

DESCRIPTION

Foods or Beverages Providing Excellent Water Absorption

5 Technical Field

[0001]

The present invention relates to a food or beverage composition useful for hydration, providing enhanced water absorption, and in particular, enhanced water absorption and gastric evacuation rate.

10 Background Art

[0002]

Various beverages have been marketed for the purpose of preventing dehydration and heat stroke due to excess sweating resulting from, for example, sports practice and competition under the hot sun, hard work at
15 construction sites, and factory work under high temperatures in e.g., iron manufacturing and metallurgical manufacturing.

[0003]

Improvement in sports performance, countermeasures against heat stroke due to work under high temperatures, and the like require efficient
20 release of heat from the body (heat loss) generated by sports or the like. This heat loss occurs with the increase of the skin blood flow rate and sweating. Hence, efficient rehydration and rapid restoration of the lost body fluid volume are necessary. For this purpose, the water absorption rate in the bowels should be increased, and a beverage for hydration is effective for this
25 purpose.

[0004]

As functions required for a hydration beverage, not only increasing the water absorption rate in the bowels, but also increasing the gastric evacuation rate are important. For example, it has been reported that people
30 tend to experience a heavy feeling in the stomach, belching, and side stitch when they exercise immediately after the intake of a beverage with a low gastric evacuation rate (Non-patent document 1). Moreover, when a person

ingests a beverage with a very low gastric evacuation rate, the overall water absorption rate after oral intake would decrease in accordance with such low gastric evacuation rate, even if the water absorption rate is high in the small intestine.

5 [0005]

Sports drinks are one type of soft drinks for the supplementation of carbohydrates consumed through sports and the supplementation of water and electrolytes lost through sweating. The higher the amount of carbohydrates supplemented, the greater the advantage in effective energy use for sports (competition), for example. Meanwhile, it is also known that an increased amount of carbohydrates supplemented results in a lower gastric evacuation rate. Carbohydrate concentration is determined in view of both factors. Furthermore, improvement in sports performance and heat stroke prevention require rapid water absorption. However, commercial sports drinks are basically required to also have palatability such as good taste, and thus they have, e.g., lower sodium concentrations. Hence, such commercial sports drinks are not necessarily sufficient in terms of water absorption rate. The reported results of a test using rats have demonstrated that commercial sports drinks are inferior to oral rehydration solutions in terms of water absorption through the small intestine (Non-patent document 2), indicating the need for further improvements.

[0006]

An oral rehydration solution (ORS) is a beverage for treatment of dehydration. ORSs have been developed to treat cholera, which causes secretory diarrhea that results in excessive sodium loss. The sodium concentrations of ORS were later changed in order to cope with infectious gastroenteritis, which causes non-secretory diarrhea with low sodium loss. The ingredients and composition of ORS are defined by the WHO (Non-patent document 3), the guideline of the American Academy of Pediatrics (AAP) (Non-patent document 4), and the like. ORSs and commercial sports drinks are almost the same in terms of ingredients, but differ from each other in terms of the concentration of each ingredient. Not only water, but also many

electrolytes are lost in cases of pathological dehydration with emesis and diarrhea. Hence, ORS has a composition in which the sodium concentration is higher than that of a sports drink. Such the oral rehydration solution is excellent in terms of water absorption, but ORS is designed to treat dehydration with excessive sodium loss, such as in cases of diarrhea or emesis, and thus does not have a composition optimized for hydration in sports or daily life. ORSs are also problematic in that they are not often drinkable because of the strong saltiness due to high sodium concentrations.

[0007]

In recent years, sports drinks have been supplemented with various nutrient ingredients, including branched-chain amino acids, in order to add useful physiological functions thereto. Also, recent reported studies have revealed that the intake of a dairy product having high-quality proteins during or after exercise can accelerate the synthesis of albumin, which is effective for water retention, and thus such intake is effective for body fluid control. Therefore, it is considered that the addition of protein sources such as amino acids or peptides enables the development of a sports drink having the effect to retain water in body in addition to the effect to provide an excellent water absorption rate.

[0008]

However, in general, when nutrients such as sugars or amino acids are added in large amounts, osmotic pressure increases in accordance with the amounts added, and the water absorption rate in the bowels and the gastric evacuation rate decrease. As a result, this causes a problem such that the water absorption rate into the body decreases.

[0009]

An example of a beverage developed to realize both a hydrating effect and an effect to supply nutrients such as amino acids is an isotonic or hypotonic sports drink containing trehalose (patent document 1). Patent document 1 states that trehalose promotes the relatively high level of intake of water. However, patent document 1 does not demonstrate that trehalose provides better water absorption than those of other sugars. Moreover, patent

document 1 teaches neither a comparison nor a study concerning actual water absorption.

[0010]

An example of a beverage developed to increase the gastric
5 evacuation rate is a beverage containing highly branched cyclic dextrin
(patent document 2). The subject of patent document 2 is not a conditioning
sports drink, the primary objective of which is water absorption, but a drink
classified as an ergogenic sports drink, the primary objective of which is
supplementation of high-concentration of sugars. General ergogenic sports
10 drinks are problematic in that the gastric evacuation rates decrease because of
their high sugar contents and high osmotic pressures, and this problem is
solved in patent document 2 by adding highly branched cyclic dextrin to
adjust the osmotic pressure to a low level. However, water absorption through
the bowels was not examined in patent document 2. The water absorption rate
15 in the bowels should be increased in order to enhance the hydration effect.

[0011]

The effects of the addition of amino acids or peptides to beverages on
water absorption have been studied to date. However, the effects that are the
subjects of such studies are merely the effects on pathological dehydration
20 such as diarrhea, and thus are limited. Regarding amino acids, there are some
reports concerning the effect on water absorption when amino acids are added
to oral rehydration solutions or the like. For example, non-patent document 5
reports that when the effect of addition of glycine to an oral rehydration
solution was examined using a cholera toxin-induced diarrhea rat model, no
25 effectiveness was found on water absorption and sodium absorption. There is
also another report concerning a study using a cholera-toxin-induced diarrhea
rabbit model wherein a glutamine-containing oral rehydration solution
exhibited higher water and sodium absorption levels than the oral rehydration
solution of WHO (non-patent document 6). However, both of them are
30 diarrhea models, which present dynamics differing from those in sports or
daily life. Moreover, it is known that some amino acids have effects opposite
to water absorption. For example, non-patent document 7 indicates that water

secretion from the bowels was observed when 5 to 40 mM arginine-containing saline was administered. There is another report that water absorption through the bowels was observed for 5 mM or 15 mM lysine-containing saline, but water secretion was observed for 40 mM lysine-containing saline.

5 [0012]

As described above, there are no known foods or beverages that allow high levels of both hydration (water absorption) and supplementation of amino acids or peptides to be realized simultaneously.

Citation List

10 Patent documents

[0013]

Patent document 1: JP Patent Publication No. 10-508744 A (1998)

Patent document 2: JP Patent Publication No. 2003-169642 A

Non-patent documents

15 [0014]

Non-patent document 1: B. T. Plunkett et al., Med. Sci. Sports Exer., 31, 1169-1175, 1999.

Non-patent document 2: D. Nishinaka et al., Pediatrics. International, 46, 315-321, 2004.

20 Non-patent document 3: WHO, ORAL REHYDRATION SALTS, Production of the new ORS, 2006.

Non-patent document 4: Use of Oral Fluid Therapy and Posttreatment Feeding Following Enteritis in Children in a Developed Country PEDIATRICS Vol. 75 No. 2, pp. 358-361, February 1985.

