

DESCRIPTION

TITLE OF INVENTION: BEVERAGE CONTAINING 3-HYDROXYBUTYRIC
ACID AND LOWER ALIPHATIC ALCOHOL, AND METHOD FOR IMPROVING
5 TASTE

TECHNICAL FIELD

[0001]

The present invention relates to a beverage
10 containing 3-hydroxybutyric acid and a lower aliphatic
alcohol. The present invention also relates to, for
example, a method of improving the taste of a beverage
containing 3-hydroxybutyric acid and a lower aliphatic
alcohol.

15

BACKGROUND ART

[0002]

R-3-hydroxybutyric acid is a type of short-chain
fatty acid and is produced as an energy source when glucose
20 in the body is depleted during carbohydrate restriction or
intense exercise, for example. It has been reported that
R-3-hydroxybutyric acid has various physiological functions
in addition to the action as an energy source. Patent
Literature 1 discloses a collagenase MMP1 and MMP3
25 production inhibitor containing R-3-hydroxybutyric acid as
an active ingredient. Patent Literature 2 discloses a
tropoelastin expression promoter containing R-3-
hydroxybutyric acid as an active ingredient.

30

CITATION LIST

- Patent Literature

[0003]

Patent Literature 1: JP 2018-158897 A

Patent Literature 2: JP 2018-158898 A

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SUMMARY OF INVENTION

- Technical Problem

[0004]

3-Hydroxybutyric acid has useful physiological
5 actions as described above. Thus, beverages such as
functional beverages that contribute to maintaining and
improving health can be developed by, for example, adding
3-hydroxybutyric acid to beverages. However, as a result
of studies by the present inventors on beverages containing
10 3-hydroxybutyric acid, they found that there are cases
where the beverages containing 3-hydroxybutyric acid give a
3-hydroxybutyric acid-induced uncomfortable irritating
sensation (unpleasant irritating sensation) during
drinking. Specifically, such beverages gave a 3-
15 hydroxybutyric acid-induced strong irritating sensation
that remains in the throat and/or oral cavity and a 3-
hydroxybutyric acid-induced unpleasant odor. Thus, the
present inventors conducted studies to reduce the 3-
hydroxybutyric acid-induced irritating sensation. As a
20 result, they found that the irritating sensation can be
reduced (alleviated) by adding a lower aliphatic alcohol to
the beverages. At the same time, they found that when a
lower aliphatic alcohol is added to the beverages, there
are cases where the distinctive flavor of the lower
25 aliphatic alcohol remains in the aftertaste, unfortunately
causing a bad aftertaste.

[0005]

The present invention aims to provide a beverage
containing 3-hydroxybutyric acid and a lower aliphatic
30 alcohol in which the 3-hydroxybutyric acid-induced
uncomfortable irritating sensation and the lower aliphatic
alcohol-induced bad aftertaste are reduced. The present
invention also aims to provide a method of improving the
taste of a beverage containing 3-hydroxybutyric acid and a
35 lower aliphatic alcohol.

- Solution to Problem

[0006]

As a result of extensive studies to solve the above
5 problem regarding beverages containing 3-hydroxybutyric
acid and a lower aliphatic alcohol, the present inventors
found that when the lower aliphatic alcohol concentration
in the beverages is adjusted to a specific range, the 3-
hydroxybutyric acid-induced uncomfortable irritating
10 sensation during drinking can be reduced and the lower
aliphatic alcohol-induced bad aftertaste can also be
reduced.

[0007]

The present invention relates to, but is not limited
15 to, the following beverage and method of improving the
taste of a beverage.

(1) A beverage containing 3-hydroxybutyric acid and a
lower aliphatic alcohol, wherein a lower aliphatic alcohol
concentration is 0.001 v/v% or more and less than 0.375
20 v/v%.

(2) The beverage according to (1) above, wherein a 3-
hydroxybutyric acid concentration is 0.01 to 4.0 g/100 mL.

(3) The beverage according to (1) or (2) above
further containing a sweetener.

25 (4) The beverage according to (3) above, wherein the
sweetener is at least one selected from the group
consisting of sucralose, acesulfame potassium, aspartame,
sucrose, glucose, maltose, erythritol, xylitol, maltitol,
trehalose, and stevia.

30 (5) The beverage according to (3) or (4) above,
wherein a sweetener concentration in terms of sucrose is
less than 20 g/100 mL.

(6) The beverage according to any one of (1) to (5)
above, wherein the lower aliphatic alcohol is a C2-C5
35 aliphatic alcohol.

