

DESCRIPTION

HIGH-CONCENTRATION-INULIN-CONTAINING TEA BEVERAGE

TECHNICAL FIELD

[0001] The present invention relates to, for example, a packaged tea beverage containing high concentrations of inulin, a method for producing the same, and a method for suppressing the inulin-specific harshness of the packaged tea beverage.

BACKGROUND ART

[0002] In recent years, many packaged beverages, which are packed in packages such as cans and PET bottles, are developed and made commercially available. In particular, speaking of packaged tea beverages, it is common that tea leaves are extracted with an aqueous solution such as water to give a liquid tea extract, and the liquid tea extract is adjusted to give a drinkable concentration and then sold in a state packed in a sealed package such as can or PET bottle.

[0003] Inulin is a type of water-soluble dietary fibers, and is known to have an intestine controlling effect. There are some reports on beverages containing inulin (PTLs 1 and 2).

Further, it is known that polydextrose, also known as a water-soluble dietary fiber, has some problems in tastes such as sourness and bitter astringency, whereas inulin has no sourness or bitter astringency and is capable of improving the taste of beverages (PTL 3).

[0004] Meanwhile, it is known that fermented or semi-fermented tea is rich in polymerized polyphenols produced by polymerization of polyphenols. For example, oolong tea, which is semi-fermented tea, is rich in oolong tea polymerized polyphenols (abbreviated as OTPPs). OTPPs are polyphenols specific to oolong tea, which are produced by polymerization of catechin compounds during the step of semi-fermentation of green tea leaves in the process of oolong tea production. There is available technique for adding OTPPs in a dissolved state to a beverage using an OTPP-rich fraction isolated from an oolong tea extract (PTL 4).

[0005] Also, black tea, which is fermented tea, is rich in oligomers such as theasinensins, theaflavins and thearubigins, as well as high-molecular-weight polyphenols in which such

oligomeric components polymerize in a complicated manner. Such black tea polyphenols are also produced by polymerization of catechin compounds present in tea leaves due to the activity of polyphenol oxidase (PTL 5).

CITATION LIST

PATENT LITERATURES

[0006] PTL 1: Japanese Patent No. JP 4087883

PTL 2: Japanese Translation of PCT International Publication No. JP 2004-504824

PTL 3: Japanese Patent No. JP 2982372

PTL 4: Japanese Domestic Re-publication of PCT International Publication No. JPWO 2005/077384

PTL 5: Japanese Patent No. JP 5118334

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0007] As mentioned above, it is known that inulin, unlike polydextrose, has no sourness or bitter astringency and is capable of improving the taste of beverages. However, the present inventors found that when a person ingests an inulin-rich beverage in relatively large amounts, s/he senses harshness specific to inulin.

[0008] An object of the present invention is to provide a packaged tea beverage comprising high concentrations of inulin having an intestine controlling effect, and characterized in that the harshness specific to inulin is suppressed.

SOLUTION TO PROBLEM

[0009] In order to achieve the aforementioned object, the present inventors have conducted intensive studies to develop a method for suppressing the harshness specific to inulin under inulin-rich conditions, and as a result found that when a polymerized polyphenol is added to a beverage at a concentration within the specified range under the condition that a catechin compound is present in an amount within the specified range, the harshness specific to inulin can be suppressed, as well as the top note of the beverage can be enhanced, a pronounced black tea-like aroma can be imparted, and also the beverage can be made easier to drink.

Thus, the inventors have completed the present invention.

[0010] More specifically, the present invention is directed to, but not limited to, the following.

- 1) A packaged tea beverage, comprising:
 - 1 to 6 g/100 mL of inulin,
 - 1 to 800 ppm of a catechin compound, and
 - a polymerized polyphenol.
- 2) The packaged tea beverage as set forth in 1), wherein inulin is present in an amount of 1.5 to 4 g/100 mL.
- 3) The packaged tea beverage as set forth in 1) or 2), wherein the catechin compound is present in an amount of 100 to 600 ppm.
- 4) The packaged tea beverage as set forth in any of 1) to 3), wherein the polymerized polyphenol is present in an amount of 1 to 600 ppm.
- 5) The packaged tea beverage as set forth in any of 1) to 4), further comprising an alcohol in an amount of less than 1 wt.%.
- 6) The packaged tea beverage as set forth in any of 1) to 5), wherein the packaged tea beverage has a ratio of an inulin content relative to a product obtained by multiplying a catechin compound content by a polymerized polyphenol content (inulin content (ppm)/(catechin compound content (ppm) × polymerized polyphenol content (ppm)), which is in the range of from 0.02 to 60000.
- 7) The packaged tea beverage as set forth in any of 1) to 6), wherein the packaged tea beverage is oolong tea or black tea.
- 8) The packaged tea beverage as set forth in any of 1) to 7), wherein the packaged tea beverage has an intestine controlling effect.
- 9) The packaged tea beverage as set forth in any of 1) to 8), wherein the packaged tea beverage is a packaged beverage with a volume of 500 mL or more.
- 10) A method for producing a packaged tea beverage, the method comprising the steps of:
 - adjusting an inulin content in the beverage to be in the range of 1 to 6 g/100 mL;

adjusting a catechin compound content in the beverage to be in the range of 1 to 800 ppm; and

adjusting a polymerized polyphenol content in the beverage to be in the range of 1 to 600 ppm.

