

DESCRIPTION

METHOD FOR PRODUCING BEVERAGE WITH RICH TASTE ADDED

TECHNICAL FIELD

[0001] The present invention relates to a method for producing a beverage with richness imparted.

BACKGROUND ART

[0002] Decisive factors of palatability of foods and beverages include taste, aroma, texture, and color. In addition, "richness" has been regarded as an important decisive factor of palatability, recently. It is considered that "richness" is a flavor that can be recognized when more stimuli to three senses, i.e., taste (the sense of taste), aroma (the sense of smell), and texture (the sense of touch) are given with good balance, and thickness/complexity, mouthfulness, and lastingness are felt (NON-PATENT LITERATURES 1 and 2).

As for substances that impart richness to foods and beverages, it has been reported that sulfur-containing compounds, such as alliin, γ -glutamyl-S-allyl-L-cysteine (γ -L-glutamyl-S-allyl-L-cysteine (GSAC)), and S-methyl-cysteine sulfoxide (S-methyl-L-cysteine sulfoxide (SMCS)), which are derived from garlic, and isoalliin (S-propenyl-L-cysteine sulfoxide (PeCSO)) and γ -glutamyl peptide of isoalliin (γ -L-glutamyl-PeCSO), which are derived from onion, and peptides, such as yeast-derived peptides, glycopeptides, and Maillard peptides impart thickness, complexity, lastingness, and mouthfulness to a savoriness solution (NON-PATENT LITERATURES 3, 4, and 5). It has also been reported that when an onion concentrate produced through heating is added to consomme soup, richness is imparted, and that particularly, lastingness of aroma is enhanced (NON-PATENT LITERATURE 6).

[0003] Such a substance that imparts richness has effects on enhancing thickness, lastingness, and mouthfulness of the base taste. However, since beverages are poor in terms of taste (particularly, savoriness) and texture of its base, in nature, a problem is that it is difficult to enhance the thickness, lastingness, and mouthfulness. Accordingly, there is a

need for a method for imparting richness to a beverage or effectively enhancing richness of a beverage. Techniques for imparting richness to a beverage are known, including a method including adding potato-derived dextrin having a DE of 2 or more and less than 5 to a coffee-containing beverage or tea beverage having a reduced saccharide content of 2.5 w/v% or less (PATENT LITERATURE 1); a method for enhancing richness of a beverage, the method including adding cyclodextrin (PATENT LITERATURE 2); a method for imparting richness to a food or beverage, the method including adding rare sugar containing D-psicose to a food or beverage, such as blend tea, black tea, or coffee, and heating the resultant (PATENT LITERATURE 3); a method for imparting richness to a beverage or enhancing richness thereof, the method including adding an amino acid-containing composition to milk or another protein-containing beverage, wherein the composition containing specific amino acids (L-methionine, L-lysine, L-leucine and L-threonine) in a specific ratio (PATENT LITERATURE 4).

CITATION LIST

PATENT LITERATURE

[0004] PTL 1: JP 2012-115247A

PTL 2: JP S54-145268A

PTL 3: JP 2014-113059A

PTL 4: JP 2009-11209A

NON-PATENT LITERATURE

[0005] NPL 1: Toshihide Nishimura, The Japanese Journal of Clinical Nutrition, 119(6), 616-617(2011)

NPL 2: Toshihide Nishimura, Ai Egusa, A Technical Journal on Food Chemistry & Chemicals, 2014-8 Vol.352: 25-31, (2014)

NPL 3: Agricultural and Biological Chemistry 54(1), 163-169, 1990

NPL 4: Bioscience, Biotechnology, and Biochemistry, 58(1), 108-110, 1994

NPL 5: Food Chemistry 99, 600-604, 2006

NPL 6: Tsutomu Odawara, et al., Summary of 65th Annual Meeting of Japan

Society of Nutrition and Food Science, p.213(2011)

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0006] As described above, some techniques for imparting richness to a beverage are known. However, beverages are undergoing diversification in terms of its kinds and flavors/tastes nowadays, and there is a possibility that richness cannot be imparted to every kind of beverages only by conventional techniques. It is desirable to develop novel methods different from conventional techniques to widen, if only a little, the range of the kinds of beverages to which richness can be favorably imparted.

[0007] An object of the present invention is to provide a novel method for producing a beverage with richness imparted effectively without need for any complicated step or special apparatus.

SOLUTION TO PROBLEM

[0008] As a result of earnest studies for the above-described object, the present inventors have found that heated product of L-ergothioneine (L-ergothioneine having been heated) can effectively impart richness to a beverage, and have completed the present invention. The present invention encompasses the following aspects, but is not limited thereto.

[1] A method for producing a beverage, including the following steps a) to d):

- a) preparing a beverage preparation liquid,
- b) adding L-ergothioneine to the beverage preparation liquid to 0.3 to 440 ppm (w/w),
- c) adjusting a pH (20°C) of the beverage preparation liquid to 5.0 to 7.5, and
- d) heating the beverage preparation liquid containing L-ergothioneine,

wherein conditions for heating in the step d) satisfies conditions of the following formula (1):

$$\text{formula (1): } Y \geq 34 \times (X - 60)^{-1.1}$$

wherein X represents a heating temperature (°C), Y represents a heating time (min), and $61 \leq X \leq 150$.

[2] A method for producing a beverage, including the following steps a) and x) to z):

a) preparing a beverage preparation liquid,
x) preparing a solution containing L-ergothioneine,
y) heating the solution containing L-ergothioneine to prepare a solution containing heated L-ergothioneine, and

z) mixing the beverage preparation liquid and the solution containing heated L-ergothioneine such that a resulting mixed liquid has an L-ergothioneine concentration of 0.3 to 440 ppm (w/w),

wherein conditions for heating in the step y) satisfies conditions of the following formula (1):

$$\text{formula (1): } Y \geq 34 \times (X - 60)^{-1.1}$$

wherein X represents a heating temperature (°C), Y represents a heating time (min), and $61 \leq X \leq 150$, and

wherein the beverage has a pH (20°C) of 5.0 to 7.5.

[3] The method for producing a beverage according to [1] or [2], wherein the beverage contains 10 to 20000 ppb of a pyrazine compound.

ADVANTAGEOUS EFFECTS OF INVENTION

[0009] According to the present invention, a beverage to which richness has been effectively imparted can be produced only by allowing the beverage to contain heated products of L-ergothioneine. Advantageously, this production method needs no special investment in equipment, and brings about extremely small adverse effects on the industrial productivity.

