-limiting manner, a ratio of propylene glycol to glycerol is 1:1 to 1:3, more preferably 1:1 to 1:2.5, and further preferably 1:about 2.4.

[0058] In an embodiment, the liquid composition for a liquid heating-type flavor inhaler has a water content of 10 weight% or less, 5 weight% or less, 3 weight% or less, or 1.5 weight% or less. In an embodiment, the liquid composition for a liquid heating-type flavor inhaler contains substantially no water. The expression of"...contains substantially no water" means that "water" is not added in the steps of preparing the liquid composition.

[0059] The liquid composition for a liquid heating-type flavor inhaler may further contain, in addition to components (1), (2) and (4), other components for an aerosol source of the liquid heating-type flavor inhaler. In an embodiment, the liquid composition contains a flavor.

6. Method (II) of Preparing Liquid Composition for Liquid Heating-type Flavor Inhaler

[0060] The present invention relates to a method of preparing a liquid composition for a liquid heating-type flavor inhaler.

[0061] In an embodiment, a method of preparing a liquid composition for a liquid heating-type flavor inhaler includes steps of:

(i') preparing a solution (B) by dissolving lactic acid in glycerol;
(ii') preparing, as necessary, a solution (C) by dissolving one or more organic acids excluding benzoic acid and lactic acid in propylene glycol or glycerol; and
(iii') mixing nicotine, solution (B), and solution (C).

[0062] The matters concerning a liquid composition for a liquid heating-type flavor inhaler are as described in "5. Liquid Composition (II) for Liquid Heating-type Flavor Inhaler."

[0063] Lactic acid has properties of relatively satisfactory solubility in glycerol and propylene glycol compared with benzoic acid and other organic acids. Among other organic acids, for example, there exist those having a higher dissolution rate in propylene glycol than in glycerol, such as tartaric acid and malic acid. The preparation method of the present invention includes: first dissolving lactic acid in glycerol (solution (B)) (step (i'); further dissolving, as necessary, one or more organic acids excluding benzoic acid and lactic acid in propylene glycol or glycerol (solution (C)) (step (ii')); and after dissolving the respective organic acids, mixing nicotine, solution (B), and solution (C). Since benzoic acid is not used for a liquid composition (II) for a liquid heating-type flavor inhaler, the preparation method does not require a step of dissolving benzoic acid first in propylene glycol in the presence of nicotine. Nicotine may appropriately be mixed into, for example, after dissolving organic acids to be used in propylene glycol or glycerol.

[0064] In a non-limiting manner, the method of preparing a liquid composition for a liquid heating-type flavor inhaler further includes adding a flavor. The preparation method (II) does not include a relatively time-consuming step of dissolving

benzoic acid in propylene glycol. Accordingly, the timing of adding a flavor is not particularly limited and may be before, simultaneously with, or after step (i'), step (ii') or step (iii').

7. Liquid Heating-type Flavor Inhaler (II)

[0065] The present invention relates to a liquid heating-type flavor inhaler. The liquid heating-type flavor inhaler includes a liquid composition for a liquid heating-type flavor inhaler of the present invention.

[0066] The matters concerning a liquid composition for a liquid heating-type flavor inhaler as well as a liquid heating-type flavor inhaler are as described in "1. Liquid Composition (I) for Liquid Heating-type Flavor Inhaler" or "5. Liquid Composition (II) for Liquid Heating-type Flavor Inhaler."

EXAMPLES

[0067] Hereinafter, the present invention will be described in detail on the basis of working examples. However, the present invention is by no means limited to these examples. A person skilled in the art would easily modify or change the present invention on the basis of the description in the present specification, but such modifications or changes are encompassed in the technical scope of the present invention.

Example 1 Investigation for Reducing Benzoic acid Odor

1-1 Outline of Experiments

[0068] In this Example, reduction in the amount of benzoic acid to be used was investigated as an approach to reduced benzoic acid odor. Specifically, it was decided to inspect two approaches of 1) simply reducing the amount of benzoic acid to be used (resulting in mole not equal to nicotine) or 2) reducing benzoic acid while replacing by another organic acid to make up for the shortfall in acid. Moreover, the prerequisite for the development was to ensure the function in lowering smoke flavor inhibition caused by nicotine, which is expected as the intrinsic function of benzoic acid, at a level comparable to an equimolar mixture of benzoic acid and nicotine.

[0069] For selecting organic acids excluding benzoic acid in 2), the following two points were taken into account.

(i) common acids that are widely approved as food additives and preferably widely contained in food and that are of extremely low health concern
(ii) acids having satisfactory solubility in PG and GL

[0070] As acids satisfying these conditions, it was decided to employ two acids of acetic acid (AA) and citric acid (CA) for investigation. As for citric acid, experiments were conducted using citric acid monohydrate ($CA \cdot H_2O$), which is more common as a food additive, but not anhydrous citric acid.

1-2 Experimental Procedure

[0071] Each e -liquid (a liquid composition for a liquid heating-type flavor inhaler) having the composition shown in Table 1 was prepared, and a capsule for a liquid heating-type flavor inhaler that heats a liquid at 200°C to 300°C was filled with 1.5 mL of the e-liquid. Sensory evaluation was conducted by a panel of seven experts (a panel that is routinely engaged in flavor development and has high ability in sensory evaluation) using a device for a liquid heating-type flavor inhaler that heats a liquid at 200°C to 300°C.

[0072] As a comparative example, an e-liquid solely containing, as an acid, benzoic acid in mole equal to nicotine was used. Table 1 shows the composition of each sample e-liquid subjected to the sensory evaluation.

Table 1 Composition of E-liquids

[0073]

[Table 1]

Lot	Weight%							Mole ratio of Nic to organic acid(s)				
	PG	GL	Nic	AA	BA	$CA \cdot H_2O$	TA	Nic	AA	BA	CA	TA
Comp. Ex.	27.37	63.87	5.00	-	3.76	-	-	1.00	-	1.00	-	-

(continued)

Lot	Weight%							Mole ratio of Nic to organic acid(s)				
	PG	GL	Nic	AA	BA	CA·H_2O	TA	Nic	AA	BA	CA	TA
1-1	27.65	64.52	5.00	-	2.82	-	-	1.00	-	0.75	-	-
1-2	27.60	64.40	5.00	0.74	2.26	-	-	1.00	0.40	0.60	-	-
1-3	27.05	63.11	5.00	-	2.26	2.59	-	1.00	-	0.60	0.40	-

[0074] Table 2 shows comments obtained in the sensory evaluation.

Table 2 Comments in Sensory Evaluation

[0075]

[Table 2]

Lot	Main comment in sensory evaluation (selected comment made by several experts)	Number of experts who made the comment (among 7 experts)
Comp. Ex.	gunpowder-like smell	6
1-1	smoke flavor inhibition caused by nicotine stronger than Comp. Ex.	7
1-2	vinegar-like acidic smell (acetic acid odor)	5
	sour taste	3
1-3	gunpowder-like smell	4
	slightly acidic smell	3

1-3 Results and Discussion

[0076] As the results shown in Table 2, Lot 1-1, in which the amount of benzoic acid is merely simply reduced, exhibits evidently weak effects of lowering smoke flavor inhibition caused by nicotine without satisfying the prerequisite for the development and hence is unsuitable.