25 Non-patent document 5: R.M. Cunha Ferreira et al., Acta Paediatr., 46-50, 81 (1), 1992.

Non-patent document 6: A.C. Silvia et al., J. Pediatr. Gastroenterol. Nutr., 26 (5), 513-519, 1998.

Non-patent document 7: J.E. Hegarty et al., Gut, 22 (2), 108-113, 1981.

30

Summary of the Invention

Problem to Be Solved by the Invention

[0015]

It is a problem underlying the present invention to provide a food or beverage composition useful for hydration, providing enhanced water absorption.

Means for Solving the Problem

5 [0016]

As a result of intensive studies to achieve the above problem, the present inventors have discovered that a food or beverage composition containing a protein hydrolysate such as whey peptides and/or a specific amino acid together with a sugar and an electrolyte, and having an osmotic pressure of about 40-250 mOsm/kg H₂O, significantly enhances the water absorption through the bowels, and thus have completed the present invention. Thus, in one aspect, the present invention refers to a food or beverage composition, comprising 0.5 to 3.0 wt% of sugar, electrolytes comprising 10 to 30 mM sodium; and at least one selected from protein hydrolysate and amino acid, and having an osmotic pressure of 40 to 250 mOsm/kg H₂O, wherein the sugar is glucose or trehalose, and wherein the protein hydrolysate is of 0.25 to 7.5 wt% and is whey peptides or casein peptides, and wherein the amino acid is of 20 to 30 mM and is lysine or alanine. In still another aspect, the present invention refers to a premix composition for preparing the food or beverage composition of the present invention, comprising a sugar, electrolytes comprising sodium, and at least one selected from protein hydrolysate and amino acid, wherein the sugar is glucose or trehalose, and wherein the protein hydrolysate is whey peptides or casein peptides, and the amino acid is lysine or alanine, and wherein the premix composition comprises 0.06 g to 12 g of the sugar and 0.1 to 12 mmol sodium per gram of said at least one selected from protein hydrolysate and amino acid.

[0017]

Specifically, the present disclosure encompasses the following [1] to [16].

25 [0018]

[1] A food or beverage composition, comprising a protein hydrolysate and/or an amino acid, a sugar, and an electrolyte, and has an osmotic pressure of 40 to 250 mOsm/kg H₂O.

[0019]

30 [2] The food or beverage composition according to [1] above, which comprises 0.25 to 7.5 wt% of the protein hydrolysate.

[0020]

[3] The food or beverage composition according to [1] or [2] above, which comprises 0.5 to 3.0 wt% of the sugar and 10 to 30 mM sodium.

[0021]

35 [4] The food or beverage composition according to [1] to [3] above, wherein the osmotic pressure ranges from 50 to 200 mOsm/kg H₂O.

[0022]

40 [5] The food or beverage composition according to [4] above, wherein the protein hydrolysate is at least one selected from the group consisting of whey peptides, casein peptides, and soy peptides.

[0023]

[6] The food or beverage composition according to [1] to [5] above, wherein the amino acid is at least one selected from the group consisting of lysine, arginine, glycine, alanine, glutamic acid, leucine, isoleucine, and valine.

5 [0024]

[7] The food or beverage composition according to [1] to [6] above, wherein the sugar comprises glucose, and/or a sugar containing glucose as a constituent monosaccharide.

[0025]

10 [8] The food or beverage composition according to [1] to [7] above, wherein the electrolyte comprises sodium, potassium, calcium, and magnesium.

[0026]

[9] The food or beverage composition according to [1] to [8] above, wherein the composition further comprises citric acid.

15 [0027]

[10] The food or beverage composition according to [1] to [9] above, which is for use in hydration.

[0028]

20 [11] A premix composition for preparing the food or beverage composition of [1] to [10] above, comprising a protein hydrolysate and/or an amino acid, a sugar, and an electrolyte.

[0029]

25 [12] The premix composition according to [11] above, wherein the composition comprises 0.06 g to 12 g of the sugar and 0.1 to 12 mmol sodium per gram of the protein hydrolysate and/or the amino acid.

[0030]

[13] The premix composition according to [11] or [12] above, wherein the protein hydrolysate is at least one selected from the group consisting of whey peptides, casein peptides, and soy peptides.

30 [0031]

[14] The premix composition according to [11] to [13] above, wherein the electrolyte comprises sodium, potassium, calcium, and magnesium.

[0032]

[15] The premix composition according to [11] to [14] above, wherein the sugar comprises glucose and/or a sugar containing glucose as a constituent monosaccharide.

5 [0033]

[16] The premix composition according [11] to [15] above, wherein the composition further comprises citric acid.

[0034]

10 The present inventors have also discovered that a food or beverage containing a specific amino acid and/or whey peptides, a sugar, and an electrolyte enhances the water absorption through the bowels and also increases the gastric evacuation rate.

[0035]

15 Specifically, the present invention encompasses the following [A] to [F].

[0036]

[A] A beverage providing excellent water absorption, comprising an amino acid and/or whey peptides, a sugar, and an electrolyte.

[0037]

20 [B] The beverage providing excellent water absorption according to [A] above, wherein the amino acid comprises at least one selected from lysine, arginine, glycine, alanine, glutamic acid, leucine, isoleucine, and valine.

[0038]

25 [C] The beverage providing excellent water absorption according to [A] and [B] above, wherein the amino acid comprises lysine and/or alanine.

[0039]

[D] The beverage providing excellent water absorption according to [A] above, wherein the whey peptides are a whey enzyme degradate.

[0040]

30 [E] The beverage providing excellent water absorption according to [A] above, wherein the sugar is trehalose and/or glucose.

[0041]

[F] The beverage providing excellent water absorption according to [A] above, wherein the electrolyte is sodium, potassium, calcium, and magnesium.

Effect of the Invention

[0042]

5 According to the present invention, a food or beverage with a high hydration effect because of its enhanced water absorption, preferably its enhanced water absorption and increased gastric evacuation rate can be provided.

[0043]

10 This description includes disclosure in Japanese Patent Application No. 2012-052776, from which the present application claims the priority.

Brief Description of Drawings

[0044]

Fig. 1 is a schematic diagram of a rat small intestinal perfusion test.

15 Fig. 2 is a graph showing the average water absorption rate for each beverage in the small intestine (the mean and standard deviation). For each group, $n = 3$. In the graph, O, Aqua Support (Meiji Co., Ltd); H, hypotonic beverage; Val, valine-containing beverage; Leu, leucine-containing beverage; Ile, isoleucine-containing beverage; Gly, glycine-containing beverage; Ala, alanine-containing beverage; Glu, glutamic acid-containing beverage; Asp, aspartic acid-containing beverage; Lys, lysine-containing beverage; and Arg, arginine-containing beverage. "*" indicates the presence of a significant difference compared with O (Aqua Support) ($p < 0.05$).

25 Fig. 3 is a graph showing the average water absorption rate for each beverage in the small intestine (the mean and standard deviation). For each group, $n = 4$. In the graph, S, sports drink; O, Aqua Support (Meiji Co., Ltd); H, hypotonic beverage; and P, peptide-containing beverage. The graph indicates that there is a significant difference between different letters (a, b) ($p < 0.05$).

30 Fig. 4 is a graph showing rat blood hematocrit levels (%) in a small intestinal perfusion test (the mean and standard deviation). For each group, $n = 4$. In the graph, S, sports drink; O, Aqua Support (Meiji Co., Ltd); H,

hypotonic beverage; and P, peptide-containing beverage. The graph indicates that there is a significant difference between different letters (a, b) ($p < 0.05$).