11) A method for suppressing the harshness specific to inulin in a packaged tea beverage, wherein the suppression of harshness is achieved by adjusting a catechin compound content in the beverage to be in the range of 1 to 800 ppm and adjusting a polymerized polyphenol content in the beverage to be in the range of 1 to 600 ppm.

ADVANTAGEOUS EFFECT OF INVENTION

[0011] The present invention can provide a packaged tea beverage comprising high concentrations of inulin having an intestine controlling effect, and characterized in that the harshness specific to inulin is suppressed.

BRIEF DESCRIPTION OF DRAWING

[0012] [FIG. 1] FIG. 1 depicts a HPLC chart showing the peak of a tea polymerized polyphenol.

DESCRIPTION OF EMBODIMENTS

[0013] The following provides descriptions on the packaged tea beverage of the present invention (hereinafter also referred to as “tea beverage of the present invention”) and its related methods.

[0014] Tea beverage

As referred to in the present invention, the “tea beverage” refers to: tea such as black tea, oolong tea, or puerh tea, which is produced mainly using the leaves and/or stems of the tea plant (scientific name: *Camellia sinensis*); a blend of such tea with unpolished rice, barley or similar cereals, or any other various plant ingredients; or a beverage of a liquid extracted with an aqueous solvent from an ingredient including mainly the leaves, stems, underground stems, roots, flowers, or fruits of any other plants besides tea plant, or from a blend of those ingredients.

[0015] The packaged tea beverage of the present invention encompasses not only tea

beverages that are packed in various packages including can, PET bottle, and paper package and are made available for drinking purpose for a long time, but also beverages prepared from condensed liquid tea extracts which are intended for use to prepare the aforementioned beverages or for use by dilution at the time of drinking.

[0016] The tea beverage of the present invention encompasses semi-fermented teas (*e.g.*, oolong tea) and fermented teas (*e.g.*, black tea). To be specific, the tea beverage of this invention can be exemplified by various kinds of tea, including: semi-fermented teas such as *Hoshucha*, *Tekkannon* tea and oolong tea; and fermented teas such as black tea, *Awa-bancha*, and puerh tea. The part of the tea plant to be used to produce tea is not limited at all as long as it can be used to extract drinkable tea -- leaves, stems, and/or other parts can be used as appropriate. The form of the part to be used is also not limited -- big tea leaves, powdered tea leaves, and any other forms are fine. The tea beverage of this invention is preferably oolong tea or black tea.

[0017] (Inulin)

Inulin is a group of polysaccharides found in various plants, and is a polymer composed of multiple numbers of fructose units linked to a terminal glucose. Inulin, a type of water-soluble dietary fibers, is known to contribute to the growth of intestinal microbiotas beneficial to the human body (intestinal microbiota growth promoting effect). Inulin passes through the stomach and duodenum without being digested, and acts as a substance beneficial to intestinal microbiota.

[0018] Inulin has an intestine controlling effect and thus is capable of conditioning the gut including intestines and digestive tracts. To be specific, inulin is capable of improving, ameliorating or enhancing intestinal functions and states, and colonic environment. Further, inulin is effective in promoting intestinal movements and in alleviating or preventing constipation.

[0019] The inulin that can be used in the beverage of the present invention is a fructan consisting of fructosyl units linked mainly by β -2,1 linkages, and having a chain length ranging from 2 to 100, preferably from 2 to 60. At least 90% of the linkages found in inulin

are β -2,1 linkages. For example, Frutafit® and Raftiline® are available as inulin products derived from chicory. Inulin can also be obtained from many species of plants by a method well known to skilled artisans.

[0020] The content of inulin in the beverage of the present invention is in the range of 1 to 6 g/100 mL, preferably 1.2 to 5.8 g/100 mL, 1.3 to 5.6 g/100 mL, or 1.7 to 5.3 g/100 mL, more preferably 1.8 to 4.0 g/100 mL, most preferably 2 to 3.6 g/100 mL. The inventive beverage may also contain both or either of citric acid and malic acid.

[0021] The inulin content can be quantified using a known method such as HPLC. For example, the inulin content can be determined by any known methods such as GC-MS and HPLC.

[0022] The average degree of polymerization of inulin can be analyzed according to the procedure described below. It should be noted that the “degree of polymerization” refers to the number of saccharide units (fructose and glucose units) in inulin, and that the “average degree of polymerization” can be regarded, for example, as the top of the peak in the analysis results obtained by a common analysis method such as HPLC, GC or HPAEC according to the following procedure. First, the degrees of polymerization of produced inulin samples are determined using, for example, ULTRON PS-80N (8×300 mm) (solvent: water; flow rate: 0.5 mL/min.; temperature: 50°C) produced by Shinwa Chemical Industries Ltd., or TSK-GEL G3000PWXL (7.8×300 mm) (solvent: water; flow rate: 0.5 mL/min.; temperature: 50°C) produced by Tosoh Corporation, as a column, and using a differential refractometer as a detector, and then the determined degrees of polymerization are compared to calibration curves constructed using, for example, the plant-derived inulin products, Raftiline ST (average degree of polymerization: 11) and Raftiline HP (average degree of polymerization: 22) produced by Orafiti, as reference materials, to yield an average degree of polymerization of inulin. Additionally, analysis of the degree of polymerization of inulin can be made according to the method described in Loo, *et al.* (*Critical Reviews in Food Science and Nutrition*, 35(6), 525-552 (1995)).