[0077] It was concluded that Lot 1-3 using citric acid exhibits weak effects of reducing benzoic acid odor and thus fails to exhibit the intended function in reducing benzoic acid odor satisfactorily.

[0078] Since no comments of "strong" were made by the experts concerning benzoic acid odor or smoke flavor inhibition caused by nicotine, it is possible that Lot 1-2 using acetic acid would attain the original object and satisfy the prerequisite for the development. Although a plurality of experts made comments on acetic acid odor and acidic taste, it may be rather possible to mask gunpowder odor originating from benzoic acid when a substance having a readily detectable smell, such as acetic acid odor, coexists with benzoic acid.

[0079] Here, acetic acid has the following advantages when the physical/chemical characteristics are compared with other organic acids, such as citric acid.

- due to its pKa, as an acidity indicator, close to benzoic acid (benzoic acid: 4.21, acetic acid: 4.76), it is possible that acetic acid would exhibit behavior close to benzoic acid in the neutralization reaction with nicotine.
- acetic acid has an advantage in production due to its extremely high solubility in PG and GL (dissolves in any proportion).
- the amount used is relatively small on a weight basis due to its small molecular weight.

[0080] By taking into account the foregoing comprehensively, acetic acid (AA) was selected as the most promising candidate for an organic acid that replaces benzoic acid and used for the subsequent investigation.

Example 2 Investigation of Range in which Acetic acid Acts to Reduce Benzoic acid Odor

2-1 Outline of Experiments

[0081] In this Example, the composition in which acetic acid exhibits effects of reducing benzoic acid odor was investigated. Specifically, each e-liquid of the composition containing both acetic acid and benzoic acid was prepared, and the effects were confirmed through sensory evaluation.

2-2 Experimental Procedure

[0082] Each e -liquid having the composition shown in Table 3 was prepared, and a capsule for a liquid heating-type flavor inhaler that heats a liquid at 200°C to 300°C was filled with 1.5 mL of the e-liquid. Sensory evaluation was conducted by a panel of 14 experts using a device for a liquid heating-type flavor inhaler that heats a liquid at 200°C to 300°C. As a comparative example, an e-liquid solely containing, as an acid, benzoic acid in mole equal to nicotine was used.

Table 3 Composition of E-liquids for Investigating Reduction in Amount of Benzoic acid

[0083]

[Table 3]

Lot	Weight%					Mole ratio of Nic to organic acid (s)		
	PG	GL	Nic	AA	BA	Nic	AA	BA
Comp. Ex.	27.37	63.87	5.00	0.00	3.76	1.00	-	1.00
2-1	27.43	64.00	5.00	0.19	3.39	1.00	0.10	0.90
2-2	27.49	64.13	5.00	0.37	3.01	1.00	0.20	0.80
2-3	27.54	64.27	5.00	0.56	2.63	1.00	0.30	0.70
2-4	27.60	64.40	5.00	0.74	2.26	1.00	0.40	0.60
2-5	27.66	64.53	5.00	0.93	1.88	1.00	0.50	0.50

[0084] According to the definition of each evaluation item in Table 4, the intensity of each sensory evaluation item was determined as "strong," "same," or "weak" for each lot relative to the Comparative Example.

Table 4 Sensory Evaluation Items and Definitions thereof

[0085]

[Table 4]

Sensory evaluation item	Definition
BA odor	gunpowder-like (smell after firing starting pistol for track and field races), burnt
Acetic acid odor	sour (vinegar-like acidic odor), acidic
Acidic taste	vinegar-like taste, sour

2-3 Results and Discussion

[0086] When any difference from the Comparative Example is not perceived, in other words, when acetic acid fails to act to reduce benzoic acid odor, it is expected that votes in the sensory evaluation would concentrate on "same" or the number of votes for three groups of "strong," "same," and "weak" would be distributed at N/3 = 4.67.

[0087] In this Example, a common χ^2 test (Pearson's χ^2 test) (reference: Muto, Shinsuke. Tokei Kaiseki Handbook, second printing on October 1, 1996, Asakura Publishing Co., Ltd.) was employed to confirm the existence of any difference from the Comparative Example produced by using acetic acid or the existence of any significant difference in the actual

number of votes relative to the expected value. When a probability value calculated in the χ^2 test does not exceed a set statistical significance level, it is determined that the panel is randomly dispersed among the items of "strong," "same," and "weak," in other words, no significant difference exists. This indicates that the panel intentionally chooses certain items to concentrate thereon rather than the panel has difficulty in determining differences among "strong," "same," and "weak" through evaluation. In this Example, a statistical significance level α was set to commonly employed 0.05 (significance level of 5%). When a value p calculated as a frequency of the distribution result of the panel is 0.05 or less, it is determined that the value exceeds the statistical significance level, in other words, is significant.

[0088] Tables 5, 7, 9, 11, and 13 (analysis results A) show results on whether the vote distribution for each lot is significantly deviated from the expected value. In analysis results A, the numerical values for "strong," "same," and "weak" in the respective evaluation items of "benzoic acid odor," "acetic acid odor," and "acidic taste" represent the number of experts who chose each rating (14 experts in total). The expected values are expected values when the number of votes is evenly distributed among three groups of "strong," "same," and "weak" at N/3 = 4.67. The probability (p) indicates the probability of such deviation for each evaluation item of "benzoic acid odor," "acetic acid odor," and "acidic taste." As the degree of deviation increases, the probability (p) decreases. The probability (p) of 0.05 or less means that the distribution of the panel experts is particularly concentrated on the corresponding item, in other words, the deviation is significant.

[0089] Further, when analysis results A demonstrate significantly deviated distribution, Tables 6, 8, 10, 12, and 14 (analysis results B) show the probability obtained by the χ^2 test, which indicates whether the number of votes is significantly concentrated among "strong," "same," and "weak" relative to the expected value. Each numerical value in these tables indicates the probability of the number of experts who would choose "strong," "same," and "weak" in each evaluation of "benzoic acid odor," "acetic acid odor," and "acidic taste." For example, the numerical value of "0.001" in "strong" for "acetic acid odor" in Table 6 represents the probability in the χ^2 test for the fact that 11 experts, among 14 experts of the panel, chose "strong" (from Table 5). The probability of 0.05 or less means that the distribution of the panel experts is particularly concentrated on the corresponding item, in other words, the choice is significant. Accordingly, the numerical value of "0.001" in "strong" for "acetic acid odor" in Table 6 is 0.05 or less and thus means that the choice made by 11 experts, among 14 experts of the panel, is significant.