Fig. 5 is a graph showing gastric evacuation rate (%) for 5 minutes after the administration of each beverage (the mean and standard deviation).

5 For each group, $n = 3$ to 4 . In the graph, C, commercially available highly branched cyclic dextrin-containing beverage; Lys, lysine-containing beverage; Ala, alanine-containing beverage; P, peptide-containing beverage; and S, commercially available sports drink; and O, commercially available oral rehydration solution.

10 Fig. 6 is a graph showing the relationship between the sodium concentration of each beverage and the water absorption. Numerical values are indicated as mean value and standard deviation. For each group, $n = 5$. Dunnett's test was conducted with OS-1 as a control group. "*" denotes $p < 0.05$, and "***" denotes $p < 0.01$.

15 Fig. 7 is a graph showing blood hematocrit levels measured in an small intestinal perfusion test using peptide-containing beverages having different sodium concentrations. Numerical values are indicated as mean and standard deviation. For each group, $n = 5$. Dunnett's test was conducted with OS-1 as a control group. "*" denotes $p < 0.05$, and "***" denotes $p < 0.01$.

20 Fig. 8 is a graph showing the relationship between concentrations of whey peptides and average water absorption rates. All numerical values are indicated as mean and standard deviation. For each group, $n = 4$ to 6 . Steel's test was conducted with a control group using a hypotonic solvent (control beverage, peptide 0%). The significance level was set at 5%.

25 Fig. 9 is a graph showing the relationship between types of peptide mixtures and average water absorption rates. All numerical values are indicated as mean and standard deviation. For each group, $n = 4$ to 6 . Tukey-kramer test was conducted for 4 groups using different peptide mixture-containing beverages. The significance level was set at 5%.

30 Fig. 10 is a graph showing the relationship between sugar concentrations and water absorption. All numerical values are indicated as mean and standard deviation. For each group, $n = 4$. Tukey-kramer test was

conducted for 4 groups. The significance level was set at 5%. The graph indicates that there is a significant difference between different letters (a, b).

Fig. 11 is a graph showing the comparison of the effects of whey peptides and whey proteins on water absorption. WPI denotes whey proteins. Numerical values are indicated as mean and standard deviation. For each group, $n = 4$. Steel-Dwass test was conducted for 4 groups using peptide mixture-containing beverages. The significance level was set at 5%.

Modes for Carrying Out the Invention

[0045]

The present invention will be described more specifically as follows, but the present invention is not limited to the following individual embodiments.

[0046]

The present invention relates to a food or beverage composition (beverage composition or food composition) containing a protein hydrolysate and/or an amino acid, a sugar, and an electrolyte. The food or beverage composition according to the present invention exhibits excellent water absorption through the bowels.

[0047]

In an embodiment, the food or beverage composition according to the present invention comprises at least one amino acid as well as a sugar and an electrolyte. The food or beverage composition according to the present invention comprises, but not limited to, 10 to 150 mM, preferably 10 to 50 mM, and more preferably 20 to 30 mM amino acids. In particular, the food or beverage composition providing excellent water absorption of the present invention is characterized by containing a specific amino acid. Examples of amino acids to be contained in the food or beverage composition of the present invention include lysine, arginine, glycine, alanine, glutamic acid, leucine, isoleucine, and valine. The food or beverage composition of the present invention comprises preferably at least one amino acid selected from the group consisting of lysine, arginine, glycine, alanine, glutamic acid, leucine, isoleucine, and valine. These amino acids may be naturally occurring

or synthetic amino acids, or may be used as a single or as a mixture thereof. Moreover, when these amino acids are added, not only free amino acids, sodium salts, hydrochlorides, acetates or the like of these amino acids may also be used. The food or beverage composition providing excellent water
5 absorption of the present invention particularly preferably comprises lysine and/or alanine in view of increasing water absorption, as described later in Examples. Furthermore, lysine has an effect of enhancing sugar metabolism and lipid metabolism, and thus is useful in terms of an anti-fatigue effect, in addition to the enhancement of the water absorption according to the present
10 invention. Alanine is known to have an effect to cause secretion of glucagon that accelerates glycogen degradation, and thus is also useful in energy supplementation during exercise.

[0048]

In another embodiment, the food or beverage composition according
15 to the present invention comprises a protein hydrolysate as well as a sugar and an electrolyte. The food or beverage composition of the present invention may also comprise an amino acid in addition to a sugar, an electrolyte, and a protein hydrolysate. The term "protein hydrolysate" in the context of the present invention refers to a peptide mixture obtained via hydrolysis of a
20 protein with a hydrolase into mainly oligopeptides (peptides with a length of 10 amino acids or less in length, preferably dipeptides and/or tripeptides). The protein hydrolysate to be used for the food or beverage composition according to the present invention may be a peptide product that is a food additive, such as a milk-derived peptide (e.g., whey peptides and casein
25 peptides), soy peptides, collagen peptides, milk peptides, or egg peptides, or a combination thereof, and preferably at least one selected from the group consisting of whey peptides, casein peptides, and soy peptides. The protein hydrolysate to be used for the food or beverage composition according to the present invention may have an average molecular weight of 1500 or less, and
30 preferably 1200 or less, e.g., 1100 or less. The beverage of the present invention comprises preferably 0.25 to 7.5 wt%, more preferably 0.3 to 6 wt%, and particularly preferably 1.0 to 3.0 wt% of the protein hydrolysate. The

protein hydrolysate to be used for the food or beverage composition according to the present invention can be prepared by hydrolyzing a food-derived protein with protease. In one embodiment, the food or beverage composition providing excellent water absorption of the present invention is characterized by containing whey peptides. Examples of the whey peptides of the present invention include products obtained by enzymatic degradation (hydrolysates) of milk protein(s) selected from the group consisting of whey, a whey protein isolate (WPI), a whey protein concentrate (WPC), β -lactoglobulin, α -lacto-albumin, bovine lactoferrin, and a milk protein concentrate (MPC). For the food or beverage composition providing excellent water absorption of the present invention, any whey peptides can be used without particular limitation. Whey peptides having a high proportion of dimer and tetramer whey peptides having good water absorption and digestion properties are also preferred. Moreover, whey peptides having an anti-inflammatory effect as an added value are further preferably employed.

[0049]

The food or beverage composition according to the present invention comprises one or more sugars at, but are not limited to, e.g., 0.1% to 4.0%, preferably 0.5 to 3.0 wt%, more preferably 0.5 to 2.5 wt%, and further preferably 0.5 to 1.0 wt%. Sugars to be used in the food or beverage composition according to the present invention may be monosaccharides such as glucose, disaccharides such as trehalose, or polysaccharides and the like. Examples of such sugars include reducing sugars such as glucose, sucrose, fructose, and maltose; non-reducing sugars such as trehalose, erythritol, maltitol, palatinose, and xylitol; and dextrin. Glucose, and/or a sugar containing glucose as a constituent monosaccharide (e.g., a disaccharide such as trehalose, sucrose, and palatinose and a polysaccharide such as dextrin) are more preferred. Glucose is preferred in view of, e.g., its advantage that it enhances sodium ion absorption through the small intestine. Moreover, a sugar containing glucose, such as trehalose, is degraded by an enzyme such as trehalase that is expressed in the small intestine, and then absorbed in the form of glucose, and thus is also preferred as with glucose. Furthermore,

trehalose is a non-reducing sugar, and thus does not cause Maillard reaction even when trehalose is added together with an amino acid or a peptide and then subjected to heat sterilization. Hence, trehalose is preferred in view of appropriateness in production of the food or beverage composition, for example.