(7) The beverage according to any one of (1) to (6) above, wherein the lower aliphatic alcohol is at least one selected from the group consisting of ethanol, propylene glycol, 1-propanol, 2-propanol, 1-butanol, 2-butanol, 1-pentanol, 2-pentanol, 3-pentanol, and ethylene glycol.

(8) A method of improving the taste of a beverage containing 3-hydroxybutyric acid and a lower aliphatic alcohol, the method including adjusting a lower aliphatic alcohol concentration in the beverage containing 3-hydroxybutyric acid and a lower aliphatic alcohol to 0.001 v/v% or more and less than 0.375 v/v%.

(9) The method of improving the taste according to (8) above, wherein the improving the taste is reducing a 3-hydroxybutyric acid-induced uncomfortable irritating sensation and a lower aliphatic alcohol-induced bad aftertaste.

- Advantageous Effects of Invention [0008]

The present invention can provide a beverage containing 3-hydroxybutyric acid and a lower aliphatic alcohol in which the 3-hydroxybutyric acid-induced uncomfortable irritating sensation and the lower aliphatic alcohol-induced bad aftertaste are reduced. The present invention can also provide a method of improving the taste of a beverage containing 3-hydroxybutyric acid and a lower aliphatic alcohol.

DESCRIPTION OF EMBODIMENTS

[0009]

The beverage of the present invention contains 3-hydroxybutyric acid and a lower aliphatic alcohol and has a lower aliphatic alcohol concentration of 0.001 v/v% or more and less than 0.375 v/v%.

When the lower aliphatic alcohol concentration in the

beverage containing 3-hydroxybutyric acid is in the above range, the 3-hydroxybutyric acid-induced uncomfortable irritating sensation is reduced. When the lower aliphatic alcohol concentration is in the above range, the flavor
5 from the lower aliphatic alcohol is less likely to be imparted to the beverage containing 3-hydroxybutyric acid. This can reduce the 3-hydroxybutyric acid-induced uncomfortable irritating sensation and the lower aliphatic alcohol-induced bad aftertaste and can improve the taste of
10 the beverage containing 3-hydroxybutyric acid and a lower aliphatic alcohol.

In the present invention, regarding the reduction in the 3-hydroxybutyric acid-induced uncomfortable irritating sensation, it suffices as long as at least one of the
15 followings is reduced: the 3-hydroxybutyric acid-induced strong irritating sensation that remains in the throat and/or oral cavity; and the 3-hydroxybutyric acid-induced unpleasant odor.

[0010]

20 3-Hydroxybutyric acid is a type of short-chain fatty acid and is also referred to as " β -hydroxybutyric acid". In the present invention, the 3-hydroxybutyric acid may be in the R-form (R-3-hydroxybutyric acid), the S-form (S-3-hydroxybutyric acid), or a mixture of the R-form and the S-
25 form. Preferably, the 3-hydroxybutyric acid is R-3-hydroxybutyric acid. The 3-hydroxybutyric acid may be derived from any source and produced by any method. It may be a chemically synthesized product or may be a product produced by a fermentation method or an enzymatic method.
30 A commercial 3-hydroxybutyric acid is available, and a commercial product can also be used. The 3-hydroxybutyric acid may be added in the form of a salt thereof to a beverage. The salt is preferably one that can be used in food or beverages. Preferred examples include metal salts
35 such as sodium salt, potassium salt, magnesium salt, and

calcium salt, and basic amino acid salts such as arginine salt.

[0011]

Preferably, in the beverage of the present invention,
5 the 3-hydroxybutyric acid concentration is 0.01 to 4.0 g/100 mL. When the 3-hydroxybutyric acid concentration is in the above range, the above-described effect of the present invention can be more sufficiently exerted. When
10 the 3-hydroxybutyric acid concentration in the beverage is less than 0.01 g/100 mL, the 3-hydroxybutyric acid-induced uncomfortable irritating sensation may be weak, so that the effect of the present invention for reducing the irritating sensation may be small.

The 3-hydroxybutyric acid concentration in the
15 beverage is more preferably 0.1 g/100 mL or more, still more preferably 0.5 g/100 mL or more, particularly preferably 1.0 g/100 mL or more, and is more preferably 3.0 g/100 mL or less, still more preferably 2.0 g/100 mL or less. In one embodiment, the 3-hydroxybutyric acid
20 concentration in the beverage is more preferably 0.1 to 3.0 g/100 mL, still more preferably 0.5 to 2.0 g/100 mL, particularly preferably 1.0 to 2.0 g/100 mL. The 3-hydroxybutyric acid concentration can be measured by a high-performance liquid chromatography (HPLC) system (e.g.,
25 LC-10 series available from Shimadzu Corporation). The following measurement conditions and the like can be employed.