[0023] (Catechin compound)

It is important that the tea beverage of the present invention should have a catechin compound content adjusted to be in the range of 1 to 800 ppm, preferably 10 to 750 ppm, 20 to 700 ppm, 30 to 650 ppm, or 50 to 600 ppm, more preferably 100 to 600 ppm, most preferably 150 to 400 ppm, based on the volume of the tea beverage. As referred to herein, “ppm” refers to ppm by weight/volume and corresponds to mg/L. A tea beverage with a catechin compound content exceeding 800 ppm may taste pungently bitter and/or astringent when put in the mouth.

[0024] As referred to herein, the “catechin compound” is a generic name for catechin, epicatechin, galocatechin, epigallocatechin, catechin gallate, epicatechin gallate, galocatechin gallate, and epigallocatechin gallate. Additionally, for the sake of confirmation, the catechin compound contents mentioned hereinabove refer to the total amount of those catechin compounds.

[0025] The compositional profile of a catechin compound present is not particularly limited, but gallate-type catechin compounds (a generic name particularly used for catechin gallate, epicatechin gallate, galocatechin gallate, and epigallocatechin gallate), which are known to be particularly strong in bitterness and astringency, are preferably present, and a tea beverage with a proper balance between umami taste and astringency can be produced through the use of such a catechin compound. Therefore, a tea beverage containing high proportions of a gallate-type catechin compound is also included as one of the preferred modes of the present invention. To be specific, the proportion of a gallate-type catechin(s) in all catechin compounds present ($[\text{mass of a gallate-type catechin compound(s)}]/[\text{mass of all catechin compounds}] \times 100\%$) is in the range of about 40 to 95%, preferably about 45 to 90%, more preferably about 46 to 80%.

[0026] The catechin compound content can be adjusted by adding a condensed green tea extract (*e.g.*, a commercially available product, such as “Polyphenon” (Mitsui Norin Co., Ltd.), “Teaflan” (ITO EN, Ltd.), or “Sunphenon” (Taiyo Kagaku Co., Ltd.)) depending on the need. The proportion of a gallate-type catechin compound(s), in many cases, falls within the aforementioned range without any particular treatment for adjusting the same.

[0027] (Polymerized polyphenol)

It is important that the tea beverage of the present invention should have a polymerized polyphenol incorporated therein. In the absence of a polymerized polyphenol, the harshness specific to inulin cannot be fully suppressed merely by incorporating a catechin compound alone. However, adding a polymerized polyphenol to a beverage enhances the top note to the beverage, imparts a pronounced black tea-like aroma, and makes the beverage easier to drink. The type of a polymerized polyphenol is not particularly limited as long as it is a polyphenolic polymer, and examples include, but are not limited to, anthocyanins, resveratrol, isoflavones, lignans, hesperidins, curcumins, catechin compounds, and tannins.

[0028] The polymerized polyphenol preferably used in the present invention is a tea polymerized polyphenol in which catechin compounds are polymerized. As referred to herein, the “tea polymerized polyphenol” refers to a polyphenolic polymer having a structure in which a plurality of non-polymerized monomeric catechin compounds (*i.e.*, (+)-catechin, (-)-epicatechin, (+)-gallocatechin, (-)-epigallocatechin, (-)-catechin gallate, (-)-epicatechin gallate, (-)-gallocatechin gallate, and (-)-epigallocatechin gallate (hereinafter also referred to as “non-polymerized catechin compounds”)) are linked together by a tea-derived or any other enzyme, light exposure, change in pH, or the like. To be specific, the polymerized polyphenol is a component that peaks at the same elution time (referential elution time: 25 min.) as theaflavin (produced by Kurita Research Center) when analyzed by HPLC under the following conditions.

- Column: TSK-gel ODS-80TsQA (4.6 mmφ × 150 mm, Tosoh Corporation)

- Mobile phase:

A: water:acetonitrile:trifluoroacetic acid = 900:100:0.5

B: water:acetonitrile:trifluoroacetic acid = 200:800:0.5

- Flow rate: 1.0 mL/min

- Column temperature: 40°C

- Gradient conditions:

5 minutes from the start of analysis: 0% liquid B

- 5-11 minutes: 0 to 8% liquid B
- 11-21 minutes: 8 to 10% liquid B
- 21-22 minutes: 10 to 100% liquid B
- 22-30 minutes: Held at 100% liquid B
- 30-31 minutes: 0% liquid B

- Detection: A 280 nm (data collection time: 30 minutes); the peak area was used for quantification.

- Injection volume: 10 μ L

- Reference material: Oolonghomobisflavan B (abbreviated as OHBF-B)

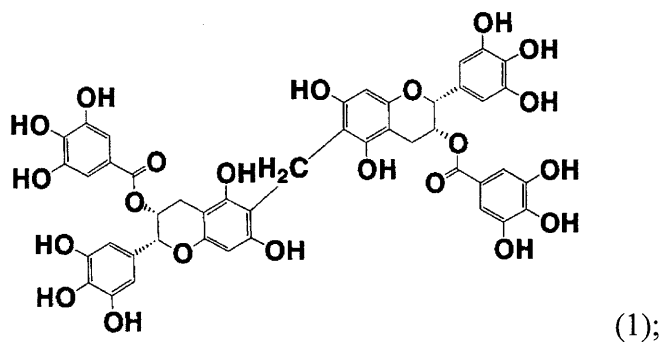
[0029] The amount of a polymerized polyphenol can be determined by constructing a calibration curve using OHBF-B as a reference material. Examples of OHBF-B that can be used as a reference material include, but are not limited to, the one synthesized by the method described in *Chem. Pharm. Bull* 37 (12), 3255-3563 (1989) or by the method described in Japanese Patent Application Publication No. JP 2005-336117 (Example 3) (preferably purified to a purity of 98% or higher), and the one isolated from tea leaves.