[0050]

The food or beverage composition according to the present invention is characterized by containing an electrolyte. Examples of the electrolyte to be used in the food or beverage composition according to the present invention include, but are not limited to, calcium, potassium, magnesium, sodium, copper, iron, manganese, zinc, selenium, and whey minerals. For efficient intestinal absorption of electrolyte ingredients via oral intake, which have been lost by dehydration or sweating, the food or beverage composition according to the present invention preferably comprises, as an electrolyte, at least one of sodium, potassium, calcium, magnesium, and the like, in a form of an ion. The food or beverage composition more particularly preferably comprises sodium, potassium, calcium, and magnesium in forms of ions. The food or beverage composition according to the present invention preferably comprises 10 to 30 mM, and preferably 10 mM to 20 mM sodium. In a preferred embodiment of the beverage according to the present invention, the beverage may comprise 0.5 to 3.0 wt% of sugar and 10 to 30 mM (preferably 10 mM-20 mM) sodium.

[0051]

In the food or beverage composition according to the present invention, a food additive such as citric acid, lactic acid, malic acid, tartaric acid, phosphoric acid, and acetic acid or a natural product such as lemon may further be used as a pH adjuster. The palatability of the food or beverage composition providing excellent water absorption of the present invention can be increased by adjusting the pH to 3 to 6, and preferably 3 to 5 with the pH adjuster, without deteriorating the flavor at the time of heating during the production or of preservation, or while producing "refreshing feeling" in the mouth. The food or beverage composition according to the present invention

preferably further comprises citric acid, for example, 0.5 to 5.0 wt%, and preferably 1.0 to 3.0 wt% of citric acid.

[0052]

Furthermore, in the present invention, vitamins such as vitamin A,
5 vitamin B1, vitamin B2, vitamin B6, vitamin B12, vitamin C, vitamin D,
vitamin E, vitamin K, biotin, folic acid, pantothenic acid, nicotinic acid and
the like can be used. These vitamins are involved in various metabolisms
including sugar metabolism, lipid metabolism, and amino acid metabolism. In
particular, vitamin B1 and a derivative thereof are involved in sugar
10 metabolism as coenzymes in the glycolytic pathway, and thus can be expected
to efficiently convert sugars contained in foods, beverages, and the like into
energy.

[0053]

The food or beverage composition providing excellent water
15 absorption of the present invention may comprise a colorant, a flavoring, a
preservative, a fungicide, an antioxidant, an emulsifier, a gelatinizing agent,
and the like, which are commonly used in production of foods or beverages, as
necessary, as long as they do not have any adverse effect on the water
absorption and the gastric evacuation rate. Two or more of these ingredients
20 can also be used in combination.

[0054]

The food or beverage composition according to the present invention
typically have a water content of 80 wt% or more, preferably 90 wt% or more,
and more preferably 95 wt% or more compared with the total amount. The
25 term "water content" to be used herein is meant to include the amount of water
constituting ice, jelly, or the like as well as the amount of the liquid water in
the food or beverage composition. The food or beverage composition
according to the present invention may be a liquid (e.g., aqueous solution,
colloidal solution, and suspension), solid- or semi-solid products such as a
30 gelled product, a frozen product, or semi-frozen product (e.g., jelly, ice, and
sherbet), or a combination of two or more thereof. The water content of the
food or beverage composition according to the present invention can be

calculated from the weight ratio of the raw material. The food or beverage composition according to the present invention may be in any drinkable form such as a liquid or a semi-solid form. The food or beverage composition having excellent water absorption of the present invention may be formulated
5 into a beverage (drink) such as an acid soft drink, a nutrient-fortified beverage, a food or beverage for specified health use, a lactic acid beverage; or a confectionery product such as a solid jelly and an ice confectionery, for example.

[0055]

10 An important factor for the food or beverage composition providing excellent water absorption of the present invention is to have an osmotic pressure that is hypotonic compared with the physiological osmotic pressure of 285 mOsm/kg H₂O, for rapid absorption of water and electrolytes through the bowels. Meanwhile, another important factor of the food or beverage
15 composition providing excellent water absorption of the present invention is to comprise an electrolyte and a sugar at appropriate levels for more rapid absorption of water and electrolytes through the bowels. A decrease in osmotic pressure due to excessively low electrolyte and sugar contents rather makes it difficult for the bowels to absorb water and electrolytes, suppressing
20 the absorption rates. Therefore, the presence of optimal osmotic pressure range and the effects of the above-mentioned multiple factors should be taken into consideration for the effective absorption of water and electrolytes through the bowels. At this time, for example, an osmotic pressure preferably ranges from 40 to 250 mOsm/kg H₂O. The osmotic pressure of the food or
25 beverage composition according to the present invention preferably ranges from 40 to 250 mOsm/kg H₂O, more preferably ranges from 50 to 220 mOsm/kg H₂O, further preferably ranges from 50 to 200 mOsm/kg H₂O, and also preferably ranges from 50 to 150 mOsm/kg H₂O, 50 to 100 mOsm/kg H₂O, or 45 to 95 mOsm/kg H₂O, for example. The osmotic pressure of the
30 food or beverage composition according to the present invention is preferably measured by the freezing point depression method. Such measurement of osmotic pressure can be carried out by the freezing point depression based on

the supercooling method, e.g., using an osmotic pressure analyzer, OM-6060 (ARKRAY, Inc.). When the food or beverage composition according to the present invention is a frozen- or semi-frozen product, the osmotic pressure may be measured after thawing on the assumption that this corresponds to the osmotic pressure after intake. Similarly, when the food or beverage composition according to the present invention is a gelled product, osmotic pressure may be measured after disruption into an appropriate size on the assumption that this corresponds to the osmotic pressure after intake.

[0056]

The food or beverage composition according to the present invention provides excellent water absorption. The food or beverage composition according to the present invention also exhibits a good gastric evacuation rate. The water absorption by the food or beverage composition according to the present invention can be evaluated using a rat small intestinal perfusion test well known to persons skilled in the art. Please see Examples described later for the details about the rat intestinal perfusion test. The food or beverage composition according to the present invention can exhibit, e.g., but not limited to, an average water absorption rate of 180 $\mu\text{L}/\text{min}$ to 500 $\mu\text{L}/\text{min}$, and more preferably 200 to 400 $\mu\text{L}/\text{min}$ in the rat small intestinal perfusion test. Therefore, the food or beverage composition according to the present invention is suitable for hydration.

[0057]

The food or beverage composition according to the present invention can be prepared by production methods well-known by persons skilled in the art. The food or beverage composition according to the present invention may also be prepared by dissolving a premix composition in an aqueous solvent (e.g., distilled water). The food or beverage composition according to the present invention may also be prepared by processing a premix composition dissolved in an aqueous solvent into a form such that water can be released therefrom upon the intake thereof, and for example, by freezing or semi-freezing, or gelling via adding a gelling agent such as agar or a protein. The term "premix composition" in the context of the present invention refers

to a composition that comprises a mixture of the above-described protein hydrolysate and/or amino acid, sugar, and electrolyte that are ingredients of the food or beverage composition according to the present invention, in a form soluble in an aqueous solvent. Details about the protein hydrolysate, amino acid, sugar, and electrolyte, and other ingredients are as described above for the food or beverage composition according to the present invention. The present invention also relates to such premix composition. The premix composition according to the present invention comprises, preferably, 0.06 g to 12 g (more preferably 0.1 g to 8 g) of a sugar and 0.1 mmol to 12 mmol (more preferably 0.2 mmol to 7 mmol) sodium per gram of a protein hydrolysate and/or an amino acid.