BRIEF DESCRIPTION OF DRAWING

[0010] Fig. 1 is a graph on which the results of Experiment 6 in Examples are plotted.

DESCRIPTION OF EMBODIMENTS

[0011] Embodiments of the present invention will now be described, but embodiments of the present invention is not limited to examples below.

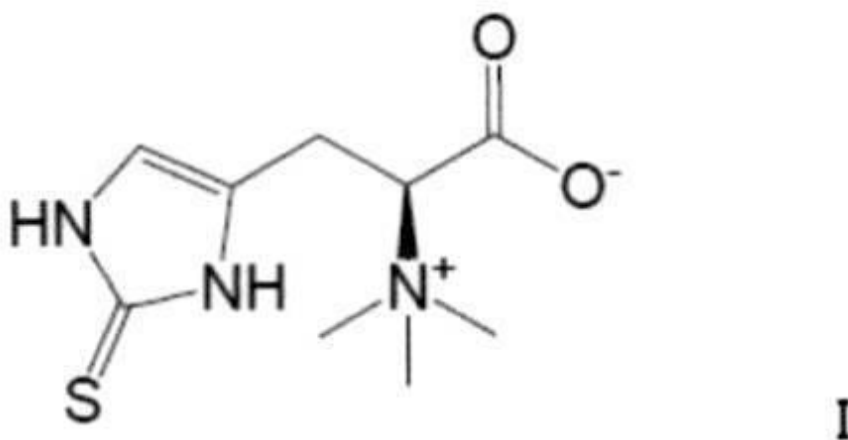
The present invention is based on the finding that richness can be imparted to a beverage by allowing the beverage to contain L-ergothioneine having been heated as an active ingredient. Herein, "richness" in the present invention means overall body, flavor

with thickness/depth, and fulfilling taste in an organoleptic test of beverages in terms of sense of taste, and "imparting richness" in the present invention means increasing/enhancing or emphasizing "richness." Specifically, it expresses enhancing the thickness, lastingness, and mouthfulness of the base taste (tea, coffee, etc.) of a beverage, or enhancing the thickness recognized as substantiality of a tasteless beverage (water, carbonated water, etc.).

[0012] (L-Ergothioneine)

The present invention is an invention based on the finding that richness can be imparted to a beverage by allowing the beverage to contain L-ergothioneine (L-(+)-Ergothioneine (CAS 58511-63-0)) (hereinafter, L-ergothioneine is abbreviated to as EGT) having been heated, as an active ingredient. Even when a beverage contains EGT not having been heated, the richness-imparting effect of the present invention is not exhibited; however, when EGT having been heated (heated EGT) is contained, the richness-imparting effect is exhibited, to thereby obtain the effect of increasing/enhancing or emphasizing "rich" flavor/taste of a beverage as compared to a case where heated EGT is not contained. EGT is a compound represented by chemical formula I below, and is known to be excellent in heat stability; however, it is surmised that a moiety of the structure of this compound is changed by heat treatment to exhibit the effect of the present invention.

[0013] [Chemical Formula 1]



[0014] Heated EGT refers to an EGT solution obtained by heating EGT in a solution state at 61 to 150°C for a time within a range that satisfies the conditions of formula (1), which will be described later. Here, as EGT serving as the raw material of heated EGT, a commercially available EGT produced by chemical synthesis may be used, or an extract from, for example, mushroom or sake lees containing EGT or a purified product thereof may be used. Examples of the mushroom that can be used for extracting EGT include Golden/Yellow Oyster mushroom (botanical name: *Pleurotus cornucopiae* var. *citrinopileatus*), which is mushroom of Pleurotaceae, *Pleurotus*; common mushroom (botanical name: *Agaricus bisporus*), such as white button mushroom, cremini mushroom, and Portabella mushroom; Grey Oyster Mushroom (botanical name: *Pleurotus ostreatus*); Shiitake mushroom (botanical name: *Lentinula edodes*); Hen of the Woods (botanical name: *Grifola Frondosa*); Reishi mushroom (botanical name: *Ganoderma lucidum*); lion's mane mushroom (botanical name: *Hericium erinaceus*); poplar mushroom (botanical name: *Agrocybe aegerita*); golden chanterelle (botanical name: *Cantharellus cibarius*); Porcini (botanical name: *Boletus edulis*); and common morel (botanical name: *Morchella esculenta*). These may be used singly or in combinations of two or more thereof. Among these, Golden/Yellow Oyster mushroom is preferred, which has a large EGT content. In a case where an extract is used as EGT, it is preferably a roughly purified product through deodorization treatment or the like since the aroma/flavor of components other than EGT may affect the beverage.

[0015] (Beverage)

The beverage obtained by the present invention preferably has a pH (20°C) of 5.0 to 7.5. The pH (20°C) is more preferably 5.5 to 7.0, even more preferably 5.5 to 6.5. For beverages having a pH less than 5.0, at which a sour flavor is sensed, there are various methods for controlling richness by kinds and amounts of the acid and kinds and amounts of sweeteners used in combination, and thus the problem to be solved by the present invention is unlikely to be recognized, so that there is a tendency that the effect of the present invention, i.e., the effect of imparting richness by adding heated EGT may not be perceptible. On the

other hand, if the pH of a beverage is more than 7.5, it is difficult to control the balance of stimuli including taste and aroma since dissolved carbon dioxide in the beverage may become carbonate ions (CO_3^{2-}), and it may thus be difficult to impart desired palatable richness. The pH of the beverage can be easily measure using a commercially available pH meter.

[0016] It was reported that among aroma substances, pyrazine compounds give mouthfulness of taste to foods and beverages and thus are substances that impart richness (Tomoaki Saitoh: "Rich taste and Richness of Foods," The Japanese journal of taste and smell research, 11, 165-174 (2004)). In a case where the beverage as a base is a beverage containing a pyrazine compound, the effect of the present invention, i.e., the effect of imparting richness by adding heated EGT is exhibited in an additive or synergistic manner. Accordingly, a beverage containing a pyrazine compound is one example of a suitable mode of the beverage according to the present invention.