[0090] Table 5 Lot 2-1 Analysis Results A

[Table 5]

Lot 2-1

	BA odor	Acetic acid odor	Acidic taste	Expected value
Strong	3	11	9	4.67
Same	3	2	4	4.67
Weak	8	1	1	4.67
Probability (p)	0.168	0.002	0.030	

[0091] Table 6 Lot 2-1 Analysis Results B

[Table 6]

Lot 2-1

	BA odor	Acetic acid odor	Acidic taste
Strong	0.160	0.001	0.013
Same	0.160	0.081	0.216
Weak	0.038	0.025	0.025

[0092] Table 7 Lot 2-2 Analysis Results A

[Table 7]

Lot 2-2

	BA odor	Acetic acid odor	Acidic taste	Expected value
Strong	5	10	11	4.67
Same	2	1	1	4.67
Weak	7	3	2	4.67
Probability (p)	0.257	0.008	0.002	

[0093] Table 8 Lot 2-2 Analysis Results B

[Table 8]

Lot 2-2

	BA odor	Acetic acid odor	Acidic taste
Strong	0.213	0.003	0.001
Same	0.081	0.025	0.025
Weak	0.089	0.160	0.081

[0094] Table 9 Lot 2-3 Analysis Results A

[Table 9]

Lot 2-3

	BA odor	Acetic acid odor	Acidic taste	Expected value
Strong	4	12	11	4.67
Same	1	2	3	4.67
Weak	9	0	0	4.67
Probability (p)	0.030	0.000	0.001	

[0095] Table 10 Lot 2-3 Analysis Results B

[Table 10]

Lot 2-3

	BA odor	Acetic acid odor	Acidic taste
Strong	0.216	0.000	0.001
Same	0.025	0.081	0.160
Weak	0.013	0.004	0.004

[0096] Table 11 Lot 2-4 Analysis Results A

[Table 11]

Lot 2-4

	BA odor	Acetic acid odor	Acidic taste	Expected value
Strong	3	12	13	4.67
Same	1	0	0	4.67
Weak	10	2	1	4.67
Probability (p)	0.008	0.000	0.000	

[0097] Table 12 Lot 2-4 Analysis Results B

[Table 12]

Lot 2-4

	BA odor	Acetic acid odor	Acidic taste
Strong	0.160	0.000	0.000
Same	0.025	0.004	0.004
Weak	0.003	0.081	0.025

[0098] Table 13 Lot 2-5 Analysis Results A

[Table 13]

Lot 2-5

	BA odor	Acetic acid odor	Acidic taste	Expected value
Strong	1	12	11	4.67
Same	1	1	2	4.67
Weak	12	1	1	4.67
Probability (p)	0.000	0.000	0.002	

[0099] Table 14 Lot 2-5 Analysis Results B

[Table 14]

Lot 2-5

	BA odor	Acetic acid odor	Acidic taste
Strong	0.025	0.000	0.001
Same	0.025	0.025	0.081
Weak	0.000	0.025	0.025

[0100] From the results in Tables 5 to 14, benzoic acid odor is considered as "weak" relative to the Comparative Example at a significance level of 5% for Lot 2-3, 2-4, and 2-5, in other words, in a mole ratio of acetic acid to benzoic acid within the range of 3:7 to 5:5 (i.e. 1:1). Consequently, it was confirmed that benzoic acid odor is effectively reduced through partial replacement of benzoic acid by acetic acid. Moreover, it is concluded that such effects are exhibited when 30% or more of benzoic acid in mole equal to nicotine is replaced by acetic acid.

[0101] Meanwhile, although natural since acetic acid is not contained in the Comparative Example, all the lots resulted in "strong" acetic acid odor and acidic taste relative to the Comparative Example at a significance level of 5%.

Example 3 Investigation of Reduction in Acetic acid Odor/Acidic Taste

3-1 Outline of Experiments

[0102] In Example 2, it was confirmed that benzoic acid odor is effectively reduced through partial replacement of benzoic acid by acetic acid. However, excessively strong acetic acid odor or acidic taste could interfere with the emission of a flavor in an e-liquid containing the flavor. In addition, it is also possible that acetic acid odor or acidic taste per se would be perceived as off-note or off-taste to damage acceptance of/preference for an e-liquid itself. This Example investigated the reduction of acetic acid odor and acidic taste as much as possible while retaining the function in reducing gunpowder odor of benzoic acid.

[0103] Specifically, to investigate to what extent the amount of acetic acid should be reduced to effectively reduce acetic acid odor/acidic taste, each e-liquid having the composition containing citric acid in addition to acetic acid and benzoic acid was prepared to confirm the effects through sensory evaluation. Here, e-liquids of this Example were added with a flavor to reproduce the state close to an embodiment that is actually used for a liquid heating-type flavor inhaler. However, to prevent acetic acid odor or benzoic acid odor itself from being masked with a scent from a flavor, a tobacco-type flavor that is empirically considered less likely to exhibit such effects was used. Accordingly, sensory evaluation concerning acetic acid odor, benzoic acid odor, and acidic taste in this Example was not affected by the flavor.

3-2 Experimental Procedure

[0104] Each e-liquid having the composition shown in Table 15 was prepared. On this occasion, citric acid monohydrate ($CA{\cdot}H_2O$) was dissolved in GL in advance to form solution C. Moreover, the flavor was added at the end after mixing solution A and solution B.

[0105] The preparation of evaluation samples and the sensory evaluation method are the same as in "2-2 Experimental Procedure" of Example 2, and sensory evaluation was conducted by the panel of 16 experts. As a comparative example, used was an e-liquid having the same organic acid composition as Lot 2-3, for which the effects of reducing benzoic acid odor had been confirmed in Example 2, in other words, having a mole ratio of acetic acid to benzoic acid of 3:7.

Table 15 Composition of E-liquids for Investigating Reduction in Acetic acid Odor/Acidic Taste

[0106]

[Table 15]

Lot	Weight%							Mole ratio of Nic to organic acids			
	PG	GL	Flavor	Nic	AA	BA	CA·H_2O	Nic	AA	BA	CA
Comp. Ex.	26.04	60.77	5.00	5.00	0.56	2.63	-	1.00	0.30	0.70	-
3-1	25.70	59.96	5.00	5.00	0.09	2.63	1.62	1.00	0.05	0.70	0.25
3-2	25.77	60.12	5.00	5.00	0.19	2.63	1.30	1.00	0.10	0.70	0.20
3-3	25.83	60.28	5.00	5.00	0.28	2.63	0.97	1.00	0.15	0.70	0.15
3-4	25.90	60.44	5.00	5.00	0.37	2.63	0.65	1.00	0.20	0.70	0.10
3-5	25.97	60.61	5.00	5.00	0.46	2.63	0.32	1.00	0.25	0.70	0.05

3-3 Results and Discussion

[0107] Analysis was conducted using the statistical method by a χ^2 test the same as in "2-3 Results and Discussion" of Example 2.