Column: SHIM-PACK SCR-102H (8 mm I.D. × 300 mm L)
(available from Shimadzu Corporation)

30 Mobile phase: mixture of water, p-toluenesulfonic acid, EDTA, and Bis-Tris

Flow rate: 0.8 mL/min

Column temperature: 40°C

Detection: electrical conductivity (with polarity set to
35 positive)

Analysis time: 30 minutes

[0012]

The beverage of the present invention contains a lower aliphatic alcohol. In the present invention, the
5 term "lower aliphatic alcohol" refers to any of lower aliphatic mono- to trihydric alcohols, with a lower aliphatic monohydric alcohol or a lower aliphatic dihydric alcohol being preferred. These lower aliphatic alcohols may be used alone or in combination of two or more. In one
10 embodiment, the lower aliphatic alcohol may be added using additives such as flavoring or masking agents.

[0013]

The lower aliphatic alcohol is preferably a C2-C5 aliphatic alcohol, more preferably a C2-C3 aliphatic
15 alcohol. Preferably, the lower aliphatic alcohol is, for example, at least one selected from the group consisting of ethanol, propylene glycol, 1-propanol, 2-propanol, 1-butanol, 2-butanol, 1-pentanol, 2-pentanol, 3-pentanol, and ethylene glycol. Particularly in the present invention, at
20 least one of ethanol or propylene glycol is more preferred.

[0014]

When the lower aliphatic alcohol concentration in the beverage is 0.001 v/v% or more, the 3-hydroxybutyric acid-induced uncomfortable irritating sensation can be reduced.
25 When the lower aliphatic alcohol concentration in the beverage is less than 0.375 v/v%, the distinctive flavor of the lower aliphatic alcohol is reduced. This can reduce the lower aliphatic alcohol-induced bad aftertaste.

The lower aliphatic alcohol concentration in the
30 beverage is preferably 0.01 v/v% or more, more preferably 0.05 v/v% or more, still more preferably 0.1 v/v% or more, because the 3-hydroxybutyric acid-induced uncomfortable irritating sensation can be more effectively reduced. The lower aliphatic alcohol concentration in the beverage is
35 preferably 0.35 v/v% or less, more preferably 0.32 v/v% or

less, still more preferably 0.3 v/v% or less, because the lower aliphatic alcohol-induced bad aftertaste is further reduced. The 3-hydroxybutyric acid-induced uncomfortable irritating sensation can also be more effectively reduced.

5 In one embodiment, the lower aliphatic alcohol concentration in the beverage is preferably 0.001 to 0.35 v/v%, more preferably 0.01 to 0.32 v/v%, still more preferably 0.01 to 0.3 v/v%, yet still more preferably 0.05 to 0.3 v/v%, particularly preferably 0.1 to 0.3 v/v%. In
10 one embodiment, preferably, the lower aliphatic alcohol concentration in the beverage is 0.1 to 0.35 v/v%. When the beverage contains two or more lower aliphatic alcohols, the lower aliphatic alcohol concentration is the total concentration thereof.

15 The lower aliphatic alcohol concentration can be measured by a method known to a skilled person. For example, it can be measured by high-performance liquid chromatography (HPLC) or the like.
[0015]

20 Preferably, the beverage of the present invention contains a sweetener. When the beverage contains a sweetener, the 3-hydroxybutyric acid-induced uncomfortable irritating sensation and/or the lower aliphatic alcohol-induced bad aftertaste can be more effectively reduced.
25 Thus, the beverage is rendered more suitable for drinking. One sweetener may be used alone, or two or more sweeteners may be used in combination. The lower aliphatic alcohol described above is not included in the sweetener in the present invention.

30 [0016]

Examples of the sweetener include sucralose, acesulfame potassium (acesulfame K), aspartame, sucrose, glucose, maltose, erythritol, xylitol, maltitol, trehalose, stevia (rebaudioside, stevioside), thaumatin, saccharin,
35 sodium saccharin, licorice, monkfruit, neotame, mabinlin,

brazzein, monellin, glycyrrhizin, alitame, cyclamate, zultin, and neohesperidin. Preferably, the sweetener is at least one selected from the group consisting of sucralose, acesulfame potassium, aspartame, sucrose, glucose, maltose, erythritol, xylitol, maltitol, trehalose, and stevia. More preferably, the sweetener is at least one of sucralose or acesulfame potassium.