[0058]

The premix composition according to the present invention may comprise, in addition to the above protein hydrolysate and/or amino acid, sugar, and electrolyte, other ingredients of the food or beverage according to the present invention, such as the above food additives or preservatives. For example, the premix composition according to the present invention may comprise citric acid. The premix composition according to the present invention may be in any form such as solid, disrupted product, granules, powder, concentrated solution, semi-solid such as a jelly, and gel. The premix composition according to the present invention can be formulated by mixing the ingredients and using any formulation methods well known to persons skilled in the art.

Examples

[0059]

The present invention will be described more specifically by the following Examples, but the present invention is not limited by these specific Examples. Also, the "%" denotation in the Examples indicates "wt%", unless otherwise specified.

[0060]

(Example 1) Examination of amino acids and water absorption

The effect of the mixing (addition) of each amino acid in a beverage on water absorption was examined using a predetermined test system. This test system is a rat small intestinal perfusion test established as a system for assessment of the water absorption through the small intestine for a beverage.

5 [0061]

Beverages indicated in Table 1 were used for this test. The hypotonic beverage was prepared as an aqueous solution having the composition indicated in Table 1. In Table 1, the sugar contained in the hypotonic beverage and the amino-acid-containing beverages is trehalose. The amino-acid-containing beverages were each prepared by adding one of valine, leucine, isoleucine, glycine, alanine, glutamic acid, aspartic acid, arginine, and lysine (9 types), respectively, at a concentration of 25 mmol/L, to the hypotonic beverage, and thus were hypotonic. Control groups use a commercially available oral rehydration solution (Aqua Support, Meiji Co., Ltd.) or the hypotonic beverage (beverage having the same composition as the amino-acid-containing beverage except for the exclusion of amino acids). Also, phenolsulfonphthalein (PSP) was added at 20 mg/L to each beverage, as a non-absorbable internal standard substance.

20 Table 1

Composition of each beverage (per 100mL)

Ingredient	Unit	Aqua Support	Hypotonic beverage	Amino-acid-containing beverages
Amino acid	mmol	0	0	2.5
Lipid	g	0	0	0
Sugar	g	2	0.6	0.6
Citric acid	mg	300	161	161
Sodium	mg	115	24	24
Potassium	mg	78	12	12
Calcium	mg	0	4.6	4.6
Magnesium	mg	0	1.2	1.2

[0062]

The rat small intestinal perfusion test method is as follows. 7-week-old male SD rats were purchased, conditioned for one or more weeks, and then fasted overnight from the day before the actual oral administration test. Urethane was subcutaneously administered to the rats at 1.4 g/kg. After one or more hours, the test was started. Fig. 1 is a schematic diagram of the rat small intestinal perfusion test. Each rat was restrained on an electric mat. The rat abdomen was disinfected with an Osvan antiseptic solution and then opened via a midline incision. An incision was made about 1 cm from the antrum of the duodenum and then a catheter was inserted into the incision for perfusate injection, followed by ligation and fixation. A catheter was inserted to the ileum end for perfusate recovery, followed by ligation and fixation. Each test solution (30 mL each) was slowly injected manually from a syringe for intrainstestinal lavage. Perfusion was performed by injection of the test solution at a rate of 0.5 mL/min using a syringe pump. After 1 hour of equilibration, the perfusate was collected from the ileum end for 30 minutes. A portion of aortic blood was treated with EDTA, and then used for the measurements of hematocrit levels, the number of erythrocytes, and the like using a hematology analyzer.

[0063]

The average water absorption rate was measured as follows. An aqueous NaOH solution was added to each beverage before perfusion and to each perfusate collected. Absorbance was measured at 560 nm, and then PSP concentration was quantified. The average water absorption rate was calculated using the following formula.

[0064]

$$\text{Average water absorption rate } (\mu\text{L/min}) = V \times (1 - P_i/P) \times 1000$$

V: Injection rate (mL/min)

P_i: PSP concentration (mg/L) of beverage before test (before perfusion)

P: PSP concentration (mg/L) of perfusate collected.

Numerical values determined by this test were indicated as mean and standard deviation. Statistical analysis using Bartlett's test confirmed that

homoscedasticity can be assumed. Dunnett's test was performed using a group of rats that had ingested the oral rehydration solution as a control group. A significance level of 5% (two-tailed) was employed for both tests. StatLight#04 (Comparison of Multiple Groups, Yukms Co., Ltd.) was used for these tests.

[0065]

The mean values of the average water absorption rates for beverages in the small intestine are shown in Fig. 2. Among the amino acids (9 types) of the present invention examined in this test, the amino-acid-containing beverages prepared by adding amino acids other than aspartic acid tended to exhibit higher water absorption rates than that of the hypotonic beverage used as a solvent (control). Furthermore, among these amino acids, the water absorption rates for alanine and lysine were particularly high, and thus the differences were significant compared with the oral rehydration solution. It was reported that arginine and lysine enhanced water secretion from the bowels so as to suppress water absorption. In contrast to the reported result, the present results indicate the possibility of enhancing water absorption under the hypotonic conditions. As described above, beverages containing amino acids other than aspartic acid provided higher levels of water absorption through the small intestine than that of the oral rehydration solution, and it was revealed that among the aforementioned amino acids, alanine and lysine, in particular, provide higher water absorption.

[0066]

(Example 2) Examination of whey peptides and water absorption

The effect of mixing (addition) of whey peptides in a beverage on water absorption was examined using a predetermined test system. This test system is the same as that in Example 1.

[0067]

Beverages that were aqueous solutions having the compositions indicated in Table 2 were used for this test. In Table 2, the sugar contained in the hypotonic beverage and the peptide-containing beverage is trehalose. The hypotonic beverage (Na: 24 mg/100 mL) was prepared as an aqueous solution

having the composition in Table 2. The peptide-containing beverage was prepared by adding whey peptides (Arla Foods, weight-average molecular weight: 700-1100) at a concentration of 3g/L to the hypotonic beverage. Control groups use a commercially available oral rehydration solution (Aqua Support, Meiji Co., Ltd.) or a commercially available sports drink (Pocari Sweat, Otsuka Pharmaceutical Co., Ltd.). Also, phenolsulfonphthalein (PSP) was added at 20 mg/L to each beverage, as a non-absorbable internal standard substance.

Table 2
Composition of each beverage (per 100mL)

Ingredient	Unit	Sports drink	Aqua Support	Hypotonic beverage	Peptide-containing beverage
Whey peptides	g	0	0	0	0.3
Lipid	g	0	0	0	0
Sugar	g	6.7	2	0.6	0.6
Citric acid	mg	64	300	161	161
Sodium	mg	49	115	24	24
Potassium	mg	20	78	12	12
Calcium	mg	2	0	4.6	4.6
Magnesium	mg	0.6	0	1.2	1.2

[0068]

The mean values of the average water absorption rates for the beverages in the small intestine are shown in Fig.3. The hematocrit levels of rat blood in a small intestinal perfusion test are shown in Fig. 4. The rat small intestinal perfusion test method, the measurement of average water absorption rates, and the method for statistical analysis are performed as described in Example 1. The water absorption rate was significantly lower in the case of the sports drink compared with the other 3 groups. The water absorption rate in the case of the hypotonic beverage was almost equal to that in the case of the Aqua Support. The water absorption rate in the case of the whey

peptides-containing beverage of the present invention tended to be higher than those in the cases of the Aqua Support and the hypotonic beverage. Also, hematocrit levels shown in the cases of the Aqua Support and the peptide-containing beverage were lower than that of the sports drink. When the blood plasma levels increased, hematocrit levels decreased. Hence, it was shown in the cases of the Aqua Support and the peptide-containing beverage that the blood plasma level increased after perfusion to a higher degree than that of the sports drink. It was thus revealed that the whey peptides-containing beverage is more useful for, e.g., hydration upon dehydration compared with a conventional sports drink and oral rehydration solution.