[0017] Specifically, the beverage obtained by the present invention preferably contains 10 to 20000 ppb of the pyrazine compound. Examples of the beverage containing the pyrazine compound include beverages containing an extract from a roasted product of a plant (roasted plant). Examples of the plant as the raw material of the roasted plant include tea leaves from *Camellia sinensis*, such as green tea, black tea, oolong tea, and puerh tea; cereals from Poaceae plants such as coix barley, brown rice, barley, and buckwheat, Fabaceae plants, and Polygonaceae plants; and coffee beans from Rubiaceae family, *coffea* genus. Herein, a beverage containing a tea leaf extract as the main component refers to as a tea beverage; a beverage containing, as the main component, an extract from a cereal without any plant of *Camellia sinensis* refers to as a cereal tea beverage; and a beverage containing an extract from coffee beans refers to as a coffee beverage. Among others, the beverage according to the present invention is preferably a cereal tea beverage such as barley tea or brown rice tea or a tea beverage such as green tea, in view of remarkably exhibiting the effect of the present invention. The beverage according to the present invention may contain a single kind of roasted plant extract or may contain a plurality of kinds of roasted plant extracts. For

example, a blend tea is one suitable mode of the present invention.

[0018] As mentioned above, the beverage preferably contains 10 to 20000 ppb of the pyrazine compound. In a case where the beverage is a coffee beverage, the beverage preferably contains 2000 to 20000 ppb, more preferably 3000 to 17000 ppb, even more preferably 4000 to 15000 ppb, of the pyrazine compound. In a case where the beverage is a cereal tea beverage, the beverage preferably contains 1000 to 10000 ppb, more preferably 2000 to 9000 ppb, even more preferably 3000 to 8000 ppb, of the pyrazine compound. In a case where the beverage is a tea beverage, the beverage preferably contains 10 to 500 ppb, more preferably 12 to 400 ppb, even more preferably 15 to 300 ppb, of the pyrazine compound. The pyrazine compound in the present invention means the total of pyrazine, 2-methylpyrazine, 2,5-dimethyl pyrazine, 2,6-dimethyl pyrazine, ethyl pyrazine, 2,3-dimethyl pyrazine, 3-ethyl-2,5-dimethylpyrazine, and 2-ethyl-3,5-dimethyl pyrazine.

[0019] The pyrazine compound concentration of the beverage can be determined by GC/MS measurement. The quantitative ion having favorable detection sensitivity, shape of the peak, and separation of the peak and selected from the ions shown below can be used. In a case where the shape of the peak or sensitivity may not be favorable even when any of the following ions is used, the sample liquid can be diluted with distilled water appropriately or the SIM mode can be used.

- pyrazine m/z 80 or 53
- 2-methylpyrazine m/z 94, 67, or 53
- 2,5-dimethyl pyrazine m/z 108, 81, or 109
- 2,6-dimethyl pyrazine m/z 108, 67, 81, or 109
- 2,3-dimethyl pyrazine m/z 67, 108, 66, or 109
- ethyl pyrazine m/z, 107, 108, 80, 53, or 81
- 3-ethyl-2,5-dimethylpyrazine m/z 135, 136, 108, 107, or 121
- 2-ethyl-3,5-dimethyl pyrazine m/z 135, 136, 108, or 121

Generally, on foods and beverages having "thick viscosity," a thick flavor/taste can be sensed and "richness" is recognized. Accordingly, the problem to be solved by the

present invention is difficult to become apparent on a beverage having thick viscosity. On the other hand, it is generally difficult for consumers to sense "richness" on beverage lacking thick viscosity. According to the present invention, "richness" can be imparted even to a beverage lacking thick viscosity, and it can thus be said that a beverage lacking thick viscosity is preferable as a subject to which the production method of the present invention is applied. The beverage lacking thick viscosity specifically refers to a beverage having a viscosity of 20 mPa·s or less, preferably 15 mPa·s or less, more preferably 10 mPa·s or less, or a beverage containing no thickener. The viscosity herein is a value determined by measurement using a Brookfield viscometer under conditions of a number of revolution of 60 rpm, a sample temperature of 10°C, and a measurement time of 30 seconds.

[0020] It is also empirically known that foods and beverages containing oil/fat has "richness." On the other hand, it is generally difficult for consumers to sense "richness" on a beverage containing no oil/fat. According to the present invention, "richness" can be imparted to a beverage containing no oil/fat, and it can thus be said that a beverage containing no oil/fat is preferable as a subject to which the production method of the present invention is applied. The beverage containing no oil/fat refers to a beverage containing no animal oil/fat such as milk fat or vegetable oil/fat such as palm oil (also including processed vegetable oil/fat), and specifically, a beverage having a lipid content of 1.5 w/v% or less, preferably 1.0 w/v% or less, more preferably 0.5 w/v% or less, and particularly preferably 0 w/v%.

[0021] Similarly, it is generally difficult for consumers to sense "richness" on a beverage containing a little savory ingredient. However, "richness" can be imparted to such a beverage by using the production method of the present invention, and it can thus be said that a beverage containing a little savory ingredient is preferable as a subject of the present invention. Examples of the beverage containing a little savory ingredient include a beverage containing a small amount of saccharide or dextrin and a beverage having a small protein content. The beverage containing a small amount of saccharide refers to a beverage having a total carbohydrate content of 6.0 w/v% or less, preferably 5.0 w/v% or less, more

preferably 4.0 w/v% or less, even more preferably 3.0 w/v% or less, and particularly preferably 2.0 w/v%, or 0 w/v%. The beverage containing a small protein content refers to a beverage having a protein content of 1.5 w/v% or less, preferably 1.0 w/v% or less, more preferably 0.5 w/v% or less, and particularly preferably 0 w/v%.

[0022] Similarly, it is generally difficult for consumers to sense "richness" on a beverage having a little soluble solids content. However, "richness" can be imparted to such a beverage by using the production method of the present invention, and it can thus be said that a beverage having a little soluble solids content is preferable as a subject of the present invention. The beverage having a little soluble solids content refers to a beverage having a soluble solids content (Brix value) of 8 or less, preferably 6 or less, more preferably 4 or less, even more preferably 2 or less, and particularly preferably 1 or less. The lower limit of the soluble solids content is not particularly limited. However, when the soluble solids content (Brix value) of the beverage is 0.1 or more, richness can be more effectively imparted, which is preferable. The soluble solids content can be evaluated in terms of a Brix value obtained using a saccharimeter or refractometer, for example. The Brix value here is a value obtained by converting the refractive index found at 20°C to a mass/mass percent of a sucrose solution on the basis of the conversion table by ICUMSA (International Commission for Uniform Methods of Sugar Analysis). The soluble solids content is in unit "°Bx," "%," or "degrees."