Analysis results A: analysis whether the vote distribution for each lot is significantly deviated from the expected value (analysis on significance in deviation)
Analysis results B: analysis on significance in each rating (the number of votes) for each item

[0108] Analysis results A are shown in Tables 16, 18, 20, 22, and 24, and analysis results B are shown in Tables 17, 19, 21, 23, and 25.

[0109] Table 16 Analysis Results A for Lot 3-1

[Table 16]

Lot 3-1

	BA odor	Acetic acid odor	Acidic taste	Expected value
Strong	4	3	4	5.33
Same	6	2	2	5.33
Weak	6	11	10	5.33
Probability (p)	0.779	0.010	0.039	

[0110] Table 17 Analysis Results B for Lot 3-1

[Table 17]

Lot 3-1

	BA odor	Acetic acid odor	Acidic taste
Strong	0.177	0.110	0.177
Same	0.189	0.048	0.048
Weak	0.189	0.003	0.011

[0111] Table 18 Analysis Results A for Lot 3-2

[Table 18]

Lot 3-2

	BA odor	Acetic acid odor	Acidic taste	Expected value
Strong	7	2	1	5.33
Same	3	4	5	5.33
Weak	6	10	10	5.33
Probability (p)	0.444	0.039	0.022	

[0112] Table 19 Analysis Results B for Lot 3-2

[Table 19]

Lot 3-2

	BA odor	Acetic acid odor	Acidic taste
Strong	0.133	0.048	0.013
Same	0.110	0.177	0.209
Weak	0.189	0.011	0.011

Table 20 Analysis Results A for Lot 3-3

[0113]

[Table 20]

Lot 3-3				
	BA odor	Acetic acid odor	Acidic taste	Expected value
Strong	4	5	5	5.33
Same	5	3	3	5.33
Weak	7	8	8	5.33
Probability (p)	0.646	0.305	0.305	

Table 21 Analysis Results B for Lot 3-3

[0114]

[Table 21]

Lot 3-3			
	BA odor	Acetic acid odor	Acidic taste
Strong	0.177	0.209	0.209
Same	0.209	0.110	0.110
Weak	0.133	0.074	0.074

Table 22 Analysis Results A for Lot 3-4

[0115]

[Table 22]

Lot 3-4				
	BA odor	Acetic acid odor	Acidic taste	Expected value
Strong	6	7	7	5.33
Same	3	1	1	5.33
Weak	7	8	8	5.33
Probability (p)	0.444	0.068	0.068	

Table 23 Analysis Results B for Lot 3-4

[0116]

[Table 23]

Lot 3-4			
	BA odor	Acetic acid odor	Acidic taste
Strong	0.189	0.133	0.133
Same	0.110	0.013	0.013
Weak	0.133	0.074	0.074

Table 24 Analysis Results A for Lot 3-5

[0117]

[Table 24]

Lot 3-5				
	BA odor	Acetic acid odor	Acidic taste	Expected value
Strong	7	5	3	5.33
Same	5	2	4	5.33
Weak	4	9	9	5.33
Probability (p)	0.646	0.099	0.144	

Table 25 Analysis Results B for Lot 3-5

[0118]

[Table 25]

Lot 3-5			
	BA odor	Acetic acid odor	Acidic taste
Strong	0.133	0.209	0.110
Same	0.209	0.048	0.177
Weak	0.177	0.032	0.032

[0119] First, no significant difference, from the Comparative Example, in the intensity of benzoic acid odor was recognized for all the lots. Accordingly, it is concluded that the function in reducing benzoic acid odor can be ensured even if acetic acid is partially replaced by equimolar citric acid monohydrate.

[0120] It is then considered from the results of lots 3-1 and 3-2 that acetic acid odor and acidic taste are "weak" relative to the Comparative Example at a significance level of 5% when a mole ratio of acetic acid, benzoic acid, and citric acid falls within the range of 0.05:0.70:0.25 to 0.10:0.70:0.20. Consequently, it was confirmed that partial replacement of acetic acid by citric acid effectively reduces acetic acid odor and acidic taste. Moreover, it is concluded that such effects are exhibited when a mole ratio of acetic acid falls within a certain range, for example, a mole ratio of acetic acid to nicotine within the range of 1/10 or less and a mole ratio of acetic acid to benzoic acid within the range of 1/7 or less.

Example 4 Investigation of Mixing Procedure in Method of Preparing E-liquids

4-1 Outline of Experiments

[0121] Benzoic acid is a relatively hydrophobic substance with low solubility in water. Main solvents of an e-liquid are PG and GL. However, the solubility of benzoic acid in these solvents is not so high. Consequently, prolonged stirring or heating is often required for dissolving benzoic acid alone in these solvents.

[0122] To resolve these problems and invent further efficient methods of preparing e-liquids, the present inventors

focused on the facts that benzoic acid neutralized with nicotine or in the state of nicotine benzoic acid salt exhibits enhanced hydrophilicity and that PG would be a more suitable solvent for dissolving a hydrophobic substance than GL in comparison of structures between PG having two hydrophilic hydroxy groups and GL having three such groups. Specifically in this Example, the inventors made hypothesis based on the above consideration that two conditions for efficiently dissolving benzoic acid are (a) dissolving benzoic acid in a solvent in the presence of nicotine and (b) dissolving in PG alone, followed by investigation of mixing procedures in methods of preparing e-liquids.

4-2 Experimental Procedure

[0123] E-liquids of the composition shown in Table 26 were prepared through two mixing procedures of I and II below to compare the time required for completely dissolving benzoic acid.

Table 26 Composition of E-liquids for Mixing Tests

[0124]

[Table 26]

Solvent	Nic:BA mole ratio	Weight%			
		PG	GL	Nic	BA
PG:GL = 3:7 (weight ratio)	1:1	27.37	63.87	5.00	3.76

I. A procedure including feeding all of PG, GL, nicotine, and benzoic acid first and then stirring/mixing at room temperature

II. A procedure including feeding only PG, nicotine, and benzoic acid, stirring/mixing at room temperature, adding GL (solution B) after confirming complete dissolution of benzoic acid (solution A), and stirring/mixing at room temperature again

[0125] Each weighed raw material was fed into a beaker and stirred at 1000 rpm using a stir bar within the beaker and a magnetic stirrer. After the end of stirring, the presence or absence of dissolution residue was observed through visual inspection.

4-3 Results and Discussion

[0126] In the case of procedure I, benzoic acid powder was observed even after stirring for 6 hours or more without complete dissolution.

[0127] Meanwhile, in the case of procedure II, benzoic acid powder disappeared 30 minutes after starting the first stirring of only PG, nicotine, and benzoic acid to confirm the complete dissolution. Subsequently, the resulting solution was added with GL, stirred again, and observed as a uniform liquid after 10 minutes.

[0128] From these results, it was confirmed possible to dissolve benzoic acid in a short time even under room temperature conditions through mixing procedure II, in which GL is added after completely dissolving benzoic acid in the presence of only PG and nicotine.