[0030] In the analysis under the aforementioned conditions, the peak of a tea polymerized polyphenol may overlap with those of other components. Examples of a beverage containing such other components include, but are not limited to, beverages containing fruit juice and beverages containing a plant extract. In such a case, the aforementioned analysis conditions are fit for identification of a tea polymerized polyphenol but not fit for quantification of a tea polymerized polyphenol. In that case, the peak that appears at about 14 min. is used for quantification. A value obtained by multiplying the peak area at about 14 min. by 10 is compared with the peak area that appears at about 25 min., and if the former value is smaller, the former value is used for quantifying a polymerized polyphenol. FIG. 1 is an example of a HPLC chart showing such peaks.

[0031] Specific examples of the tea polymerized polyphenol include not only polymerized polyphenols called by such trivial name as thearubigin, but also polymerized polyphenols exemplified by:

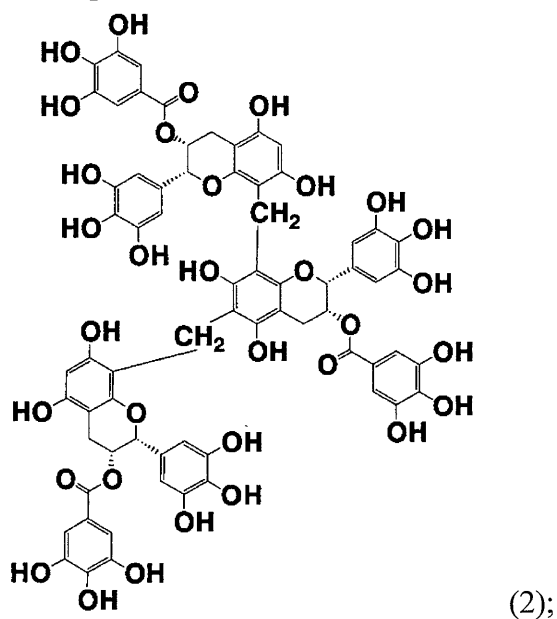
an epigallocatechin gallate dimer represented by the formula (1):

[Chem. 1]



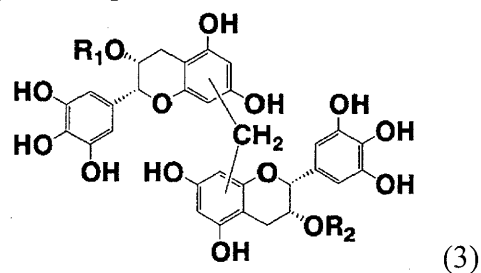
[0032] an epigallocatechin gallate trimer represented by the formula (2):

[Chem. 2]



[0033] an epigallocatechin dimer represented by the formula (3):

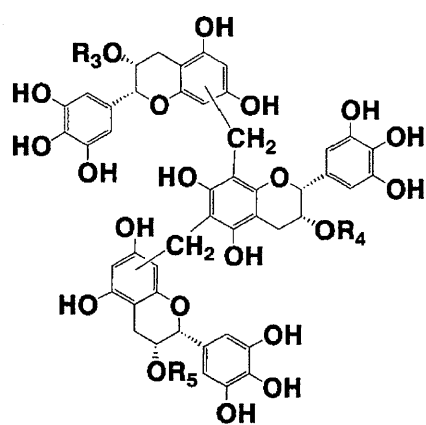
[Chem. 3]



(wherein R₁ and R₂ each independently represent H or a galloyl group);

[0034] an epigallocatechin trimer represented by the formula (4):

[Chem. 4]

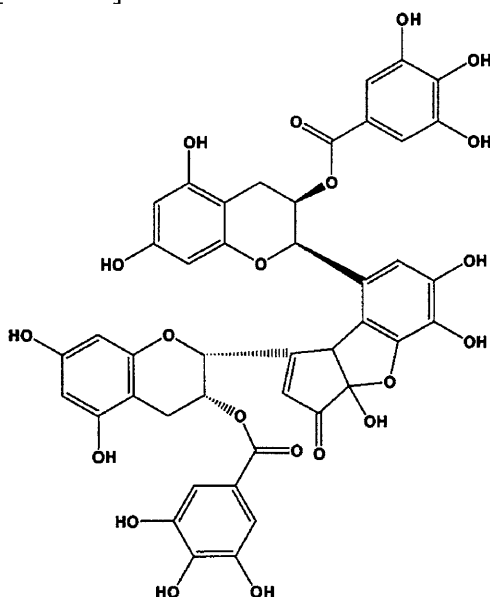


(4)

(wherein R₃, R₄ and R₅ each independently represent H or a galloyl group); and

[0035] oolongtheanine-3'-O-gallate represented by the formula (5):

[Chem. 5]



(5).