[0023] Furthermore, various additives and the like may be added to the beverage according to the present invention as with common beverages, as long as the effect of the present invention is not impaired. Examples of the various additives include flavorings, extracts, vitamins, minerals, colorants, and antioxidants.

[0024] The beverages according to the present invention encompasses a concentrate that it is to be diluted with water or the like before serving for drinking.

(Method for Producing Beverage)

In the present invention, EGT may be added to a preparation liquid for beverage, followed by heat treatment, so that the resulting beverage contains heated EGT (Method A),

or heated EGT may be added to a beverage (Method B). Specifically, the present invention encompasses the aspects of production methods including the following steps.

[0025] (Method A)

A method for producing a beverage, including the following steps a) to d):

- a) preparing a beverage preparation liquid,
- b) adding EGT to the beverage preparation liquid,
- c) adjusting a pH of the beverage preparation liquid to 5.0 to 7.5, and
- d) heating the beverage preparation liquid containing EGT.

(Method B)

A method for producing a beverage, including the following steps a) and x) to z):

- a) preparing a beverage preparation liquid,
- x) preparing a EGT-containing solution,
- y) heating the EGT-containing solution to prepare a solution containing a heated product of EGT , and
- z) mixing the beverage preparation liquid and the solution containing the heated product of EGT.

[0026] Method A will be described in detail by way of an example in which the beverage is a green tea beverage. Step a) of preparing a beverage preparation liquid includes: (a1) roasting a plant (tea leaves) to obtain a roasted plant; (a2) subjecting the roasted plant to extraction to obtain a roasted plant extract (tea leaves extract liquid) from the roasted plant; and optionally (a3) adding an antioxidant, water, and others to the tea leaves extract liquid to prepare a preparation liquid.

[0027] Roasting step (a1) can be carried out using a heating machine or a roasting machine for use in tea manufacturing process. In the roasting step, it is preferable to select a condition under which a pyrazine compound will be produced. Examples thereof include heating/roasting at a tea temperature of 100 to 160°C for 5 to 30 minutes, and heating/roasting at a tea temperature of 150 to 250°C for 5 to 20 minutes.

[0028] In extraction step (a2), a tea leaves extract liquid is obtained from the roasted tea

leaves. As the extraction method, any known method can be used, including extraction using a kneader, stirring extraction, dripping extraction, and column extraction. The liquor ratio (mass of water for use in extraction/ mass of tea leaves) and the extraction time can be appropriately set according to the extraction method. For example, the liquor ratio is preferably 5 to 50, even more preferably 10 to 40, and particularly preferably 15 to 30. The extraction time is preferably 3 to 120 minutes, and particularly preferably 7 to 60 minutes.

[0029] Examples of water for use in extraction include distilled water, desalinated water, tap water, alkaline ionized water, deep ocean water, ion exchange water, deoxygenated water, and water containing an inorganic salt, and appropriate one can be selected from these and used. Particularly, pure water and ion exchange water are preferably used. The temperature of the water for use in extraction is preferably 50 to 95°C and more preferably 60 to 90°C, in view of extraction efficiency and flavor/taste. The tea leaves extract obtained is cooled and then subjected to filtration and/or centrifugal separation treatment to thereby remove impurities.

[0030] In preparation step (a3), an antioxidant (ascorbic acid, etc.) and the others are added, if needed. Dilution with water or the like may be carried out so that a pyrazine compound content in the final beverage becomes 10 to 20000 ppb.

[0031] In step b), EGT is added to the beverage preparation liquid to prepare an EGT-containing beverage preparation liquid. EGT is added so that an EGT concentration is 0.3 ppm (w/w) or more, preferably 0.5 ppm (w/w) or more, more preferably 1 ppm (w/w) or more, even more preferably 4 ppm (w/w) or more, and particularly preferably 6 ppm (w/w) or more, in the preparation liquid. The upper limit of the EGT concentration is not particularly limited. However, in light of economical merits, the EGT concentration is approximately 440 ppm (w/w) or less, since even adding a larger amount of EGT does not enhance the richness-imparting effect. The EGT concentration is preferably 300 ppm (w/w) or less, more preferably 200 ppm (w/w) or less, even more preferably 100 ppm (w/w) or less, and particularly preferably 80 ppm (w/w) or less.

[0032] In step c), the pH of the beverage preparation liquid is adjusted to 5.0 to 7.5. The

beverage preparation liquid to be subjected to step c) may be the beverage preparation liquid provided in step a), the beverage preparation liquid to which EGT has been added in step b), or the beverage preparation liquid after heating a EGT-containing beverage preparation liquid in step d), which will be described later. Preparation step (a3) and step (c) may be carried out simultaneously. The pH adjustment of the beverage preparation liquid can be carried out appropriately with a pH adjuster, such as sodium bicarbonate or sodium hydroxide.

[0033] In step d), the beverage preparation liquid containing EGT is heat-treated. Step d) may be carried out any time as long as it is after carrying out step b) of adding EGT. Step d) may be carried out just after step b). Alternatively, step b) and then step c) may be carried out, followed by step d). In step d), the heating is carried out under conditions that the following formula (1) is satisfied:

$$\text{formula (1): } Y \geq 34 \times (X - 60)^{-1.1}$$

wherein $61 \leq X \leq 150$. X represents the heating temperature (°C), and Y represents the heating time (min). Herein, the temperature mentioned in relation to the heating treatment means the liquid temperature. It has been found that when heating is carried out under conditions that formula (1) is satisfied, it is possible to obtain heated EGT that can effectively impart "richness."

[0034] The heating temperature is not particularly limited as long as it is within a range from 61 to 150°C and satisfies formula (1). The temperature is preferably 65°C or more, more preferably 80°C or more, and more preferably 90°C or more. If the temperature is less than 61°C, change of EGT due to heating is not expected, and the effect of the present invention, specifically, the richness-imparting effect by heated EGT may not be obtained. In terms of the effect of the present invention, the upper limit of the heating temperature is 150°C, and preferably, 140°C or less.

[0035] The heating time may be selected as long as it satisfies formula (1) depending on the heating temperature. Usually, the upper limit of the heating time is preferably 60 minutes or less, even more preferably 30 minutes or less, and more preferably 15 minutes or less.

[0036] The beverage preparation liquid obtained by method A, which contains heated EGT,

can be made into a packed beverage, as it is or after it is diluted. When a packed beverage is produced, the method includes step e) of filling the beverage liquid into a container, after step c) or step d). Examples of the container into which the beverage liquid is to be filled include general packaging containers as with common beverages, such as a molded container made mainly of polyethylene terephthalate (a so-called PET bottle), a metal can, a container made of paper combined with metal foil or a plastic film, and a glass bottle.