Example 5 Investigation on Use of Acids Excluding Acetic acid and Benzoic acid

5-1 Outline of Experiments

[0129] It is considered that when preparing e-liquids using organic acids (third organic acids) excluding benzoic acid and acetic acid (citric acid in Example 3), such organic acids fed to PG (solution A) together with nicotine and benzoic acid compete for the neutralization reaction between benzoic acid and nicotine and thus impede dissolution of benzoic acid. Accordingly, such organic acids excluding benzoic acid and acetic acid are presumably suitable for dissolving in GL solvent in advance separately from solution A. Alternatively, it is presumed that when such organic acids are liquid organic acids with high solubility in PG and GL, such as acetic acid, the organic acids may be fed into the system (solution A) directly without dissolving in GL in advance.

[0130] Although citric acid was used in Example 3 as an organic acid (third organic acid) excluding benzoic acid and acetic acid, any acid may be used in place of citric acid provided that a required amount of the acid can be dissolved in

GL completely. Conditions for a possible embodiment of a case in which a third organic acid reaches the highest concentration when dissolved in GL in advance within the scope of the present invention are as follows.

- the amount of nicotine to be added is 5 weight%
- the amount of a flavor to be added is 5 weight%
- a weight ratio of PG:GL as solvents is 50:50
- one third organic acid is used
- a mole ratio of nicotine: acetic acid: benzoic acid: third organic acid is 1.00:0.05:0.50:0.45

[0131] Candidates for those usable as third organic acids would be organic acids that have been approved as food additives as mentioned in 1-1 of Example 1 and that are expected to have moderate solubility in PG and GL (= those having a high proportion of polar functional group(s) within a molecule). For example, long-chain fatty acids, such as stearic acid and palmitic acid, exhibit evidently high hydrophobicity and hence are considered unsuitable due to low solubility in PG and GL. Meanwhile, organic acids having a short carbon chain or a plurality of polar functional groups are expected to have satisfactory solubility in PG and GL and thus can be candidate substances. Such examples include adipic acid, citric acid, fumaric acid, lactic acid, malic acid, malonic acid, pyruvic acid, sorbic acid, succinic acid, and tartaric acid. This Example investigated whether these organic acids as candidates for third organic acids can be used under the above-described conditions.

5-2 Experimental Procedure

[0132] The composition of e-liquids under the above-described conditions was simulated, and the molality of each third organic acid was calculated for the simulated composition on the premise that the third organic acid is dissolved only in the formulation amount of GL in advance. The results are shown in Table 27.

Table 27 Results of Simulated Composition of E-liquids for Third Organic acid Candidates

[0133]

[Table 27]

Third organic acid	Weight%							Molality [mol/kg] when third organic acid is dissolved in GL in advance for complete dissolution
	PG	GL	Flavor	Nic	AA	BA	Third organic acid	
Citric acid monohydrate	42.56	42.56	5.00	5.00	0.09	1.88	2.91	0.326
Lactic acid	43.39	43.39	5.00	5.00	0.09	1.88	1.25	0.320
Malic acid	43.08	43.08	5.00	5.00	0.09	1.88	1.86	0.322
Malonic acid	43.29	43.29	5.00	5.00	0.09	1.88	1.44	0.320
Pyruvic acid	43.40	43.40	5.00	5.00	0.09	1.88	1.22	0.320
Tartaric acid	42.97	42.97	5.00	5.00	0.09	1.88	2.08	0.323

[0134] As understood from the simulated composition shown in Table 27, "solubility in GL of 0.32 mol/kg or more in molality" would be a guide to selecting third organic acids that can realize the composition of an e-liquid as well as a mixing method therefor anticipated within the scope of the present invention.

[0135] Next, to verify whether such composition can actually be realized by the mixing methods of the present invention, solubility tests in GL were conducted. GL and each acid in the amounts shown in Table 28 were weighed into a beaker and stirred using a stir bar within the beaker and a magnetic stirrer at 500 rpm and room temperature for 12 hours. After the end of stirring, the presence or absence of dissolution residue was observed through visual inspection, and a solution with observed solid residue was determined as undissolved.

Table 28 Results and Levels of Observed Solubility in GL for Third Organic Acid Candidates

[0136]

[Table 28]

Third organic acid	Weight%		Molality [mol/kg] of organic acid in complete dissolution	Observation of complete dissolution	MW
	GL	Third organic acid			
Citric acid monohydrate	93.50	6.50	0.331	observed	210.14
Lactic acid	97.20	2.80	0.320	observed	90.08
Malic acid	95.80	4.20	0.327	observed	134.09
Malonic acid	96.70	3.30	0.328	observed	104.06
Pyruvic acid	97.20	2.80	0.327	observed	88.06
Tartaric acid	95.30	4.70	0.329	observed	150.09

5-3 Results and Discussion

[0137] Six organic acids of citric acid, lactic acid, malic acid, malonic acid, pyruvic acid, and tartaric acid exhibited solubility in GL of 0.32 mol/kg or more. In other words, it was revealed that these organic acids can be used for an e-liquid of the present invention even in an embodiment in which such a third organic acid is used at the highest concentration anticipated within the scope of the present invention.

Example 6 Effects of Lowering Smoke Flavor Inhibition caused by Nicotine by Each Organic Acid Alone

[0138] This Example investigated the effects of lowering smoke flavor inhibition caused by nicotine (nicotine impact) by each organic acid alone.

[0139] Each e-liquid (a liquid composition for a liquid heating-type flavor inhaler) having the composition shown in Table 29 was prepared, and a capsule for a liquid heating-type flavor inhaler that heats a liquid at 200°C to 300°C was filled with 1.5 mL of the e-liquid. Sensory evaluation was conducted by a panel of eight experts (a panel that is routinely engaged in flavor development and has high ability in sensory evaluation) using a device for a liquid heating-type flavor inhaler that heats a liquid at 200°C to 300°C.

[0140] As a negative comparative example, an e-liquid containing nicotine alone but not any organic acid was used. As a positive comparative example, an e-liquid containing, as an organic acid, benzoic acid in mole equal to nicotine was used. Table 29 shows the composition of each sample e-liquid subjected to sensory evaluation and the results of the sensory evaluation.