[0069]

(Example 3) Examination of the gastric evacuation rates for amino acid beverage and peptide beverage

The effects of mixing (addition) of amino acids and whey peptides in beverages on the gastric evacuation rates were examined using a rat test.

[0070]

Beverages that were aqueous solutions having the compositions indicated in Table 3 and Table 4 were used for this test. In Table 3, the sugar contained in the amino-acid-containing beverages and the peptide-containing beverage is trehalose. The amino-acid-containing beverages (lysine-containing beverage and alanine-containing beverage), the peptide-containing beverage, and the commercially available highly branched cyclic dextrin-containing beverage (CCD drink, EZAKI GLICO CO., LTD.) were used. The highly branched cyclic dextrin-containing beverage was prepared by dissolving a bag (42.5g) of a commercial product in 500 mL of distilled water.

[0071]

The test method is as follows. 6-week-old male SD rats were purchased, conditioned for 1 or more weeks, and then fasted for 24 hours before and deprived of water for 4 hours before the actual oral administration test. Feedstuffs employed during the conditioning and test period were solid CRF-1. Before oral administration, phenolsulfonphthalein (PSP) was added at

50 mg/L to each beverage, as a non- absorbable internal standard substance and then the beverage was heated at about 37°C. A single dose of each beverage was administered in a volume of 20 mL/kg to a rat via forced oral administration. Five minutes after the oral administration, each rat was quickly euthanized by cervical dislocation. The rat abdomen was immediately opened and after ligation of the gastric cardia and the pylorus, the stomach was removed, and then gastric contents were collected.

[0072]

Gastric evacuation rate (%) is measured as follows. After the addition of an aqueous NaOH solution to a beverage before oral administration and to a gastric content, absorbance was measured at 560 nm, and then the PSP concentration was quantified. Gastric evacuation rate (%) was calculated with the following formula.

[0073]

Gastric evacuation rate (%) = (1 - PSP for gastric content/PSP for beverage before oral administration) x 100

Table 3

Composition of each beverage (per 100mL)

Ingredient	Unit	Amino-acid-containing	Peptide-containing
		beverages	beverage
Amino acid	mmol	2.5	0
Whey peptides	g	0	0.3
Lipid	g	0	0
Sugar	g	0.6	0.6
Citric acid	mg	161	161
Sodium	mg	40	40
Potassium	mg	12	12
Calcium	mg	4.6	4.6
Magnesium	mg	1.2	1.2

Table 4

Composition of highly-branched cyclic dextrin-containing beverage (powder)
(per 42.5 g/bag)

Ingredient	Unit	
Protein	g	0
Lipid	g	0
Carbohydrate	g	40
Sodium	mg	250
Calcium	mg	6
Potassium	mg	90
Vitamin B1	mg	0.23
Vitamin B2	mg	0.22
Niacin	mg	2.5
Vitamin B6	mg	0.23
Folic acid	μg	45
Vitamin B12	μg	0.4
Pantothenic acid	mg	1.4

5 [0074]

Gastric evacuation rate (%) shown during 5 minutes after administration of each beverage is shown in Fig. 5. The lysine-containing beverage, the alanine-containing beverage, and the peptide-containing beverage exhibited gastric evacuation rate (%) higher than that of the highly branched cyclic dextrin-containing beverage (conventional beverage with a high gastric evacuation speed). It was thus revealed that the lysine-containing beverage, the alanine-containing beverage, and the peptide-containing beverage had gastric evacuation rates higher than that of the highly branched cyclic dextrin-containing beverage.

15 [0075]

(Example 4) Examination of the relationship between the sodium concentrations and water absorption of peptide-containing beverage

Hypotonic peptide-containing beverages having different sodium concentrations were assessed for water absorption through the small intestine by the rat small intestinal perfusion test, thereby examining the relationship between the sodium concentrations and water absorption of the beverages.

Four types of peptide-containing beverage, which were aqueous solutions having the compositions indicated in Table 5, were used as test beverages. In Table 5, the sugar contained in peptide-containing beverages is glucose. The rat small intestinal perfusion test was conducted as described in Example 1. The oral rehydration solution OS-1 (Otsuka Pharmaceutical Co., Ltd.) was used as a control beverage. Phenolsulfonphthalein (PSP) was added at a final concentration of 20 mg/L to each beverage, as a non-absorbable internal standard substance and then subjected to the test.

Table 5

Comparison of compositions of test beverages (per 100mL)

Ingredient	Unit	Peptide-containing beverages				
		OS-1	0 mM Na	10mM Na	20mM Na	30mM Na
Whey peptides	g	0	0.3	0.3	0.3	0.3
Lipid	g	0	-	-	-	-
Sugar	g	2.5	0.6	0.6	0.6	0.6
Citric acid	mg	0	161	161	161	161
Lactic acid	mg	Added	-	-	-	-
Sodium	mg	115	-	23	46	69
Potassium	mg	78	12	12	12	12
Calcium	mg	0	4.6	4.6	4.6	4.6
Magnesium	mg	2.4	1.2	1.2	1.2	1.2

[0076]

The measured average water absorption rates are shown in Fig. 6, and the measured hematocrit levels are shown in Fig. 7. A hematocrit level decreases when water is absorbed by the body and the blood plasma level

increases.

[0077]

In Fig. 6, when the hypotonic peptide-containing beverages having 10 mM or more sodium concentrations were administered, statistically significantly higher average water absorption rates than that of the oral rehydration solution OS-1 were exhibited. In particular, the hypotonic peptide-containing beverages particularly having sodium concentrations of 20 mM to 30mM exhibited even higher average water absorption rates. As shown in Fig. 7, by administration of the peptide-containing beverages having 10 mM or more sodium concentrations, hematocrit levels remarkably decreased and the blood plasma levels increased. Hence, the effect of the beverages to make blood hydrated was also demonstrated.

[0078]

Therefore, the high water absorption rates and the high hydration effect could be successfully realized by adding 10 mM or more sodium to hypotonic peptide-containing beverages.

[0079]

(Example 5) Examination of the relationship between concentrations of whey peptides and water absorption

Hypotonic peptide-containing beverages having different peptide concentrations (0.1, 0.2, 0.3, 1.0, 3.0, 6.0, and 10% concentrations) were assessed for water absorption through the small intestine by the rat small intestinal perfusion test, thereby examining the relationship between the peptide concentrations of beverages and water absorption. Test beverages were 6 types of beverages containing whey peptides at concentrations of 0.1, 0.2, 0.3, 1.0, 3.0, 6.0, and 10% in a hypotonic solvent (aqueous solution) having the composition shown in Table 6. The whey peptides used herein were the same as that used in Example 2. As a control beverage, a hypotonic solvent (aqueous solution) having the composition shown in Table 6 was used without adding any whey peptides (peptide concentration 0%). Phenolsulfonphthalein (PSP) was added at a final concentration of 20 mg/L to each beverage, as a non-absorbable internal standard substance and then

subjected to the test.