[0037] Next, method B will be described in detail by way of an example in which the beverage is a green tea beverage. As with method A, step a) of preparing a beverage preparation liquid includes: (a1) roasting a plant (tea leaves) to obtain a roasted plant; (a2) subjecting the roasted plant to extraction to obtain a roasted plant extract (tea leaves extract liquid) from the roasted plant; and optionally (a3) adding an antioxidant, water, and others to the tea leaves extract to prepare a preparation liquid.

[0038] In step x), an EGT-containing solution is prepared. The EGT concentration of the solution is 1.0 ppm or more, preferably 3.0 ppm or more, more preferably 5 ppm or more, and even more preferably 10 ppm or more. The upper limit of the EGT concentration of the solution is not particularly limited as long as EGT is in a dissolved state. Usually, the upper limit is approximately 10000 ppm. The medium of the EGT solution is preferably water. Examples thereof include distilled water, desalinated water, tap water, alkaline ionized water, deep ocean water, ion exchange water, deoxygenated water, and water containing an inorganic salt, and appropriate one can be selected from these and used. If the EGT used is an extract in a liquid form from mushroom or sake lees, it can be used as it is or after concentrating or the like as needed, for example.

[0039] In step y), the EGT-containing solution is heated to prepare an EGT solution having been heated. The heating conditions in step y) is the same as in step d) in method A. If concentration of the extract by heating under a condition satisfying the heating condition of step y) is carried out in step x), step y) can be omitted.

[0040] In step z), the beverage preparation liquid prepared in step a) is mixed with the EGT solution having been heated obtained in step y). The mixing is carried out such that an EGT

concentration of the mixed liquid is 0.3 to 440 ppm (w/w). The EGT concentration of the mixed liquid is preferably 0.5 ppm (w/w) or more, more preferably 1 ppm (w/w) or more, even more preferably 4 ppm (w/w) or more, and particularly preferably 6 ppm (w/w) or more. In light of economical merits, the EGT concentration is 440 ppm (w/w) or less, since even adding a larger amount of EGT does not enhance the richness-imparting effect. The EGT concentration is preferably 300 ppm (w/w) or less, more preferably 200 ppm (w/w) or less, even more preferably 100 ppm (w/w) or less, and particularly preferably 80 ppm (w/w) or less.

[0041] The pH of the mixed liquid is adjusted, if needed, such that the pH falls within a range from 5.0 to 7.5. The adjustment of the pH of the mixed liquid can be appropriately carried out with a pH adjuster such as sodium bicarbonate or sodium hydroxide.

[0042] The mixed liquid obtained by method B of the present invention can be made into a packed beverage, as it is or after it is diluted.

EXAMPLES

[0043] Details of the present invention will be specifically described by way of Examples given below, but the present invention is not limited thereto. In Examples, the components and physical properties were determined by the following methods.

(Determination of viscosity)

A Brookfield viscometer was used for determination of the viscosity. The conditions for the determination were as follows.

- Type of meter used: Brookfield viscometer (type TVB-10, manufactured by Toki Sangyo Co., Ltd)
- Rotor: No. 20
- Sample for determination: 400 mL
- Determination temperature: 10°C
- Determination time: 30 seconds
- Number of revolution of rotor: 60 rpm

(Determination of Soluble Solids Content)

The Brix value was determined at 20°C in terms of a reading on a refractometer for sugar (ATAGO CO., LTD., RX-5000).

[0044] (Quantification of pyrazine compounds)

5 mL of the beverage liquid as a sample was placed in a 20 mL volume glass bottle with screw thread (diameter 18 mm, manufactured by GERSTEL GmbH & Co. KG), and the glass bottle was hermetically closed with a metal lid having a septum made of polytetrafluoroethylene (PTFE) (manufactured by GERSTEL GmbH & Co. KG), followed by extraction of aroma components by solid phase micro extraction (SPME). Quantification was carried out by the standard addition method on the basis of peak areas detected by the EIC mode of GC/MS. Apparatus and conditions used are shown below.

- SPME fiber: StableFlex/SS, 50/30 µm DVB/CAR/PDMS (manufactured by Spelco)
- Automatic introduction apparatus for extraction of volatile components:
MultiPurposeSampler MPS2 XL (manufactured by GERSTEL GmbH & Co. KG)
- Preheating: 40°C for 5 min
- Stirring: no
- Extraction of volatile components: 40°C for 30 min
- Desorption time of volatile components: 3 min
- GC oven: GC7890A (manufactured by Agilent Technologies, Inc.)
- Column: VF-WAXms, 60 m x 0.25 mm i.d. df = 0.50 µm (manufactured by Agilent Technologies, Inc.)
- Temperature condition for GC: 40°C (5 min) → 5°C/min → 260°C (11 min)
- Carrier gas: helium, 1.2 ml/min, constant flow mode
- Injection: splitless method
- Inlet temperature: 250°C
- Mass spectrometer: GC/MS Triple Quad7000 (manufactured by Agilent Technologies, Inc.)
- Ionizing method: EI (70eV)
- Determination method: scan determination, or scan & SIM concurrent determination
- Scan parameter: m/z 35-350

The content of pyrazine compounds is the total content of pyrazine, 2-methylpyrazine, 2,5-dimethyl pyrazine, 2,6-dimethyl pyrazine, 2,3-dimethyl pyrazine, ethyl pyrazine, 3-ethyl-2,5-dimethylpyrazine, and 2-ethyl-3,5-dimethyl pyrazine. The ions shown below were used as the ions for quantification.

- pyrazine m/z80
- 2-methylpyrazine m/z67
- 2,5-dimethyl pyrazine m/z108
- 2,6-dimethyl pyrazine m/z108
- 2,3-dimethyl pyrazine m/z108
- ethyl pyrazine m/z107
- 3-ethyl-2,5-dimethylpyrazine m/z135
- 2-ethyl-3,5-dimethyl pyrazine m/z135

(Quantification of lipids, carbohydrates, and proteins)

The beverage liquid as a sample was analyzed for the contents each of lipids, carbohydrates, and proteins defined in Food Labeling Standards in Japan (April 1, 2015 in force) based on the provision of Article 4(1) of Food Labeling Act in Japan (Act No. 70, 2013).