[0141] Table 29 Effects of Lowering Smoke Flavor Inhibition caused by Nicotine by Each Organic acid Alone (Sensory Evaluation)

[Table 29]

Lot	Organic acid used		E-liquid recipe [weight%]					Nic impact		Comment on taste or smell (selected comments made by several experts)
	Name	Molecular weight	PG	GL	Flavor	Nic	Organic acid*	Score**	Comment	
Negative CTL	none	-	27.00	63.00	5.00	5.00	0.00	10.0	-	-
Positive CTL	benzoic acid (BA)	122.1	25.87	60.37	5.00	5.00	3.76	5.0	-	gunpowder-like smell
1	acetic acid	60.05	26.44	61.70	5.00	5.00	1.85	5.3	comparable to BA to slightly stronger	strong acidic odor, strong acidic taste
2	adipic acid	146.1	25.65	59.85	5.00	5.00	4.50	6.3	stronger than BA	weak acidic taste, acidic odor
3	citric acid monohydrate	210.1	25.06	58.47	5.00	5.00	6.48	6.4	stronger than BA	weak acidic odor
4	fumaric acid (FA)	116.1	25.93	60.50	5.00	5.00	3.58	4.9	comparable to BA	weak acidic odor
5	lactic acid (LCA)	90.08	26.17	61.06	5.00	5.00	2.78	4.8	slightly weaker than to comparable to BA	weak acidic odor, slightly oily
6	levulinic acid (LVA)	116.1	25.93	60.49	5.00	5.00	3.58	5.6	slightly stronger than BA	weak acidic odor, slightly oily
7	malic acid	134.1	25.76	60.11	5.00	5.00	4.13	4.9	comparable to BA	weak acidic odor
8	malonic acid (MA)	104.1	26.04	60.75	5.00	5.00	3.21	5.3	comparable to BA to slightly stronger	weak acidic taste, acidic odor
9	pyruvic acid	88.06	26.19	61.10	5.00	5.00	2.71	6.1	stronger than BA	strong acidic odor
10	sorbic acid	112.1	25.96	60.58	5.00	5.00	3.46	5.3	comparable to BA to slightly stronger	weak acidic taste, acidic odor, strong off-odor
11	tartaric acid (TA)	150.1	25.61	59.76	5.00	5.00	4.63	5.0	comparable to BA	absence of any particular negative element

* in mole equal to Nic (molecular weight of 162.23)
** relative score when N-CTL is fixed to 10 and P-CTL to 5, average of n = 8

[0142] Sensory evaluation items are as follows.

Table 30 Sensory Evaluation Items

[0143]

[Table 30]

Item	Definition
Nic impact	choking sensation in throat, irritation to throat, impact
Gunpowder odor	gunpowder-like (smell after firing starting pistol for track and field races), medicinal, burnt
Acidic odor	sour (vinegar-like acidic odor), acidic
Acidic taste	vinegar-like taste, sour
Flavor intensity	overall intensity of scent from flavor

[0144] As shown in Table 29, concerning the effects of lowering smoke flavor inhibition caused by nicotine (nicotine impact), a plurality of organic acids were found to exhibit such lowering effects comparable to benzoic acid. Among the organic acids tested in this Example, lactic acid attained particularly strong effects. Lactic acid, which is liquid and exhibits satisfactory solubility in PG and GL, has a great advantage of easy handling in production. Meanwhile, slightly negative sensory elements (slight acidic odor, slight oiliness) were perceived for lactic acid. Accordingly, it is considered further desirable to combine lactic acid with other organic acids.

[0145] Example 7 Investigation of Liquid Compositions Containing Benzoic acid, Lactic acid, and Other Organic acids

[0146] The present Example investigated the composition for liquid compositions containing benzoic acid, lactic acid, and other organic acids.

[0147] A ratio of benzoic acid to nicotine was set to 0.6 or less.

[0148] Tartaric acid, fumaric acid, levulinic acid, and malonic acid, which lack strong negative elements and exhibit strong effects of lowering nicotine impact in Example 6, were investigated as candidates for combining with lactic acid. A ratio of lactic acid to organic acids excluding benzoic acid and lactic acid was set to 3:1. As a comparative example, an e-liquid of the composition containing benzoic acid alone but neither lactic acid nor other organic acids was used.

[0149] Table 31 shows the composition of each sample e-liquid subjected to sensory evaluation and the results of the sensory evaluation (by a panel of 14 experts).

[0150]

Table 31 Lowering Effects by Combinations of Benzoic acid, Lactic acid, and Other Organic acids (Sensory Evaluation)

[Table 31]

Marketing candidate	Sample	E-liquid recipe (weight%)										Mole ratio of Nic to organic acids						
		PG	GL	Flavor	Nic	BA	LCA	FA	LVA	MA	TA	Nic	BA	LCA	FA	LVA	MA	TA
	(Ref)	25.87	60.37	5.00	5.00	3.76	-	-	-	-	-	1.00	1.00	-	-	-	-	-
Second promising	FA 0.10	25.97	60.59	5.00	5.00	2.26	0.83	0.36	-	-	-	1.00	0.60	0.30	0.10	-	-	-
	FA 0.15	26.01	60.70	5.00	5.00	1.51	1.25	0.54	-	-	-	1.00	0.40	0.45	0.15	-	-	-
	FA 0.20	26.06	60.81	5.00	5.00	0.75	1.67	0.72	-	-	-	1.00	0.20	0.60	0.20	-	-	-
Second promising	LVA 0.10	25.97	60.59	5.00	5.00	2.26	0.83	-	0.36	-	-	1.00	0.60	0.30	-	0.10	-	-
	LVA 0.15	26.01	60.70	5.00	5.00	1.51	1.25	-	0.54	-	-	1.00	0.40	0.45	-	0.15	-	-
	LVA 0.20	26.06	60.81	5.00	5.00	0.75	1.67	-	0.72	-	-	1.00	0.20	0.60	-	0.20	-	-
	MA 0.10	25.98	60.61	5.00	5.00	2.26	0.83	-	-	0.32	-	1.00	0.60	0.30	-	-	0.10	-
	MA 0.15	26.03	60.73	5.00	5.00	1.51	1.25	-	-	0.48	-	1.00	0.40	0.45	-	-	0.15	-
	MA 0.20	26.08	60.86	5.00	5.00	0.75	1.67	-	-	0.64	-	1.00	0.20	0.60	-	-	0.20	-
Most promising	TA 0.10	25.93	60.51	5.00	5.00	2.26	0.83	-	-	-	0.46	1.00	0.60	0.30	-	-	-	0.10
	TA 0.15	25.97	60.59	5.00	5.00	1.51	1.25	-	-	-	0.69	1.00	0.40	0.45	-	-	-	0.15
	TA 0.20	26.00	60.66	5.00	5.00	0.75	1.67	-	-	-	0.93	1.00	0.20	0.60	-	-	-	0.20

Sample	Sensory evaluation results (relative comparison to Ref)				
	Nic impact	Gunpowder odor	Acidic odor	Acidic taste	Flavor intensity
(Ref)					
FA 0.10	weak*	weak**	comparable	comparable	strong*
FA 0.15	weak**	weak*	comparable	strong*	comparable
FA 0.20	comparable	weak*	comparable	strong*	comparable
LVA 0.10	comparable	weak*	comparable	comparable	comparable
LVA 0.15	weak*	weak*	comparable	comparable	weak*
LVA 0.20	comparable	comparable	comparable	strong*	comparable
MA 0.10	weak**	weak**	strong**	strong**	weak*
MA 0.15	comparable	weak**	strong**	strong*	weak**
MA 0.20	comparable	weak**	strong**	strong**	comparable
TA 0.10	comparable	comparable	comparable	strong*	comparable
TA 0.15	comparable	weak**	strong*	strong**	comparable
TA 0.20	comparable	weak**	strong*	strong*	weak**

*: 5% significance
**: 1% significance

[0151] The results of the sensory evaluation in Table 31 analyzed by a binomial test are shown.