Table 6

Composition of hypotonic solvent

Ingredient	Unit	Concentration
Sugar (trehalose)	g/100 mL	0.50
Citric acid	g/100 mL	0.16
Sodium	mM	10.0
Potassium	mM	3.0
Calcium	mM	1.2
Magnesium	mM	0.5

5

[0080]

Water absorption assay was performed using the rat small intestinal perfusion test by a method similar to that in Example 1. Purchased 7-week-old male SD rats were conditioned for one or more weeks and then used for the test. In the small intestinal perfusion test, first, the rats were fasted overnight (16 or more hours and 20 or less hours). Urethane (1.5 g/kg) was administered subcutaneously to the rats, and then the rats were anesthetized. A catheter was inserted to a portion of 1 to 2 cm from the pylorus of the duodenum and the ileum end, followed by ligation and fixation. Each test beverage (about 30 mL) was slowly injected manually from a syringe for intraintestinal lavage. Each test beverage was injected with a syringe pump at a rate of 0.75 mL/min for perfusion. After 40 minutes, the perfusate was recovered for 20 minutes. After completion of the recovery of the perfusate, whole blood was collected from the abdominal aorta. The portion of duodenum to ileum was excised and then lyophilized, followed by the measurement of the dry weight. The collected blood was subjected to measurement of hematocrit levels, hemoglobin concentrations, and the like as indicators for *in vivo* fluid status using a hematology analyzer.

15

20

[0081]

Average water absorption rates were measured as follows. NaOH was added at a final concentration of 1 M to test beverages before perfusion and to the recovered perfusates to make the solutions alkaline. Absorbance was measured at a wavelength of 560 nm, and then PSP concentrations were quantified. Average water absorption rates were calculated with the following formula.

[0082]

Average water absorption rate ($\mu\text{L}/\text{min}$) = $V \times (1 - P_i/P) \times 1000$

V: Injection rate (mL/min)

P_i: PSP concentration (mg/L) of test beverage before perfusion

P: PSP concentration (mg/L) of recovered perfusate

The results are shown in Fig. 8. Fig. 8 indicates that beverages with peptide concentrations ranging from, higher than 0.2%, to about 6% exhibited increased average water absorption rates compared with the hypotonic solvent (peptide 0%) as a control beverage. In Fig. 8, the average water absorption rate peaked out in the case of the peptide concentration of 1% or more, and it decreased in the case of the peptide concentration of higher than 3%. As a result of both the effect of peptide absorption along with water absorption and the effect of secretion of water into the bowels due to intra-bowel peptide-derived osmotic pressure, an optimal concentration range of the whey peptides is considered to be 1-3%. Also concerning hematocrit levels, the peptide concentrations of 0.3-6% resulted in lower values compared with the control beverage with a peptide concentration of 0%. Meanwhile, a peptide concentration of more than 6% resulted in a higher hematocrit level than in the case of the control beverage with a peptide concentration of 0%.

[0083]

These results demonstrated that in view of water absorption, peptide concentrations of hypotonic peptide-containing beverages are preferably higher than 0.2% and less than 10.0%, and preferably range from about 0.25% to 0.75%, and particularly the peptide concentrations ranging from 1.0% to 3.0% leads to a very high effect of water absorption.

[0084]

(Example 6) Examination of the relationship between peptide product types and water absorption

As demonstrated in Example 5, not only sugars and electrolytes, but
5 also the presence of peptides are greatly involved in increase of the water
absorption for hypotonic peptide-containing beverages. Hence, next, the
relationship between peptide product types and water absorption was
examined by the rat small intestinal perfusion method using, as test
10 beverages, hypotonic peptide-containing beverages containing various peptide
products (protein hydrolysates) including whey peptides. As peptide products
to be assayed herein, in addition to whey peptides, casein peptides and soy
peptides that are often used as food materials were used. Moreover, 2 types of
whey peptides were used to examine whether a protein hydrolysis method used
15 upon production of peptide products had an effect on water absorption. Whey
peptides A was the same as the one used in Examples 2-5. Water absorption
was assayed by the small intestinal perfusion method as described in Example
5. The test beverages were prepared by adding peptide products at a final
concentration of 1.0% to the hypotonic solvent (Table 6) used in example 5.
As a control beverage, a hypotonic solvent with a peptide concentration of 0%
20 same as that in Example 5 was used. The peptide products used herein were
the following commercial products.

[0085]

- Whey peptides A (Arla Foods), weight-average molecular weight: 700-1100
- Whey peptides B (Tatua)
- 25 ·Casein peptides CE90GMM (Nippon Shinyaku Co., Ltd.), weight-average
molecular weight: 450
- Soy peptide Hinate-AM (Fuji Oil Co., Ltd.)

Measured average water absorption rates are shown in Fig. 9. Four
types of peptide product exhibited almost the same values, and no significant
30 difference was observed among the groups. In addition, all peptide products
used herein had high dipeptide and tripeptide contents, and average molecular
weights of about 1100 or less.

[0086]

In the test using peptide products from different raw-material proteins, no difference was observed in water absorption. This indicated that the amino acid compositions of the peptide products and the sequences of peptide fragments contained in the peptide products did not significantly affect the water absorption of the hypotonic peptide-containing beverages. It was considered that the peptide product types did not significantly affect water absorption, since the degrees of degradation of peptide products added to beverages and the average molecular weights were at almost the same levels.

[0087]

(Example 7) Examination of the relationship between sugar concentrations and water absorption

The relationship between sugar concentrations and water absorption was examined by the rat small intestinal perfusion method using hypotonic peptide-containing beverages with different sugar concentrations as test beverages. As the test beverages, peptide-containing beverages (sodium concentration of 20 mM and peptide concentration of 0.3%) having glucose concentrations of 0.5%, 1.0%, 2.5%, and 5.0%, which were aqueous solutions having the compositions indicated in Table 7, were used. Water absorption was assayed by the small intestinal perfusion method similar to that in Example 5.

Table 7

Composition of each test beverage (per 100mL)

Ingredient	Unit	Peptide-containing beverage			
		0.5% Glu	1.0% Glu	2.5% Glu	5.0% Glu
Whey peptides	g	0.3	0.3	0.3	0.3
Lipid	g	-	-	-	-
Sugar (glucose)	g	0.5	1.0	2.5	5.0
Citric acid	mg	161	161	161	161
Sodium	mg	46	46	46	46

Potassium	mg	12	12	12	12
Calcium	mg	4.6	4.6	4.6	4.6
Magnesium	mg	1.2	1.2	1.2	1.2

[0088]

Measured average water absorption rates are shown in Fig. 10. The above whey peptides-containing beverages having glucose concentrations ranging from 0.5% to 2.5% exhibited good water absorption rates, however, almost no water absorption was observed in the case of glucose concentration of 5%.

[0089]

(Example 8) Osmotic pressure measurement

10 The beverages used for the tests in Examples 1, 2 and 4 to 7 were subjected to osmotic pressure measurements using an osmotic pressure analyzer OM-6060 (ARKRAY, Inc.). The results are shown in Table 8.