[0017]

Preferably, the sweetener concentration in terms of sucrose in the beverage is less than 20 g/100 mL. When the sweetener concentration in terms of sucrose in the beverage is less than 20 g/100 mL, the 3HB-induced uncomfortable irritating sensation and the lower aliphatic alcohol-induced bad aftertaste are effectively reduced. The sweetener concentration in terms of sucrose is preferably 0.1 g/100 mL or more, more preferably 1 g/100 mL or more, still more preferably 3 g/100 mL or more, particularly preferably 5 g/100 mL or more. The sweetener concentration in terms of sucrose is preferably 15 g/100 mL or less, more preferably 14 g/100 mL or less. The sweetener concentration in terms of sucrose is preferably 0.1 g/100 mL or more and less than 20 g/100 mL, more preferably 1 to 15 g/100 mL, still more preferably 3 to 15 g/100 mL, particularly preferably 5 to 14 g/100 mL. When the beverage contains two or more sweeteners, the sweetener concentration is the total concentration thereof.

The concentration in terms of sucrose is obtained by converting the sweetener concentration in the beverage into the sucrose concentration. The sweetener concentration in terms of sucrose is calculated using the sweetness level of the sweetener and the sweetness level of sucrose. The sweetness level is an index that indicates the sweetness of a beverage as determined based on the sweetness of 100 g of a beverage containing 1 g of sucrose, which is taken as 1. For example, in the case of sucralose, the concentration in

terms of sucrose can be calculated by multiplying the
sucralose concentration by "sweetness level (600) of
sucralose/sweetness level (1) of sucrose". In the case of
acesulfame potassium, the concentration in terms of sucrose
5 can be determined by multiplying the acesulfame potassium
concentration in a beverage by "sweetness level (200) of
acesulfame potassium/sweetness level (1) of sucrose". The
concentration in terms of sucrose can be similarly
determined for other sweeteners such as aspartame
10 (sweetness level 100), glucose (sweetness level 0.6),
maltose (sweetness level 0.4), erythritol (sweetness level
0.8), xylitol (sweetness level 0.6), maltitol (sweetness
level 0.8), trehalose (sweetness level 0.4), and stevia
(sweetness level 100). The sweetener concentration in the
15 beverage can be measured by a high-performance liquid
chromatography (HPLC) system or the like.

[0018]

The beverage of the present invention may contain,
for example, various additives as in general beverages, as
20 long as the effect of the present invention is not
impaired. Examples of the additives include flavoring or
masking agents, vitamins, pigments, antioxidants,
acidulants, emulsifiers, preservatives, seasonings,
extracts, pH adjusters, and quality stabilizers. Food
25 ingredients such as fruit juices, coffee extracts, tea leaf
extracts, and milk ingredients may also be added depending
on the purpose. The beverage of the present invention
contains water. The beverage of the present invention is a
liquid composition usually containing water as a base.

30 [0019]

The beverage of the present invention may contain,
for example, one or more metal ions. Preferred metal ions
are, for example, ions of metals such as Na, Ca, Mg, K, and
the like. The metal ions may be added in the form of
35 salts.

[0020]

Non-limiting examples of the beverage of the present invention include soft drinks such as fruit beverages, tea beverages, coffee beverages, milk beverages, functional
5 beverages, energy drinks, and sport drinks.

[0021]

In the present invention, the beverage may be in any form and can be provided as a beverage sealed in a container. The container can be a known beverage container
10 (examples include metal containers such as cans, bottles (e.g., a glass bottle), retort pouches, plastic bottles, and cartons). Of these, plastic bottles, cans, and glass bottles are preferred, and plastic bottles are more preferred.

15 [0022]

The beverage of the present invention may or may not be heat sterilized but is preferably heat sterilized. When the beverage of the present invention is heat sterilized, any known method can be used for the treatment.

20 [0023]

The beverage of the present invention may be produced by any method. For example, the above-described components are appropriately added, and the concentration of each component is adjusted as necessary, whereby the beverage
25 can be produced.

When the beverage is provided as a beverage sealed in a container, any method may be used to fill the container with the beverage, and the method can be selected according to the container and the like. For example, a method such
30 as a hot pack filling method or an aseptic filling method can be employed. Filling conditions can be appropriately set according to the container type and the like. The container is sealed after filling, whereby a beverage sealed in a container can be obtained. Heat sterilization
35 may be performed after the container is filled with the

beverage.

[0024]

The present invention also encompasses the following method of improving the taste of a beverage containing 3-hydroxybutyric acid and a lower aliphatic alcohol:

a method of improving the taste of a beverage containing 3-hydroxybutyric acid and a lower aliphatic alcohol, the method including

adjusting a lower aliphatic alcohol concentration in the beverage containing 3-hydroxybutyric acid and a lower aliphatic alcohol to 0.001 v/v% or more and less than 0.375 v/v%.