[0152] Table 32 Results of Lowering Effects by Combinations of Benzoic acid, Lactic acid, and Other Organic acids (Sensory Evaluation) Analyzed by Binomial Test

[Table 32]

Sample	Number of votes for "strong"					p value for number of votes for "strong"				
	Nic impact	Gunpowder odor	Acidic odor	Acidic taste	Flavor intensity	Nic impact	Gunpowder odor	Acidic odor	Acidic taste	Flavor intensity
FA 0.10	4	3	6	7	10	0.910	0.971	0.605	0.395	0.029
FA 0.15	3	4	9	10	9	0.971	0.910	0.090	0.029	0.090
FA 0.20	6	4	8	10	5	0.605	0.910	0.212	0.029	0.788
LVA 0.10	7	4	7	9	6	0.395	0.910	0.395	0.090	0.605
LVA 0.15	4	4	9	9	4	0.910	0.910	0.090	0.090	0.910
LVA 0.20	6	6	8	10	7	0.605	0.605	0.212	0.029	0.395
MA 0.10	3	3	13	13	4	0.971	0.971	0.000	0.000	0.910
MA 0.15	5	1	12	10	3	0.788	0.999	0.001	0.029	0.971
MA 0.20	6	2	12	12	5	0.605	0.994	0.001	0.001	0.788
TA 0.10	5	5	8	10	6	0.788	0.788	0.212	0.029	0.605
TA 0.15	5	3	10	11	6	0.788	0.971	0.029	0.006	0.605
TA 0.20	6	2	10	10	3	0.605	0.994	0.029	0.029	0.971

Sample	Number of votes for "weak"					p value for number of votes for "weak"				
	Nic impact	Gunpowder odor	Acidic odor	Acidic taste	Flavor intensity	Nic impact	Gunpowder odor	Acidic odor	Acidic taste	Flavor intensity
FA 0.10	10	11	8	7	4	0.029	0.006	0.212	0.395	0.910
FA 0.15	11	10	5	4	5	0.006	0.029	0.788	0.910	0.788
FA 0.20	8	10	6	4	9	0.212	0.029	0.605	0.910	0.090
LVA 0.10	7	10	7	5	8	0.395	0.029	0.395	0.788	0.212
LVA 0.15	10	10	5	5	10	0.029	0.029	0.788	0.788	0.029
LVA 0.20	8	8	6	4	7	0.212	0.212	0.605	0.910	0.395
MA 0.10	11	11	1	1	10	0.006	0.006	0.999	0.999	0.029
MA 0.15	9	13	2	4	11	0.090	0.000	0.994	0.910	0.006
MA 0.20	8	12	2	2	9	0.212	0.001	0.994	0.994	0.090
TA 0.10	9	9	6	4	8	0.090	0.090	0.605	0.910	0.212
TA 0.15	9	11	4	3	8	0.090	0.006	0.910	0.971	0.212
TA 0.20	8	12	4	4	11	0.212	0.001	0.910	0.910	0.006

[0153] Concerning a binomial test, the p value for the number of votes for "strong" or "weak" indicates a statistical probability of the number of times in which "strong" was chosen to occur relative to the total number n. For example, gunpowder odor (benzoic acid odor) of sample FA 0.10 will be described. When the number of times in which "weak" was chosen is 11 out of n = 14, the p value is 0.006, in other words, 0.6%. This means that when "strong" and "weak" are randomly chosen 14 times at a probability of 50% each, the statistical probability of a pattern in which "weak" is coincidentally chosen 11 times is 0.6%. This value of 0.6% is smaller than a typical significance level of 1%, and hence it is concluded that the deviation in which "weak" was chosen 11 times out of 14 times is meaningful deviation at a

significance level of 1%.

[0154] All the lots in which lactic acid was combined with fumaric acid, levulinic acid, malonic acid, or tartaric acid in various proportions resulted in nicotine impact comparable to or weaker than the comparative example (Ref). Accordingly, it was confirmed that the effects of lowering nicotine impact are ensured even if benzoic acid is partially replaced by the combinations of lactic acid and other organic acids. Moreover, all the lots resulted in gunpowder odor weaker than the comparative example (the number of votes for "weak" is larger even in a lot without significant difference). Consequently, it was confirmed that gunpowder odor can be reduced, compared with the composition containing benzoic acid alone as an organic acid, through partial replacement of benzoic acid by the combinations of lactic acid and other organic acids.

Example 8 Solubility of Malic acid and Tartaric acid in Propylene glycol and Glycerol

[0155] In this Example, the dissolution rate of malic acid and tartaric acid in propylene glycol and glycerol was examined by (1) weighing an organic acid and PG or GL into a glass screw tube; (2) continuing stirring at room temperature and a stirring rate of 500 rpm using a magnetic stirrer; and (3) visually observing whether the organic acid has dissolved completely. The results are shown in Table 33.

Table 33 Test Results for Dissolution Rate of Malic acid and Tartaric acid in Propylene glycol and Glycerol

[Table 33]

Acid	Target acid concentration	Dilution solvent	Weight (g)			Stirring time (min)										
			Acid	PG	GL	30	60	90	120	180	240	300	360	420	480	1440
Malic acid	10%	PG	2.0	18.0	-	NG	OK	-	-	-	-	-	-	-	-	-
	20%		4.0	16.0	-	NG	NG	OK	-	-	-	-	-	-	-	-
	10%	GL	2.0	-	18.0	NG	NG	NG	NG	NG	NG	NG	NG	OK	-	-
	20%		4.0	-	16.0	NG	NG	NG	NG	NG	NG	NG	NG	NG	OK	-
Tartaric acid	10%	PG	2.0	18.0	-	NG	NG	NG	NG	NG	OK	-	-	-	-	-
	20%		4.0	16.0	-	NG	NG	NG	NG	NG	NG	NG	NG	NG	OK	-
	10%	GL	2.0	-	18.0	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	OK
	20%		4.0	-	16.0	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG

OK : complete dissolution confirmed without visible solids
NG : determined as still undissolved with remaining solids

[0156] In Table 33, "OK" represents those for which complete dissolution was confirmed without visible solids, and "NG" represents those determined as still undissolved with remaining solids. Both malic acid and tartaric acid had a faster dissolution rate in propylene glycol than in glycerol.

Claims

1. A liquid composition for a liquid heating-type flavor inhaler, comprising

   (1) propylene glycol and glycerol,
   (2) nicotine,
   (3) benzoic acid, and
   (4) one or more organic acids excluding benzoic acid.