[0036] The tea polymerized polyphenol of the present invention can be obtained as a plant extract containing a tea polymerized polyphenol. Such a plant extract can be obtained by, for example, subjecting tea leaves to extraction with a solvent. The tea leaves that are preferably used as a source ingredient are leaves of semi-fermented tea or fermented tea which are rich in polymerized polyphenols, and in particular, leaves of oolong tea or black tea. Examples of an extraction solvent to be used include cold or hot water, methanol, ethanol, isopropanol, ethyl acetate, and the like, and extraction is performed using any one of such solvents alone or using a mixture of two or more of them. The solvent extract of tea leaves may be used as it is, but a concentrated or purified form of tea leaf extract, which is

obtained by selectively removing compounds other than a tea polymerized polyphenol(s) from the solvent extract of tea leaves to increase polymerized polyphenol content, is preferably used. Another procedure that may be used besides direct extraction of a tea polymerized polyphenol(s) from tea leaves is to treat tea leaves or an extract thereof containing a tea polymerized polyphenol(s) and/or a non-polymerized catechin compound(s) with an enzyme such as polyphenol oxidase to thereby increase the degree of polymerization of a tea polymerized polyphenol(s) as compared with that of those polyphenols inherently present in oolong tea. As the degree of polymerization of a polymerized polyphenol(s) becomes higher and the proportion of the polymerized polyphenol(s) becomes higher than that of a non-polymerized catechin compound(s), the resulting beverage becomes lower in unfavorable bitter astringency and more favorable in flavor.

[0037] Tea polymerized polyphenols are soluble components. From viewpoints such as prevention of precipitation during storage, it is preferable to subject a solvent extract of tea leaves to separation or clarification by centrifugation or filtration to remove insoluble solids. In the present invention, the tea polymerized polyphenol may be used in a liquid form or in a powdered form obtained by spray-drying, frost-shattering or the like.

[0038] The proportion of a polymerized polyphenol incorporated in the beverage of the present invention is in the range of 1 to 600 ppm, preferably 10 to 500 ppm, 20 to 450 ppm, or 50 to 400 ppm, more preferably 70 to 300 ppm, based on the total volume of the beverage. If a polymerized polyphenol is present only at a concentration of less than 1 ppm, the harshness specific to inulin cannot be fully suppressed merely by incorporating a catechin compound alone. If a polymerized polyphenol is present at a concentration of more than 600 ppm, the resulting beverage can deteriorate in taste and flavor.

[0039] $(\text{Inulin content} / (\text{catechin compound content} \times \text{polymerized polyphenol content}))$

The ratio of an inulin content (ppm) relative to a product obtained by multiplying a catechin compound content (ppm) by a polymerized polyphenol content (ppm) (inulin content (ppm) / (catechin compound content (ppm) $\times$ polymerized polyphenol content (ppm))) in the beverage of the present invention is in the range of from 0.02 to 60000, preferably

from 0.1 to 4000, more preferably from 0.15 to 2, most preferably from 0.25 to 1.

[0040] (Other components)

The packaged tea beverage of the present invention may have any of various additives added thereto alone or in combination, such as antioxidant, emulsifier, preservative, pH adjustor, flavoring, seasoning, sweetener, acidifier, and quality stabilizer. From the viewpoint of flavor, *i.e.*, because the flavor inherent in tea can be enjoyed, it is preferred not to add such an additive as flavoring, seasoning, sweetener or acidifier, and from the viewpoint of storage stability, it is preferred to adjust the pH to be in the range of 5.0 to 7.0.

[0041] The beverage of the present invention may also have added thereto not only the aforementioned components but also other additives commonly used in beverages, such as flavoring, vitamin, pigment, antioxidant, preservative, seasoning, extract, pH adjustor, and quality stabilizer, as long as such additives do not impair the effects of this invention.

[0042] The beverage of the present invention contains an alcohol in an amount of less than 1 wt.%, preferably not more than 0.3 wt.%, more preferably not more than 0.1 wt.%, yet more preferably not more than 0.01 wt.%. In other words, the incorporation of an alcohol is achieved through addition of a flavoring, but the beverage of this invention is preferably low in flavoring content, and is particularly preferably free of flavoring. Examples of the "alcohol", as referred to herein, include, but are not limited to, ethanol, 1-propanol, isopropanol, 1-butanol, isobutanol, amyl alcohol, isoamyl alcohol, 2-pentanol, 1-hexanol, 2-hexanol, 3-hexanol, 1-heptanol, 2-heptanol, 3-heptanol, 4-heptanol, propylene glycol, 1,3-butanediol, neopentylglycol, and glycerol.

[0043] (Packaged tea beverage)

The tea beverage of the present invention is provided in a form packed in a package. Examples of the package include, but are not limited to, metal package such as can, PET bottle, paper package, glass bottle, and pouch. A sterilized, packaged beverage product can be produced through, for example, taking the step of performing heat sterilization such as retort sterilization after the beverage of this invention is packed in a package, or the step of packing the beverage into a package after the beverage is sterilized.

[0044] The packaged beverage of the present invention can not only be drunk directly from a package, but also can be consumed for drinking purpose by pouring the beverage packed in a bulk package such as bag-in-box or in a portion package into a different container. Also, a liquid concentrate of the inventive beverage can be diluted when consumed for drinking purpose. It goes without saying that in such a case, the effects of this invention can be obtained as long as the concentrations of different components in the beverage diluted for drinking fall within the ranges defined in this invention. Therefore, such types of beverages are also one of the modes of this invention.

[0045] Since the beverage of the present invention is characterized in that the harshness specific to inulin is suppressed so that the beverage “can be drunk in large gulps”, the volume of the beverage is preferably relatively large, and can be, for example, 500 mL or more, or more specifically 550 mL or 600 mL.

[0046] (Method for producing a tea beverage)

In another aspect, the present invention is directed to a method for producing a packaged tea beverage. This method comprises the steps of: adjusting an inulin content in the beverage to be in the range of 1 to 6 g/100 mL; adjusting a catechin compound content in the beverage to be in the range of 1 to 800 ppm; and adjusting a polymerized polyphenol content in the beverage to be in the range of 1 to 600 ppm.