In the beverage containing 3-hydroxybutyric acid and a lower aliphatic alcohol, adjusting the lower aliphatic alcohol to the above concentration is effective in improving the taste of the beverage. The 3-hydroxybutyric acid-induced uncomfortable irritating sensation can be reduced by adjusting the lower aliphatic alcohol to the above concentration. Adjusting the lower aliphatic alcohol to the above concentration is effective in reducing the lower aliphatic alcohol-induced bad aftertaste. Preferred ranges of the 3-hydroxybutyric acid concentration and the lower aliphatic alcohol concentration in the beverage are the same as the preferred ranges of the 3-hydroxybutyric acid concentration and the lower aliphatic alcohol concentration in the beverage of the present invention described above. The lower aliphatic alcohol concentration can be adjusted by, for example, adding the alcohol to the beverage.

[0025]

In the above method, preferably, the improving the taste is reducing the 3-hydroxybutyric acid-induced uncomfortable irritating sensation and the lower aliphatic alcohol-induced bad aftertaste. The method of improving the taste of the present invention can be used as a method

of reducing the 3-hydroxybutyric acid-induced uncomfortable irritating sensation and the lower aliphatic alcohol-induced bad aftertaste.

[0026]

5 The numerical range defined by the lower limit and the upper limit herein, i.e., "the lower limit to the upper limit", includes the lower limit and the upper limit. For example, the range defined by "1 to 2" means 1 or more and 2 or less, with 1 and 2 being inclusive. Herein, the range
10 may be any combination of any upper limit and any lower limit.

EXAMPLES

[0027]

15 The following provides Examples that more specifically describe the present invention. The present invention is not limited to these Examples.

[0028]

20 In Examples, R-hydroxybutyric acid (D-3-hydroxybutyric acid) (hereinafter described as "3HB") was used as the 3-hydroxybutyric acid. Commercially available mineral water was used as the water to prepare beverages. The following raw materials were used.

3HB: available from Osaka Gas Co., Ltd.

25 Ethanol: available from Japan Alcohol Trading Co., Ltd.

Acesulfame K: available from Celanese Production Germany GmbH & Co. KG

Sucralose: available from TATE & LYLE Sucralose LLC

Propylene glycol: available from FUJIFILM Wako Pure

30 Chemical Corporation

[0029]

<Reference Example 1>

Water was mixed with 3HB to prepare 3HB-containing beverages (3HB concentration: 0.3 to 3.0 g/100 mL) of
35 samples 2 to 4 shown in Table 1. Each of the resulting

beverages had a colorless and transparent appearance. A sample 1 in Table 1 is water (3HB-free water) used to prepare the samples 2 to 4.

[0030]

5 The resulting samples were subjected to sensory evaluation of aroma and flavor by three fully trained panelists. The aroma and flavor were evaluated in terms of the uncomfortable irritating sensation due to 3HB (specifically, irritating sensation, which is distinctive
10 to 3HB, to the throat and oral cavity and an unpleasant odor distinctive to 3HB) with one to four points (four-point scale) based on the following criteria. Then, the scores given by the panelists were averaged. As the reference points, the uncomfortable irritating sensation
15 due to 3HB of the sample 1 (water) during drinking was given one point, and the uncomfortable irritating sensation due to 3HB of the sample 4 (3HB concentration: 3.0 g/100 mL) during drinking was given four points.

[0031]

20 Sensory evaluation criteria

1 point: No uncomfortable irritating sensation due to 3HB is felt.

2 points: The uncomfortable irritating sensation due to 3HB is slightly felt.

25 3 points: The uncomfortable irritating sensation due to 3HB is felt.

4 points: The uncomfortable irritating sensation due to 3HB is strongly felt.

[0032]

30 Table 1 shows the evaluation results. The 3HB-containing samples gave the uncomfortable irritating sensation due to 3HB.

[0033]

[Table 1]

Sample		1	2	3	4
Concentration	3HB (g/100 mL)	0	0.3	1.0	3.0
Evaluation results (points)	Panelist 1	1	2	3	4
	Panelist 2	1	2	3	4
	Panelist 3	1	2	2	4
	Average	1.0	2.0	2.7	4.0

[0034]

<Example 1>

Water was mixed with 3HB to prepare a 3HB-containing
5 beverage (3HB concentration: 1.75 g/100 mL) as a control A.

Water was mixed with 3HB and ethanol to prepare
beverages (samples A1 to A10) shown in Table 2. Each of
the resulting beverages had a colorless and transparent
appearance. Table 2 shows the 3HB concentration and the
10 ethanol concentration in each sample.