[0045] (Experiment 1) Richness-imparting effect of heated EGT (green tea beverage A)

First, a green tea beverage was produced from green tea leaves. Steam heat was added to raw tea leaves to deactivate oxidase contained in the raw tea leaves (deactivation), and the resulting tea leaves was then subjected to a series of the steps of a crude tea processing, which involved rolling and drying, including hot air-rolling, primary rolling, secondary rolling, and final rolling, and further subjected a heating process (using a rotary drum-type heating machine; 100°C for 10 min), to thereby prepare green tea leaves. 4000 g of ion exchanged water heated to 65°C and 130 g of the green tea leaves described above were placed in a kneader, followed by extraction for 5 minutes under stirring. The resultant was cooled to 30°C or less, and the tea leaves were removed by centrifugal separation to obtain a green tea extract liquid. The extract was diluted with water such that the soluble

solids content (Brix value) derived from the green tea leaves reached 0.3°Bx. To the resulting green tea extract liquid, 400 ppm of L-ascorbic acid and 20 ppm or 440 ppm (w/w) of ergothioneine (EGT) (manufactured by TETRAHEDRON, purity 99.5% or more) were added, and sodium bicarbonate was further added to adjust the pH (20°C) to 6.4, to thereby obtain a beverage liquid. The beverage liquid was heat-treated using a heat exchanger at 135°C for 30 seconds, and then cooled to about 80°C, and a 350 mL heat resistant PET bottle was filled therewith, hermetically sealed, and then cooled to 20°C, to thereby obtain a packed beverage (pyrazine content: 17.4 ppb, protein: 0% w/v, lipid: 0% w/v, carbohydrate: 0% w/v, soluble solids content: 0.3°Bx, viscosity: 2mPa·s, pH 6.1). For comparison, another packed beverage (20°C) was produced by filling a PET bottle with the beverage liquid as it was without heat treatment. A still another heat-treated packed beverage and a yet another packed beverage without heat treatment were produced in the same manner as above except that no EGT was added.

[0046] A beverage test on the packed beverages obtained was conducted by five expert panelists to organoleptically evaluate the richness. The organoleptic evaluation was carried out with reference to the EGT-free beverage without heat treatment as the control. For the control beverage and each EGT-containing beverage (without heat treatment, and with heat treatment), a pair that was a combination of the control and an EGT-containing beverage was given to the five expert panelists, and the panelists evaluated in which beverage of the pair given they felt richness, by two-point discrimination test. The results are shown in Table 1. It was found that the richness-imparting effect was not exhibited by only adding EGT, but that the richness-imparting effect was exhibited by adding EGT and carrying out heat treatment.

[0047] [Table 1]

Sample	The number of panelists who pointed out that richness was strong as compared to the control	
	Without heat treatment	With heat treatment
EGT-FREE	control	0/5
EGT ADDED_20 ppm	0/5	5/5
EGT ADDED_450 ppm	0/5	4/5

[0048] (Experiment 2) Examination of EGT concentration (1)

A green tea extract liquid was obtained in the same manner as in Experiment 1. To the green tea extract liquid, 0 to 440 ppm of EGT and 350 ppm of L-ascorbic acid were added, and sodium bicarbonate was added thereto to adjust the pH to 6.4, to thereby obtain a beverage liquid. 180 g of the beverage liquid was hot-packed into each of 190 mL cans, followed by heat treatment using a retort sterilization machine at 135°C for 1.5 minutes. The resultant was then cooled to 20°C to thereby obtain a packed beverage (pyrazine content: 17.5 ppb, protein: 0% w/v, lipid: 0% w/v, carbohydrate: 0% w/v, soluble solids content: 0.3°Bx, pH 6.1). The organoleptic evaluation on the packed beverages obtained was carried out by five expert panelists. In the organoleptic evaluation, the level of richness of a heat-treated beverage was evaluated by each panelist on the following evaluation scale with reference to a beverage having each EGT concentration without heat treatment as the control, and then the panelists conferred to yield a result. In the evaluation of richness, the level of richness of the heat treated beverage containing 20 ppm of EGT, in which all the panelists felt richness in Experiment 1, was regarded as 4 points.

[0049] [Evaluation scale for richness]

- 4: strong richness is felt as compared to the control (product without heat treatment).
- 3: richness is felt as compared to the control (product without heat treatment).
- 2: richness is slightly felt as compared to the control (product without heat treatment).
- 1: the level of richness is the same as that of the control (product without heat treatment).

The results are shown in Table 2. In the beverages that contained 0.3 ppm or more of heated EGT, richness was slightly added as compared to the control. In the beverages that contained 1.0 ppm or more of EGT, richness was effectively imparted.

[0050] [Table 2]

Sample No.	EGT concentration (ppm)	Score of organoleptic evaluation
2-1	0	1
2-2	0.3	2
2-3	0.5	2
2-4	1.0	3
2-5	4.0	4
2-6	10	4
2-7	20	4
2-8	100	4
2-9	200	4
2-10	440	3

[0051] (Experiment 3) Examination of EGT concentration (2)

The experiment was conducted in the same manner as in Experiment 2, except that the green tea leaves for the green tea beverage was changed to roasted tea leaves. Plucked raw tea leaves were subjected to a crude tea processing (deactivation, hot air-rolling, primary rolling, secondary rolling, and final rolling, and drying), and subjected to a roasting process using a rotary drum-type roasting machine at 180°C for 15 min, to thereby prepare roasted tea leaves, which were used as tea leaves. On the resulting packed beverage (pyrazine content: 147.7 ppb, protein: 0% w/v, lipid: 0% w/v, carbohydrate: 0% w/v, soluble solids content: 0.3°Bx, viscosity: 2 mPa·s, pH 6.1), the level of richness was evaluated in the same manner as in Experiment 2.

[0052] Results are shown in Table 3. Also among roasted tea beverages, richness was slightly added in the beverages that contained 0.3 ppm or more of heated EGT, as compared to the control. In the beverages that contained 1.0 ppm or more of EGT, richness was imparted effectively.