[0047] In this method, the inulin content may be adjusted to be in the range of 1.5 to 4 g/100 mL, the catechin compound content may be adjusted to be in the range of 100 to 600 ppm, and the polymerized polyphenol content may be adjusted to be in the range of 10 to 600 ppm.

[0048] The timings to conduct the aforementioned adjustment steps are also not limited. For example, these steps may be conducted at the same time, at different times, or in random order. It is only necessary that the finished beverage satisfy the requirements defined above.

[0049] (Method for suppressing the harshness specific to inulin)

In another aspect, the present invention is directed to a method for suppressing the harshness specific to inulin. This method involves adjusting a catechin compound content

in the beverage to be in the range of 1 to 800 ppm and adjusting a tea polymerized polyphenol content in the beverage to be in the range of 1 to 600 ppm.

[0050] (Intended use)

Since the tea beverage of the present invention contains high concentrations of inulin, this invention provides a beverage having an intestine controlling effect and capable of conditioning the gut including intestines and digestive tract. To be specific, the beverage of this invention is capable of improving, ameliorating or enhancing intestinal functions and states, and colonic environment, and also is effective in promoting intestinal movements and in alleviating or preventing constipation.

[0051] (Numerical ranges)

For the sake of clarification, all numerical ranges defined herein by upper and lower limits, *i.e.* defined as “lower limit to upper limit”, include their upper and lower limits. For example, the range defined as “1 to 2” includes 1 and 2.

EXAMPLES

[0052] Hereunder, the present invention will be described by way of working examples, but this invention is not limited to these examples.

[0053] (Production Example 1) Production of a tea polymerized polyphenol-containing extract

Six hundred kilograms (600 kg) of oolong tea leaves were subjected to extraction treatment with 7800 kg of a sodium bicarbonate solution prepared by adding 0.15 wt.% of sodium bicarbonate to hot water (95°C), to give about 7000 kg of a liquid extract of oolong tea. While the temperature of the liquid extract was held at 60 to 65°C, the liquid extract was passed through 400 kg of particulate activated carbon (GW-H32/60, produced by Kurarray Co., Ltd.) to remove non-polymerized catechin compounds and caffeine. The resulting effluent (liquid treated with activated carbon) was concentrated under reduced pressure to give about 900 kg of a polymerized polyphenol-rich essence with a Brix value of 11 (essence as a concentrated oolong tea extract; hereinafter referred to as “essence A”). The concentrations of polymerized polyphenols and non-polymerized catechin compounds in

essence A thus obtained were measured by HPLC under the following conditions. As a result, polymerized polyphenols and non-polymerized catechin compounds were found to be present at concentrations of 12000 ppm and 800 ppm, respectively.

[0054] HPLC conditions:

- Column: TSK-gel ODS-80TsQA (4.6 mmφ × 150 mm, Tosoh Corporation)

- Mobile phase:

 - A: water:acetonitrile:trifluoroacetic acid = 900:100:0.5

 - B: water:acetonitrile:trifluoroacetic acid = 200:800:0.5

- Flow rate: 1.0 mL/min

- Column temperature: 40°C

- Gradient conditions:

 - 5 minutes from the start of analysis: 0% liquid B

 - 5-11 minutes: 0 to 8% liquid B

 - 11-21 minutes: 8 to 10% liquid B

 - 21-22 minutes: 10 to 100% liquid B

 - 22-30 minutes: Held at 100% liquid B

 - 30-31 minutes: 0% liquid B

- Detection: A 280 nm

- Reference material (polymerized polyphenol): Oolonghomobisflavan B (OHBF-B)

- Retention time of polymerized polyphenol: A peak observed at approximately 25 minutes coincided with the peak of theaflavin.

- Reference material (non-polymerized catechin compounds): Epigallocatechin gallate (EGCg), gallocatechin gallate (GCg)

- The concentration of non-polymerized catechin compounds measured in working examples refers to the total concentration of epigallocatechin gallate (EGCg) and gallocatechin gallate (GCg).

[0055] (Test Example 1)

Different oolong tea beverages were prepared using commercial oolong tea leaves

according to the recipes shown in Table 1, subjected to UHT sterilization treatment, and then packed in 500 mL PET bottles, whereby different packaged tea beverages were produced. In this process, “Fuji FF” produced by Fuji Nihon Seito Corporation was added as inulin to adjust inulin content to each of the values indicated in the table, and also “Sunphenon” (produced by Taiyo Kagaku Co., Ltd.) was added as a catechin compound to adjust total catechin compound content to each of the indicated values.