2. The liquid composition according to Claim 1, wherein a mole ratio of (2) nicotine to the total of (3) benzoic acid and (4) one or more organic acids excluding benzoic acid falls within a range of 1:0.85 to 1:1.15.

3. The liquid composition according to Claim 1 or 2 comprising lactic acid as (4) one or more organic acids excluding benzoic acid.

4. The liquid composition according to Claim 3 comprising, in addition to lactic acid, any one selected from tartaric acid, fumaric acid, levulinic acid, malonic acid, acetic acid, adipic acid, citric acid, malic acid, pyruvic acid, sorbic acid, and mixtures thereof as (4) one or more organic acids excluding benzoic acid.

5. The liquid composition according to Claim 3 comprising, in addition to lactic acid, any one selected from tartaric acid, fumaric acid, levulinic acid, malonic acid, and mixtures thereof as (4) one or more organic acids excluding benzoic acid.

6. The liquid composition according to Claim 3 comprising, in addition to lactic acid, tartaric acid as (4) one or more organic acids excluding benzoic acid.

7. The liquid composition according to any one of Claims 1 to 6, wherein a mole ratio of (2) nicotine to (3) benzoic acid falls within a range of 1:0.7 to 1:0.15.

8. The liquid composition according to any one of Claims 1 to 7, wherein a mole ratio of (2) nicotine to (4) one or more organic acids excluding benzoic acid falls within a range of 1:0.9 to 1:0.3.

9. The liquid composition according to any one of Claims 1 to 8, wherein (4) one or more organic acids excluding benzoic acid have solubility in glycerol of 0.32 mol/kg or more in molality.

10. The liquid composition according to any one of Claims 1 to 9 comprising substantially no water.

11. The composition according to any one of Claims 1 to 10 further comprising a flavor.

12. A method of preparing a liquid composition for a liquid heating-type flavor inhaler, comprising steps of:

(i) preparing a solution (A) by dissolving nicotine and benzoic acid in propylene glycol;
(ii) preparing a solution (B) by dissolving lactic acid in glycerol;
(iii) preparing, as necessary, a solution (C) by dissolving one or more organic acids excluding benzoic acid and lactic acid in propylene glycol or glycerol; and
(iv) mixing solution (A), solution (B), and solution (C).

13. A method of preparing a liquid composition for a liquid heating-type flavor inhaler, comprising steps of:

(i) preparing a solution (A) by dissolving nicotine and benzoic acid in propylene glycol; and
(v) dissolving glycerol, lactic acid, and, as necessary, one or more organic acids excluding benzoic acid and lactic acid in solution (A).

14. The method according to Claim 12 or 13 further comprising adding a flavor in a step after step (i).

15. A liquid heating-type flavor inhaler comprising the liquid composition according to any one of Claims 1 to 14.

16. A method of reducing a gunpowder-like odor of benzoic acid in a liquid composition for a heating-type flavor inhaler,

wherein the liquid composition for a heating-type flavor inhaler comprises (1) propylene glycol and glycerol, (2) nicotine, and (3) benzoic acid,
the method comprising further incorporating (4) one or more organic acids excluding benzoic acid into the liquid composition for a heating-type flavor inhaler.

17. The method according to Claim 16 comprising incorporating lactic acid as (4) one or more organic acids excluding benzoic acid.

18. The method according to Claim 17 comprising incorporating, in addition to lactic acid, any one selected from tartaric acid, fumaric acid, levulinic acid, malonic acid, acetic acid, adipic acid, citric acid, malic acid, pyruvic acid, sorbic acid, and mixtures thereof as (4) one or more organic acids excluding benzoic acid.

19. A liquid composition for a liquid heating-type flavor inhaler, comprising

(1) propylene glycol and glycerol,
(2) nicotine, and
(4) one or more organic acids excluding benzoic acid.

20. The liquid composition according to Claim 19, wherein a mole ratio of (2) nicotine to (4) one or more organic acids excluding benzoic acid falls within a range of 1:0.85 to 1:1.15.

21. The liquid composition according to Claim 19 or 20 comprising lactic acid as (4) one or more organic acids excluding

benzoic acid.

22. The liquid composition according to Claim 21 comprising, in addition to lactic acid, any one selected from tartaric acid, fumaric acid, levulinic acid, malonic acid, acetic acid, adipic acid, citric acid, malic acid, pyruvic acid, sorbic acid, and mixtures thereof as (4) one or more organic acids excluding benzoic acid.

23. The liquid composition according to any one of Claims 19 to 22, wherein (4) one or more organic acids excluding benzoic acid have solubility in glycerol of 0.32 mol/kg or more in molality.

24. A method of preparing a liquid composition for a liquid heating-type flavor inhaler, comprising steps of:

(i') preparing a solution (B) by dissolving lactic acid in glycerol;
(ii') preparing, as necessary, a solution (C) by dissolving one or more organic acids excluding benzoic acid and lactic acid in propylene glycol or glycerol; and
(iii') mixing nicotine, solution (B), and solution (C).

25. The method according to Claim 24 further comprising adding a flavor.

26. A liquid heating-type flavor inhaler comprising the liquid composition according to any one of Claims 19 to 25.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2021/000169

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. A24B15/16(2020.01)i, A24F40/10(2020.01)i
FI: A24B15/16, A24F40/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl. A24B15/16, A24F40/10

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

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2021
Registered utility model specifications of Japan	1996-2021
Published registered utility model applications of Japan	1994-2021

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2015/0313275 A1 (ALTRIA CLIENT SERVICES, INC.) 05 November 2015 (2015-11-05), paragraphs [0049]-[0189]	1-11, 15-23, 26
A		12-14, 24-25
A	JP 2017-536816 A (NICOVENTURES HOLDINGS LTD.) 14 December 2017 (2017-12-14), entire text, all drawings	1-26
A	JP 2016-539645 A (PAX LABS, INC.) 22 December 2016 (2016-12-22), entire text, all drawings	1-26
P, X	WO 2020/161798 A1 (JAPAN TOBACCO INC.) 13 August 2020 (2020-08-13), entire text, all drawings	1-26

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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Date of the actual completion of the international search	Date of mailing of the international search report
04 March 2021	16 March 2021

Name and mailing address of the ISA/	Authorized officer
Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2021/000169

US 2015/0313275 A1	05 November 2015	WO 2015/167629 A1 CN 106714589 A
JP 2017-536816 A	14 December 2017	US 2018/0279667 A1 entire text, all drawings EP 3214956 B1 KR 10-2017-0065639 A CN 107105756 A
JP 2016-539645 A	22 December 2016	US 2014/0345631 A1 entire text, all drawings EP 2993999 B1 CN 105263345 A KR 10-2016-0004298 A
WO 2020/161798 A1	13 August 2020	(Family: none)

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2018532377 W **[0003] [0006]**
- JP 2016520061 W **[0004] [0006]**