[0053] [Table 3]

Sample No.	EGT concentration (ppm)	Score of organoleptic evaluation
3-1	0	1
3-2	0.3	2
3-3	0.5	2
3-4	1.0	3
3-5	4.0	4
3-6	10	4
3-7	20	4
3-8	100	4
3-9	200	4
3-10	440	3

[0054] (Experiment 4) Examination of EGT concentration (3)

The experiment was conducted in the same manner as in Experiment 2, except that the green tea beverage was changed to a barley tea beverage. Six-row barley seeds were roasted to have an L value of 32 by the hot air roasting method. 30 g of whole grains of this roasted barley were immersed in 1 L of water, followed by boiling for 10 minutes, and solid-liquid separation was carried out to obtain a barley tea extract. The extract was diluted with water such that the soluble solids content (Brix value) derived from the barley reached 0.3°Bx. 0 to 400 ppm of EGT and sodium bicarbonate were added thereto to adjust the pH to 6.5, to thereby obtain a beverage liquid. 180 g of the beverage liquid was hot-packed into each of 190 mL cans, followed by heat treatment using a retort sterilization machine at 135°C for 1.5 minutes. The resultant was then cooled to 20°C to thereby obtain a packed beverage (pyrazine content: 5965.5 ppb, protein: 0% w/v, lipid: 0% w/v, carbohydrate: 0% w/v, soluble solids content: 0.3°Bx, viscosity: 3 mPa·s, pH 6.3). On the packed beverage obtained, the level of richness was evaluated in the same manner as in Experiment 2.

[0055] Results are shown in Table 4. Also among barley tea beverages, richness was slightly added in the beverages that contained 0.3 ppm or more of heated EGT, as compared to the control. In the beverages that contained 1.0 ppm or more of heated EGT, richness was imparted effectively.

[0056] [Table 4]

Sample No.	EGT concentration (ppm)	Score of organoleptic evaluation
4-1	0	1
4-2	0.3	2
4-3	0.5	2
4-4	1.0	3
4-5	4.0	4
4-6	10	4
4-7	20	4
4-8	100	4
4-9	200	4
4-10	440	3

[0057] (Experiment 5) Examination of EGT concentration (4)

The experiment was conducted in the same manner as in Experiment 2, except that the green tea beverage was changed to a coffee beverage. First, a black coffee beverage was produced. Coffee beans (Guatemala) were roasted to a medium roast level (L value 20) using a coffee bean roaster. The roasted coffee beans were ground and subjected to extraction (95°C) using a drip extractor, to thereby obtain a coffee extract liquid in an amount of 10 times as much as the amount (weight) of the coffee beans. The extract was diluted with water such that the soluble solids content (Brix value) derived from the coffee beans reached 1.1°Bx. 0 to 440 ppm of EGT and sodium bicarbonate were added thereto to adjust the pH to 6.3, to thereby obtain a beverage liquid. The black coffee beverage liquid was heat-treated using a heat exchanger at 100°C for 3 minutes, and then a PET bottle was filled therewith aseptically, to thereby obtain a packed black coffee beverage (pyrazine content: 9330 ppb, protein: 0% w/v, lipid: 0% w/v, carbohydrate: 0% w/v, soluble solids content: 0.3°Bx, viscosity: 3 mPa·s, pH 6.3).

[0058] Then, a milk coffee beverage was produced. To the above-described coffee extract liquid (product diluted with water to a Brix value of 1.1°Bx), 5.0% w/v of sucrose, 1.5% w/v of skimmed milk powder, and 2.0% w/v of fresh cream were added, and 0 to 440 ppm of EGT and sodium bicarbonate were further added thereto to adjust the pH to 7.0, to thereby obtain a beverage liquid. The milk coffee beverage liquid was heat-treated using a heat exchanger at 145°C for 20 seconds, and then a PET bottle was filled therewith aseptically, to

thereby obtain a packed milk coffee beverage (pyrazine content: 4675 ppb, protein: 0.8% w/v, lipid: 0.5% w/v, carbohydrate: 5.0% w/v, soluble solids content: 7.0°Bx, viscosity: 5 mPa·s, pH 6.8). On the packed beverages obtained, the level of richness was evaluated in the same manner as in Experiment 2.

[0059] Results are shown in Table 5. Among the black coffee beverages, richness was slightly added in the beverages that contained 0.3 ppm or more of heated EGT, as compared to the control. In the beverages that contained 1.0 ppm or more of heated EGT, richness was imparted effectively. Among the milk coffee beverages, richness was slightly added in the beverages that contained 0.5 ppm or more of heated EGT, as compared to the control. In the beverages that contained 1.0 ppm or more of EGT, richness was imparted effectively. There was a tendency that the richness-imparting effect was significantly exhibited in the black coffee beverages, as compared to the milk coffee beverages.

[0060] [Table 5]

[Table 5-1] Black coffee

Sample No.	EGT concentration (ppm)	Score of organoleptic evaluation
5-1	0	1
5-2	0.3	2
5-3	0.5	2
5-4	1.0	3
5-5	6.0	4
5-6	10	4
5-7	20	4
5-8	100	4
5-9	200	4
5-10	440	3

[Table 5-2] Milk coffee

Sample No.	EGT concentration (ppm)	Score of organoleptic evaluation
5-11	0	1
5-12	0.3	1
5-13	0.5	2
5-14	1.0	3
5-15	6.0	4
5-16	10	4
5-17	20	4
5-18	100	3
5-19	200	3
5-20	440	3

[0061] (Experiment 6) Examination of conditions for heating

A green tea beverage liquid containing 20 ppm of EGT was produced in the same manner as in Experiment 2. 50 mL of the beverage liquid was placed in each of plastic containers with a lid, and heat-treated in a water bath at 60 to 95°C. In the cases where the heating temperature was 110°C or more, the heat treatment was carried out using a heat exchanger or a retort sterilization machine. Thus, packed beverages in a PET bottle or a can were obtained.

[0062] A beverage test on the packed beverages obtained was conducted by four expert panelists to organoleptically evaluate the richness. The organoleptic evaluation was carried out with reference to a beverage without heat treatment as the control. A pair of the control beverage and a heat-treated beverage was given to the expert panelists, and the panelists evaluated in which beverage of the pair given they felt richness, by two-point discrimination test.

[0063] A beverage in which the panelists found distinctly strong richness as compared to the control, or in other words, a beverage in which three or more panelists among four felt "strong" or "slightly strong" richness as compared to the control was rated ○, and a beverage in which all four panelists felt "strong" richness was rated ◎. On the other hand, a beverage in which less than three panelists among four felt "strong" or "slightly strong" richness was rated "×". The results are shown in Table 6. In addition, the results of the

grades are plotted in Fig. 1. From the data of ○ and ⊙, the range in which the effect by the heat treatment can be obtained can be expressed by the approximation: $Y \geq 34 \times (X - 60)^{-1.1}$, wherein X represents the heating temperature (°C), Y represents the heating time (min).