[0035]

The resulting samples were subjected to sensory
evaluation of aroma and flavor by three fully trained
panelists. The aroma and flavor were evaluated in terms of
15 the uncomfortable irritating sensation due to 3HB or the
distinctive flavor of ethanol by drinking the samples. The
uncomfortable irritating sensation due to 3HB (mainly,
uncomfortable irritating sensation to the throat, which is
a distinctive sensation of 3HB) or the distinctive flavor
20 of ethanol was evaluated with one to five points (five-
point scale) based on the following criteria. Then, the
scores given by the panelists were averaged. As the
reference points, the uncomfortable irritating sensation
due to 3HB of the control A was given one point, and the
25 uncomfortable irritating sensation due to 3HB of the sample
(sample A5) to which 0.3 v/v% ethanol was added was given
five points. One point was given when either the
uncomfortable irritating sensation due to 3HB or the
distinctive flavor of ethanol remained significantly. Two

points were given when either the uncomfortable irritating sensation due to 3HB or the distinctive flavor of ethanol remained.

[0036]

5 Sensory evaluation criteria

1 point: The uncomfortable irritating sensation due to 3HB or the distinctive flavor of ethanol remains significantly in the aftertaste.

2 points: The uncomfortable irritating sensation due to 3HB
10 or the distinctive flavor of ethanol remains in the aftertaste.

3 points: The uncomfortable irritating sensation due to 3HB is slightly alleviated.

4 points: The uncomfortable irritating sensation due to 3HB
15 is alleviated.

5 points: The uncomfortable irritating sensation due to 3HB is significantly alleviated.

[0037]

Table 2 shows the results. Adding 0.001 v/v% or more
20 ethanol to the 3HB-containing beverage alleviated the uncomfortable irritating sensation due to 3HB (samples A1 to A8), as compared to the control A. The uncomfortable irritating sensation due to 3HB was most reduced in the sample A5. In the samples A1 to A7, the distinctive flavor
25 of ethanol was not felt in the aftertaste. When the ethanol concentration was 0.4 v/v% or more (samples A9 and A10), the irritating sensation due to 3HB was alleviated, but the flavor of ethanol was felt in the aftertaste.

[0038]

30 [Table 2]

Sample		Control A	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
Concentration	3HB (g/100 mL)	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75
	Ethanol (v/v%)	0	0.001	0.01	0.1	0.2	0.3	0.32	0.35	0.37	0.4	0.5
Evaluation results (points)	Panelist 1	1	2	2	2	3	5	4	3	2	1	1
	Panelist 2	1	1	3	4	4	5	5	4	3	2	2
	Panelist 3	1	2	3	4	5	5	4	4	2	2	2
	Average	1.0	1.7	2.7	3.3	4.0	5.0	4.3	3.7	2.3	1.7	1.7

[0039]

<Example 2>

Water was mixed with 3HB or 3HB and ethanol to prepare beverages (samples B1 to B6) shown in Table 3.

5 Each of the resulting beverages had a colorless and transparent appearance. Table 3 shows the 3HB concentration and the ethanol concentration in each sample. Example 1 confirmed that no distinctive flavor of ethanol was felt in the aftertaste when the ethanol concentration
10 was 0.3 v/v%. Thus, the flavor of ethanol was not evaluated in Example 2.

[0040]

The resulting samples were subjected to sensory evaluation of aroma and flavor by three fully trained
15 panelists. The aroma and flavor were evaluated in terms of the uncomfortable irritating sensation due to 3HB by drinking the samples. Specifically, the uncomfortable irritating sensation due to 3HB (mainly, uncomfortable irritating sensation to the throat, which is a distinctive
20 sensation of 3HB) was evaluated with one to five points (five-point scale) based on the following criteria. Then, the scores given by the panelists were averaged. As the reference points, the uncomfortable irritating sensation due to 3HB of the sample B1 (3HB concentration: 1.0 g/100
25 mL) was given three points, the uncomfortable irritating sensation due to 3HB of the sample B3 (3HB concentration: 3.0 g/100 mL) was given two points, and the uncomfortable irritating sensation due to 3HB of the sample B5 (3HB concentration: 4.0 g/100 mL) was given one point.

30 [0041]

Sensory evaluation criteria

1 point: The uncomfortable irritating sensation due to 3HB remains significantly in the aftertaste.

2 points: The uncomfortable irritating sensation due to 3HB
35 remains in the aftertaste.

3 points: The uncomfortable irritating sensation due to 3HB is slightly alleviated.

4 points: The uncomfortable irritating sensation due to 3HB is alleviated.

5 5 points: The uncomfortable irritating sensation due to 3HB is significantly alleviated.

[0042]

Table 3 shows the results. Adding ethanol to the 3HB-containing beverages (samples B2, B4, and B6) alleviated the uncomfortable irritating sensation due to 3HB to the throat, as compared to the cases with no addition of ethanol (samples B1, B3, and B5).