[0056] [Table 1]

Sample name	Corn.Ex. 1	Corn.Ex. 2	Ex. 1	Ex. 2	Ex. 3	Ex. 4	Ex. 5	Ex. 6	Ex. 7	Ex. 8
Inulin (g/100 mL)	1	6	1	1	1	1	1	1	1	1
Catechin compound (ppm)	1	800	1	1	10	15	40	100	800	800
Polymerized polyphenol (ppm)	0	0	1	10	100	200	600	1	1	10
Sensory test	1	1	2	3	3	3	3	3	3	3
Inulin cont./{(Catechin cont.×Polym. polyphenol cont.)}	--	--	10000	1000	10	3.3	0.42	100	13	1.3

Sample name	Ex. 9	Ex. 10	Ex. 11	Ex. 12	Ex. 13	Ex. 14	Ex. 15	Ex. 16	Ex. 17	Ex. 18
Inulin (g/100 mL)	1	1	1	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Catechin compound (ppm)	800	800	800	1	100	100	100	800	800	800
Polymerized polyphenol (ppm)	100	200	600	1	10	200	600	10	200	600
Sensory test	3	3	3	3	4	4	4	4	4	4
Inulin cont./{(Catechin cont.×Polym. polyphenol cont.)}	0.13	0.063	0.021	13000	13	0.65	0.22	1.6	0.081	0.027

Sample name	Ex. 19	Ex. 20	Ex. 21	Ex. 22	Ex. 23	Ex. 24	Ex. 25	Ex. 26	Ex. 27	Ex. 28
Inulin (g/100 mL)	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
Catechin compound (ppm)	1	10	15	40	100	100	100	200	200	200
Polymerized polyphenol (ppm)	10	100	200	600	100	200	600	100	200	600
Sensory test	4	4	4	4	4	5	5	5	5	5
Inulin cont./{(Catechin cont.×Polym. polyphenol cont.)}	1800	18	6.0	0.75	1.80	0.9	0.30	0.90	0.45	0.15

Sample name	Ex. 29	Ex. 30	Ex. 31	Ex. 32	Ex. 33	Ex. 34	Ex. 35	Ex. 36	Ex. 37	Ex. 38
Inulin (g/100 mL)	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	2	2
Catechin compound (ppm)	400	400	400	600	600	600	600	600	10	15
Polymerized polyphenol (ppm)	100	200	600	1	10	100	200	600	100	200
Sensory test	5	5	5	3	4	5	5	5	4	4
Inulin cont./{(Catechin cont.×Polym. polyphenol cont.)}	0.45	0.23	0.075	30	3.0	0.30	0.15	0.050	20	6.7

Sample name	Ex. 39	Ex. 40	Ex. 41	Ex. 42	Ex. 43	Ex. 44	Ex. 45	Ex. 46	Ex. 47	Ex. 48
Inulin (g/100 mL)	2	2	2	2	2	2	2	2	2	2
Catechin compound (ppm)	40	100	100	100	100	200	200	200	400	400
Polymerized polyphenol (ppm)	600	10	100	200	600	100	200	600	100	200
Sensory test	4	4	4	5	5	5	5	5	5	5
Inulin cont./{(Catechin cont.×Polym. polyphenol cont.)}	0.83	20	2.0	1.0	0.33	1.0	0.5	0.17	0.50	0.25

Sample name	Ex. 49	Ex. 50	Ex. 51	Ex. 52	Ex. 53	Ex. 54	Ex. 55	Ex. 56	Ex. 57	Ex. 58
Inulin (g/100 mL)	2	2	2	2	4	4	4	4	4	4
Catechin compound (ppm)	400	600	600	600	1	10	15	40	600	600
Polymerized polyphenol (ppm)	600	100	200	600	10	100	200	600	1	10
Sensory test	5	5	5	5	4	4	4	4	3	4
Inulin cont./{(Catechin cont.×Polym. polyphenol cont.)}	0.083	0.33	0.17	0.056	4000	40	13	1.7	67	6.7

Sample name	Ex. 59	Ex. 60	Ex. 61	Ex. 62	Ex. 63	Ex. 64	Ex. 65	Ex. 66	Ex. 67	Ex. 68
Inulin (g/100 mL)	4	4	4	6	6	6	6	6	6	6
Catechin compound (ppm)	600	600	600	1	1	10	15	40	800	800
Polymerized polyphenol (ppm)	100	200	600	1	10	100	200	600	1	10
Sensory test	4	4	4	3	3	3	3	3	3	3
Inulin cont./{(Catechin cont.×Polym. polyphenol cont.)}	0.67	0.33	0.11	60000	6000	60	20	2.5	75	7.5

Sample name	Ex. 69	Ex. 70	Ex. 71
Inulin (g/100 mL)	6	6	6
Catechin compound (ppm)	800	800	800
Polymerized polyphenol (ppm)	100	200	600
Sensory test	3	3	3
Inulin cont./{(Catechin cont.×Polym. polyphenol cont.)}	0.75	0.38	0.13

[0057] The contents of inulin, catechin compounds and polymerized polyphenols in the produced beverages are as shown in Table 1.

[0058] The produced beverages were evaluated for their flavor by well-trained professional

panelists through sensory test based on the scoring method. Five professional panelists were asked to make comprehensive evaluation on the flavor of the beverages by rating them based on the following 5-point scoring system: 5 points: "tastes very good"; 4 points: "tastes good"; 3 points: "tastes passable"; 2 points: "tastes slightly harsh"; and 1 point: "tastes strongly harsh". The scores were averaged, and the test beverages were ranked into one of five levels depending on the average score. 2 or higher points were regarded as acceptable. The results are shown in Table 1.

[0059] As shown in Table 1, the harshness derived from high concentrations of inulin was not fully improved when no polymerized polyphenol was added, whereas the harshness was improved even when only 1 ppm of a polymerized polyphenol was added. When the polymerized polyphenol content was further increased, those beverages containing inulin, catechin compounds, and a polymerized polyphenol at concentrations within the specified ranges produced good results.