[0064] [Table 6]

Sample No.	Conditions for heat treatment		The number of panelists who pointed out that richness was strong as compared to the control		
	Temperature (°C)	Time (min)	Slightly strong	Strong	Grade
6-1	No heating (control)		-	-	-
6-2	60	5	0	0	×
6-3	60	10	1	0	×
6-4	60	20	1	0	×
6-5	60	45	1	0	×
6-6	63	30	2	1	○
6-7	65	1	2	0	×
6-8	65	2	2	0	×
6-10	65	10	1	3	○
6-11	67	4	0	4	⊙
6-12	67	15	0	4	⊙
6-13	70	1.5	2	0	×
6-14	70	20	0	4	⊙
6-15	85	0.5	2	0	×
6-16	85	1	0	4	⊙
6-17	85	4	0	4	⊙
6-18	85	10	0	4	⊙
6-19	95	1	0	4	⊙
6-20	110	1	0	4	⊙
6-21	110	4	0	4	⊙
6-22	120	1	0	4	⊙
6-23	120	3	0	4	⊙
6-24	135	1.5	0	4	⊙
6-25	145	0.4	0	4	⊙

[0065] (Experiment 7) Richness-imparting effect of heated EGT (water)

Packed mineral water (SUNTORY Natural Mineral Water) was used (pH 7.0). To this water, 20 ppm (w/w) of EGT was added to obtain a beverage liquid. The beverage liquid was heat-treated using a heat exchanger at 135°C for 30 seconds, and then cooled to

about 80°C, and a 350 mL heat resistant PET bottle was filled therewith, hermetically sealed, and then cooled to 20°C, to thereby obtain a packed beverage (pyrazine content: 0 ppb, protein: 0% w/v, lipid: 0% w/v, carbohydrate: 0% w/v, soluble solids content: 0°Bx, pH 6.9). For comparison, another packed beverage (20°C) was produced by filling a PET bottle with the beverage liquid as it was without heat treatment. A still another heat-treated packed beverage and a yet another packed beverage without heat treatment were produced in the same manner as above except that no EGT was added. The packed beverages (EGT-containing water) obtained were evaluated by two-point discrimination test in the same manner as in Experiment 1.

[0066] Results are shown in Table 7. It was found that the richness-imparting effect was not exhibited by only adding EGT, but that the richness-imparting effect was exhibited by adding EGT and carrying out heat treatment. However, the richness-imparting effect on water was smaller than that on the green tea beverage in Experiment 1. Richness was distinctly strong in the green tea beverage, as compared to the control, and on the other hand, slightly strong richness was felt in water.

[0067] [Table 7]

Sample	The number of panelists who pointed out that richness was strong as compared to the control	
	Without heat treatment	With heat treatment
EGT-FREE	control	0/5
EGT ADDED_20 ppm	0/5	3/5

[0068] (Experiment 8) Richness-imparting effect of heated EGT (green tea beverage B)

The packed green tea beverage (EGT-free and heat-sterilized) produced in Experiment 1 was used as a beverage to which richness was to be imparted. On the other hand, EGT was added to pure water and dissolved therein to prepare an EGT solution containing 500 ppm (w/w) of EGT, and 180 g of the EGT solution was hot-packed into each of 190 mL cans, followed by heat treatment using a retort sterilization machine at 135°C for 1.5 minutes. The resultant was cooled to 20°C to thereby obtain an EGT solution having been heated. The packed green tea beverage was opened and poured into a plastic cup, and

the solution containing heated EGT was mixed therewith such that the EGT concentration of the green tea beverage reach the concentration in Table 8, to thereby produce an EGT-containing green tea beverage (pH 6.3). As a control green tea beverage, the green tea beverage to which water (EGT-free) in the same amount as that of the solution containing heated EGT was added was prepared. A drink test on the green tea beverages obtained was conducted by five expert panelists to organoleptically evaluate the richness. The organoleptic evaluation was carried out with reference to the EGT-free beverage as the control. A pair of the control and an EGT-containing beverage was given to the five expert panelists, and the panelists evaluated in which beverage of the pair given they felt richness, by two-point discrimination test.

[0069] The results are shown in Table 8. It was found that the richness was imparted by adding a heated EGT solution. More than half of the panelists pointed out that richness was imparted in the beverage to which the heated EGT solution was added so that an EGT concentration was 0.5 ppm or more. All of the panelists pointed out that richness was imparted in the beverage to which the heated EGT solution was added so that an EGT concentration of 4.0 ppm or more.

[0070] [Table 8]

Sample EGT content	The number of panelists who pointed out that richness was strong in the sample as compared to the control (EGT-free)
0.3 ppm	2/5
0.5 ppm	3/5
1.0 ppm	3/5
4.0 ppm	5/5
10 ppm	5/5
20 ppm	5/5

CLAIMS

1. A method for producing a beverage, comprising the following steps a) to d):
 - a) preparing a beverage preparation liquid,
 - b) adding L-ergothioneine to the beverage preparation liquid to 0.3 to 440 ppm (w/w),
 - c) adjusting a pH (20°C) of the beverage preparation liquid to 5.0 to 7.5, and
 - d) heating the beverage preparation liquid containing L-ergothioneine,wherein conditions for heating in the step d) satisfies conditions of the following formula (1):
formula (1): $Y \geq 34 \times (X - 60)^{-1.1}$
wherein X represents a heating temperature (°C), Y represents a heating time (min), and $61 \leq X \leq 150$.
2. A method for producing a beverage, comprising the following steps a) and x) to z):
 - a) preparing a beverage preparation liquid,
 - x) preparing a solution containing L-ergothioneine,
 - y) heating the solution containing L-ergothioneine to prepare a solution containing heated L-ergothioneine, and
 - z) mixing the beverage preparation liquid and the solution containing heated L-ergothioneine such that a resulting mixed liquid has an L-ergothioneine concentration of 0.3 to 440 ppm (w/w),wherein conditions for heating in the step y) satisfies conditions of the following formula (1):
formula (1): $Y \geq 34 \times (X - 60)^{-1.1}$
wherein X represents a heating temperature (°C), Y represents a heating time (min), and $61 \leq X \leq 150$, and
wherein the beverage has a pH (20°C) of 5.0 to 7.5.
3. The method for producing a beverage according to claim 1 or 2, wherein the beverage comprises 10 to 20000 ppb of a pyrazine compound.