Table 8

	Beverage	Osmotic pressure (mOsm/kg H ₂ O)	Average water absorption rate (μ L/min)
Commercial product or base	Aqua Support	256	—
	Pocari Sweat	349	—
	Hypotonic beverage (base before the addition of amino acid or peptide)	53	—
	CCD drink	150	—
	OS-1	275	—
Example 1	Valine-containing beverage	74	269
	Leucine-containing beverage	75	270
	Isoleucine-containing beverage	75	249
	Glycine-containing beverage	76	238
	Alanine-containing beverage	74	316
	Glutamic acid-containing	74	222

	beverage		
	Aspartic acid-containing beverage	74	94
	Lysine hydrochloride-containing beverage	95	332
	Arginine-containing beverage	64	255
Example 2	Peptide-containing beverage	62	256.7
Example 4	0mM Na peptide-containing beverage	55	244
	10mM Na peptide-containing beverage	75	274
	20mM Na peptide-containing beverage	95	369
	30mM Na peptide-containing beverage	113	343
Example 5	0% Peptide-containing beverage	52	109.0
	0.1% Peptide-containing beverage	49	61.0
	0.2% Peptide-containing beverage	52	72.0
	0.3% Peptide-containing beverage	54	190.0
	1.0% Peptide-containing beverage	71	319.0
	3.0% Peptide-containing beverage	120	327.0
	6.0% Peptide-containing beverage	196	177.0
	10.0% Peptide-containing beverage	315	9.0
Example 6	Whey peptides A-containing beverage	71	319.0
	Whey peptides B-containing beverage	81	353.0
	CE90GMM-containing beverage	74	358.0
	Hinute-AM-containing beverage	77	354.0
Example 7	0.5% Glucose-containing	86	255

	beverage		
	1.0% Glucose-containing beverage	113	258
	2.5% Glucose-containing beverage	202	223
	5.0% Glucose-containing beverage	359	7

[0090]

As shown in Table 8, a suitable osmotic pressure of beverages with appropriate peptide or amino acid concentrations is 40 to 250 mOsm/kg H₂O, and particularly about 50 to 200 mOsm/kg H₂O in terms of water absorption rate.

[0091]

(Example 9) Production of PET plastic bottle beverage

Sugar, electrolytes, and other ingredients were added to distilled water at the amounts indicated in Table 9 per 100 ml and dissolved under agitation. After sterilization (110°C, 60 seconds) of the solution and cooling to 90°C, a PET bottle was filled therewith to produce a PET plastic bottle beverage. The whey peptides used herein were the same as that in Example 1. The osmotic pressure measured for the beverage was 84 mOsm/kg H₂O.

Table 9

Raw material	Weight (g/100mL)	Electrolyte concentration
Whey peptides	0.30	
Trehalose	0.55	
Anhydrous citric acid	0.15	
Sodium chloride	0.10	Sodium: 39 mg/100mL
Magnesium chloride hexahydrate	0.01	Magnesium: 1.2 mg/100mL
Calcium citrate tetrahydrate	0.02	Calcium: 4.2 mg/100mL
Potassium chloride	0.02	Potassium: 10.5 mg/100mL
Muscat flavor	0.10	

[0092]

(Example 10) Comparison of the effects between whey peptides and whey proteins

5 Water absorption rates were measured using a hypotonic peptide-containing beverage containing whey peptides and a hypotonic peptide-containing beverage containing whey proteins as test beverages by the rat small intestinal perfusion method, and the whey peptides and the whey proteins were compared for the effect. Aqueous solutions having the
10 compositions indicated in Table 10 were used as the test beverages. As a control sample, an isotonic aqueous solution containing whey proteins, which is prepared according to Lewis et al.'s report (Lewis et al., Journal of Athletic Training (2012) 47 (1); 61-66), was used (Table 10). Water absorption was assayed by the small intestinal perfusion method similar to that in Example 1.

15

Table 10

Composition of each test beverage (per 100mL)

Ingredient	Unit	Hypotonic		Isotonic
		Whey peptides -containing beverage	Whey proteins -containing beverage	Whey proteins -containing beverage
Whey peptides	g	1.5	-	-
Whey proteins (WPI)	g	-	1.5	1.5
Lipid	g	-	-	-
Sugar	g	0.55	0.55	5.0
Citric acid	mg	161	161	161
Sodium	mg	23.0	23.0	50.6
Potassium	mg	11.7	11.7	19.6
Calcium	mg	4.8	4.8	-
Magnesium	mg	1.2	1.2	-

[0093]

Measured average water absorption rates are shown in Fig. 11. The hypotonic whey peptides-containing beverage exhibited higher water absorption than that of the hypotonic whey proteins-containing beverage. The isotonic whey proteins-containing beverage did not exhibit sufficient water absorption. It was indicated that in terms of water absorption, peptides; that is, in a hydrolyzed form, is more advantageous than a protein.

Industrial Applicability

[0094]

According to the present invention, a food or beverage composition providing a high gastric evacuation rate and excellent water absorption through the bowels can be provided.

[0095]

All publications, patents, and patent applications cited herein are incorporated herein by reference in their entirety.

CLAIMS

1. A food or beverage composition, comprising 0.5 to 3.0 wt% of sugar, electrolytes comprising 10 to 30 mM sodium; and at least one selected from protein hydrolysate and amino acid, and having an osmotic pressure of 40 to 250 mOsm/kg H₂O, wherein the sugar is glucose or trehalose, and wherein the protein hydrolysate is of 0.25 to 7.5 wt% and is whey peptides or casein peptides, and wherein the amino acid is of 20 to 30 mM and is lysine or alanine.
2. The food or beverage composition according to claim 1, which comprises 1.0 to 3.0 wt% of the protein hydrolysate.
3. The food or beverage composition according to claim 1 or 2, wherein the osmotic pressure is from 50 to 200 mOsm/kg H₂O.
4. The food or beverage composition according to any one of claims 1 to 3, wherein said at least one selected from protein hydrolysate and amino acid is protein hydrolysate and the protein hydrolysate is whey peptides.
5. The food or beverage composition according to any one of claims 1 to 3, wherein the amino acid is alanine.
6. The food or beverage composition according to any one of claims 1 to 5, wherein the sugar is trehalose.
7. The food or beverage composition according to any one of claims 1 to 6, wherein the electrolyte comprises sodium, potassium, calcium, and magnesium.
8. The food or beverage composition according to any one of claims 1 to 7, wherein the composition further comprises citric acid.
9. The food or beverage composition according to any one of claims 1-4, wherein the composition comprises 1.0 to 3.0 wt% of whey peptides; 0.5 to 3.0 wt% of

trehalose; potassium, calcium, magnesium and 10 to 30 mM sodium; and citric acid.

10. The food or beverage composition according to any one of claims 1-4, wherein the composition comprises 0.25 to 7.5 wt% of whey peptides; 0.5 to 3.0 wt% of glucose; potassium, calcium, magnesium; and 20 to 30 mM sodium; and citric acid.

11. The food or beverage composition according to any one of claims 1 to 10, which is for use in hydration.

12. A premix composition for preparing the food or beverage composition of any one of claims 1 to 11, comprising a sugar, electrolytes comprising sodium, and at least one selected from protein hydrolysate and amino acid, wherein the sugar is glucose or trehalose, and wherein the protein hydrolysate is whey peptides or casein peptides, and the amino acid is lysine or alanine, and wherein the premix composition comprises 0.06 g to 12 g of the sugar and 0.1 to 12 mmol sodium per gram of said at least one selected from protein hydrolysate and amino acid.

13. The premix composition according to claim 12, wherein said at least one selected from protein hydrolysate and amino acid is protein hydrolysate and the protein hydrolysate is whey peptides.

14. The premix composition according to claim 12 or 13, wherein the electrolyte comprises sodium, potassium, calcium, and magnesium.

15. The premix composition according to any one of claims 12 to 14, wherein the sugar is trehalose.

16. The premix composition according any one of claims 12 to 15, wherein the composition further comprises citric acid.

Abstract

The present invention relates to a food or beverage composition containing a protein hydrolysate and/or an amino acid, a sugar, and an electrolyte, and
5 having an osmotic pressure of 40-250 mOsm/kg H₂O.