[0043]

[Table 3]

Sample		B1	B2	B3	B4	B5	B6
Concentration	3HB (g/100 mL)	1.0	1.0	3.0	3.0	4.0	4.0
	Ethanol (v/v%)	0	0.3	0	0.3	0	0.3
Evaluation results (points)	Panelist 1	3	5	2	4	1	3
	Panelist 2	3	4	2	3	1	2
	Panelist 3	3	4	2	3	1	1
	Average	3.0	4.3	2.0	3.3	1.0	2.0

[0044]

<Example 3>

Water was mixed with 3HB to prepare a 3HB-containing beverage (3HB concentration: 1.75 g/100 mL) as a control C.

20 Water was mixed with 3HB, ethanol, acesulfame K, and sucralose to prepare beverages (samples C1 to C8) shown in Table 4. Each of the resulting beverages had a colorless and transparent appearance. Table 4 shows the concentration of each component in each sample.

25 [0045]

The resulting samples were subjected to sensory evaluation of aroma and flavor by three fully trained

panelists. The aroma and flavor were evaluated in terms of the uncomfortable irritating sensation due to 3HB or the distinctive flavor of ethanol by drinking the samples. Specifically, the uncomfortable irritating sensation due to 3HB (mainly, uncomfortable irritating sensation to the throat, which is a distinctive sensation of 3HB) or the distinctive flavor of ethanol was evaluated with one to five points with increments of 0.5 points (nine-point scale) based on the following criteria. Then, the scores given by the panelists were averaged. As the reference points, the uncomfortable irritating sensation due to 3HB of the control C was given one point, and the uncomfortable irritating sensation due to 3HB of the beverage (sample C7) to which 0.3 v/v% ethanol was added was given five points. One point was given when either the uncomfortable irritating sensation due to 3HB or the distinctive flavor of ethanol remained significantly. Two points were given when either the uncomfortable irritating sensation due to 3HB or the distinctive flavor of ethanol remained.

[0046]

Sensory evaluation criteria

- 1 point: The uncomfortable irritating sensation due to 3HB or the distinctive flavor of ethanol remains significantly in the aftertaste.
- 2 points: The uncomfortable irritating sensation due to 3HB or the distinctive flavor of ethanol remains in the aftertaste.
- 3 points: The uncomfortable irritating sensation due to 3HB is slightly alleviated.
- 4 points: The uncomfortable irritating sensation due to 3HB is alleviated.
- 5 points: The uncomfortable irritating sensation due to 3HB is significantly alleviated.

[0047]

Table 4 shows the results. Use of a sweetener in

addition to ethanol further reduced the 3HB-induced uncomfortable irritating sensation. The use also further improved the ethanol-induced bad aftertaste. No ethanol-induced aftertaste was felt in the samples C4 to C8.

5 [0048]

[Table 4]

Sample		Control C	C1	C2	C3	C4	C5	C6	C7	C8
Concentration	3HB (g/100 mL)	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75
	Ethanol (v/v%)	0	0	0.001	0.005	0.01	0.1	0.2	0.3	0.35
	Acesulfame K (mg/100 mL)	0	25	25	25	25	25	25	25	25
	Sucralose (mg/100 mL)	0	15	15	15	15	15	15	15	15
Evaluation results (points)	Panelist 1	1.0	3.0	3.5	4.0	4.0	5.0	5.0	5.0	5.0
	Panelist 2	1.0	3.0	3.0	3.5	4.0	4.5	4.5	5.0	5.0
	Panelist 3	1.0	3.0	3.5	4.0	4.0	4.5	5.0	5.0	4.0
	Average	1.0	3.0	3.3	3.8	4.0	4.7	4.8	5.0	4.7

[0049]

In the samples C1 to C8, the concentration of
 10 acesulfame K in terms of sucrose and the concentration of
 sucralose in terms of sucrose are as follows.
 Acesulfame K (sweetness level 200) concentration (g/100 mL)
 in terms of sucrose: $0.025 \times 200 = 5$
 Sucralose (sweetness level 600) concentration (g/100 mL) in
 15 terms of sucrose: $0.015 \times 600 = 9$

In the samples C1 to C8, the sweetener (acesulfame K and sucralose) concentration in terms of sucrose was 14 g/100 mL.

[0050]

20 <Example 4>

Water was mixed with 3HB to prepare a 3HB-containing beverage (3HB concentration: 1.75 g/100 mL) as a control D.

Water was mixed with 3HB and propylene glycol to prepare beverages (samples D1 to D5) shown in Table 5.