[0060] (Test Example 2)

Commercial black tea leaves were subjected to extraction by putting them into hot water at 90°C so as to give a concentration of 20 g/100 mL, and the tannic acid content of the resulting liquid extract was measured by an iron tartrate colorimetric method and found to be 800 ppm. Also, the total catechin compound content of this liquid extract was measured by the method described in Production Example 1 and found to be 300 ppm. Therefore, it was found that this liquid extract had a polymerized polyphenol content of 500 ppm. Different black tea beverages were prepared according to the recipes shown in Table 2, subjected to UHT sterilization treatment, and then packed in 500 mL PET bottles, whereby different packaged tea beverages were produced. In this process, "Fuji FF" produced by Fuji Nihon Seito Corporation was added as inulin to adjust inulin content to each of the values indicated in the table, and also "Sunphenon" (produced by Taiyo Kagaku Co., Ltd.) was added as a catechin compound to adjust total catechin compound content to each of the indicated values.

[0061] [Table 2]

Sample name	Ex. 72	Ex. 73	Ex. 74	Ex. 75	Ex. 76	Ex. 77	Ex. 78	Ex. 79	Ex. 80	Ex. 81
Inulin(g/100ml)	1	1.5	1.5	1.5	1.5	1.5	1.8	1.8	1.8	1.8
Catechin compound (ppm)	800	100	100	600	600	800	100	200	400	400
Polymerized polyphenol (ppm)	100	1	10	1	10	100	100	100	100	600
Sensory test	3	3	4	3	4	4	4	5	5	5
Inulin cont./((Catechin cont.xPolym. polyphenol cont.))	0.13	150	15	25	2.5	0.19	1.8	0.90	0.45	0.075

Sample name	Ex. 82	Ex. 83	Ex. 84	Ex. 85	Ex. 86	Ex. 87	Ex. 88	Ex. 89	Ex. 90	Ex. 91
Inulin(g/100ml)	1.8	1.8	2	2	2	2	2	2	4	4
Catechin compound (ppm)	600	600	100	200	400	400	600	600	600	600
Polymerized polyphenol (ppm)	100	600	100	100	100	600	100	600	1	10
Sensory test	5	5	4	5	5	5	5	5	3	4
Inulin cont./((Catechin cont.xPolym. polyphenol cont.))	0.30	0.05	2.0	1.0	0.50	0.083	0.33	0.056	67	6.7

Sample name	Ex. 92	Ex. 93	Ex. 94
Inulin(g/100ml)	4	4	6
Catechin compound (ppm)	600	600	800
Polymerized polyphenol (ppm)	100	600	100
Sensory test	4	4	3
Inulin cont./((Catechin cont.xPolym. polyphenol cont.))	0.67	0.11	0.75

[0062] The contents of inulin, catechin compounds and polymerized polyphenols in the produced beverages are as shown in Table 2.

[0063] The produced beverages were evaluated for their flavor by well-trained professional panelists through sensory test based on the scoring method. Five professional panelists were asked to make comprehensive evaluation on the flavor of the beverages by rating them based on the following 5-point scoring system: 5 points: “tastes very good”; 4 points: “tastes good”; 3 points: “tastes passable”; 2 points: “tastes slightly harsh”; and 1 point: “tastes strongly harsh”. The scores were averaged, and the test beverages were ranked into one of five levels depending on the average score. 2 or higher points were regarded as acceptable. The results are shown in Table 2.

[0064] As shown in Table 2, even when inulin is contained at high concentrations in black tea beverages, the harshness specific to inulin is improved by adding a polymerized polyphenol at a concentration within the specified range while a catechin compound is present in an amount within the specified range.

CLAIMS

1. A packaged tea beverage, comprising:
 - 1 to 6 g/100 mL of inulin,
 - 1 to 800 ppm of a catechin compound, and
 - a polymerized polyphenol.
2. The packaged tea beverage according to claim 1, wherein inulin is present in an amount of 1.5 to 4 g/100 mL.
3. The packaged tea beverage according to claim 1 or 2, wherein the catechin compound is present in an amount of 100 to 600 ppm.
4. The packaged tea beverage according to any one of claims 1 to 3, wherein the polymerized polyphenol is present in an amount of 10 to 600 ppm.
5. The packaged tea beverage according to any one of claims 1 to 4, further comprising an alcohol in an amount of less than 1 wt.%.
6. The packaged tea beverage according to any one of claims 1 to 5, wherein the packaged tea beverage has a ratio of an inulin content relative to a product obtained by multiplying a catechin compound content by a polymerized polyphenol content (inulin content/(catechin compound content $\times$ polymerized polyphenol content)), which is in the range of from 0.02 to 60000.
7. The packaged tea beverage according to any one of claims 1 to 6, wherein the packaged tea beverage is oolong tea or black tea.

8. The packaged tea beverage according to any one of claims 1 to 7, wherein the packaged tea beverage has an intestine controlling effect.
9. The packaged tea beverage according to any one of claims 1 to 8, wherein the packaged tea beverage is a packaged beverage with a volume of 500 mL or more.
10. A method for producing a packaged tea beverage, the method comprising the steps of:
 - adjusting an inulin content in the beverage to be in the range of 1 to 6 g/100 mL;
 - adjusting a catechin compound content in the beverage to be in the range of 1 to 800 ppm; and
 - adjusting a polymerized polyphenol content in the beverage to be in the range of 1 to 600 ppm.
11. A method for suppressing the harshness specific to inulin in a packaged tea beverage, wherein the suppression of harshness is achieved by adjusting a catechin compound content in the beverage to be in the range of 1 to 800 ppm and adjusting a polymerized polyphenol content in the beverage to be in the range of 1 to 600 ppm.