25 Each of the resulting beverages had a colorless and

transparent appearance. Table 5 shows the 3HB concentration and the propylene glycol concentration in the samples.

[0051]

5 The resulting samples were subjected to sensory evaluation of aroma and flavor by three fully trained panelists. The aroma and flavor were mainly evaluated in terms of the uncomfortable irritating sensation due to 3HB or the distinctive flavor of propylene glycol by drinking
10 the samples. Specifically, the uncomfortable irritating sensation due to 3HB (mainly, uncomfortable irritating sensation to the throat, which is a distinctive sensation of 3HB) or the distinctive flavor of propylene glycol was evaluated with one to five points (five-point scale) based
15 on the following criteria. Then, the scores given by the panelists were averaged. As the reference points, the uncomfortable irritating sensation due to 3HB of the control D was given one point, and the uncomfortable irritating sensation due to 3HB of the beverage (sample D5)
20 to which 0.3 v/v% propylene glycol was added was given four points. One point was given when either the uncomfortable irritating sensation due to 3HB or the distinctive flavor of propylene glycol remained significantly. Two points were given when either the uncomfortable irritating
25 sensation due to 3HB or the distinctive flavor of propylene glycol remained.

[0052]

Sensory evaluation criteria

1 point: The uncomfortable irritating sensation due to 3HB
30 or the distinctive flavor of propylene glycol remains significantly in the aftertaste.
2 points: The uncomfortable irritating sensation due to 3HB or the distinctive flavor of propylene glycol remains in the aftertaste.
35 3 points: The uncomfortable irritating sensation due to 3HB

is slightly alleviated.

4 points: The uncomfortable irritating sensation due to 3HB is alleviated.

5 points: The uncomfortable irritating sensation due to 3HB is significantly alleviated.

[0053]

Table 5 shows the results. No distinctive flavor of propylene glycol was felt in the samples D1 to D5.

[0054]

10 [Table 5]

Sample		Control D	D1	D2	D3	D4	D5
Concentration	3HB (g/100 mL)	1.75	1.75	1.75	1.75	1.75	1.75
	Propylene glycol (v/v%)	0	0.005	0.01	0.1	0.2	0.3
Evaluation results (points)	Panelist 1	1	1	2	3	4	4
	Panelist 2	1	2	3	4	4	4
	Panelist 3	1	2	3	3	4	4
	Average	1.0	1.7	2.7	3.3	4.0	4.0

[0055]

15 The above results show that in the beverages containing 3-hydroxybutyric acid and a lower aliphatic alcohol, setting the lower aliphatic alcohol concentration to a certain range can reduce the 3-hydroxybutyric acid-induced uncomfortable irritating sensation and the lower aliphatic alcohol-induced bad aftertaste.

CLAIMS

Claim 1. A beverage comprising:
3-hydroxybutyric acid; and
5 a lower aliphatic alcohol,
wherein a lower aliphatic alcohol concentration is
0.001 v/v% or more and less than 0.375 v/v%.

Claim 2. The beverage according to claim 1,
10 wherein a 3-hydroxybutyric acid concentration is 0.01
to 4.0 g/100 mL.

Claim 3. The beverage according to claim 1 or 2
further comprising a sweetener.

15 Claim 4. The beverage according to claim 3,
wherein the sweetener is at least one selected from
the group consisting of sucralose, acesulfame potassium,
aspartame, sucrose, glucose, maltose, erythritol, xylitol,
20 maltitol, trehalose, and stevia.

Claim 5. The beverage according to claim 3,
wherein a sweetener concentration in terms of sucrose
is less than 20 g/100 mL.

25 Claim 6. The beverage according to claim 1 or 2,
wherein the lower aliphatic alcohol is a C2-C5
aliphatic alcohol.

30 Claim 7. The beverage according to claim 1 or 2,
wherein the lower aliphatic alcohol is at least one
selected from the group consisting of ethanol, propylene
glycol, 1-propanol, 2-propanol, 1-butanol, 2-butanol, 1-
pentanol, 2-pentanol, 3-pentanol, and ethylene glycol.

35

Claim 8. A method of improving the taste of a beverage containing 3-hydroxybutyric acid and a lower aliphatic alcohol, the method comprising

adjusting a lower aliphatic alcohol concentration in
5 the beverage containing 3-hydroxybutyric acid and a lower
aliphatic alcohol to 0.001 v/v% or more and less than 0.375
v/v%.

Claim 9. The method of improving the taste according
10 to claim 8,

wherein the improving the taste is reducing a 3-
hydroxybutyric acid-induced uncomfortable irritating
sensation and a lower aliphatic alcohol-induced bad
aftertaste.