

DESCRIPTION

TITLE OF INVENTION

COMPOSITION FOR INHIBITING ERYTHEMA FORMATION, METHOD OF USING SAME, METHOD FOR PREPARING SAME, METHOD FOR INHIBITING ERYTHEMA, AND LACTIC ACID BACTERIA PRODUCING SUBSTANCE

TECHNICAL FIELD

[0001]

The present invention relates to a composition for inhibiting the formation of erythema, a method of using the composition, and a method for producing the same.

The present invention also relates to a method of inhibiting the formation of erythema.

Furthermore, the present invention also relates to lactic acid bacteria producing a substance.

BACKGROUND ART

[0002]

Unlike other organs, skin, which is the largest human organ, is constantly in contact with the external environment and can be affected by various external factors.

For this reason, abnormalities of various properties can occur on the skin. Examples of such an external factor include ultraviolet rays. In recent years, with the destruction of the ozone layer, the amount of ultraviolet rays falling on the ground surface is increasing. Thus, adverse effects on the skin due to excessive ultraviolet rays, such as inflammation of the skin, immunosuppression, oxidation, DNA damage, skin cancer, deterioration of skin barrier function, erythema formation, wrinkle formation, Promotion and the like are concerned.

[0003]

By the way, when exposed to a large amount of ultraviolet rays, erythema is formed on the skin after several hours elapse. Thus, in the past, the study of "inhibiting the formation of erythema by taking a beauty product containing the genus *Lactobacillus*" has been done (see, for example, International Publication No. 2006/095764).

Prior Art Document

Patent literature

[0004]

Patent Document 1: International Publication No. 2006/095764

Summary of the invention

Problem to be Solved by Invention

[0005]

An object of the present invention is to provide a composition for inhibiting the formation of erythema that sufficiently inhibits the formation of skin erythema.

Means for solving the problem

[0006]

The composition for inhibiting erythema production according to the first aspect of the present invention is a lactic acid bacterium producing substance containing a polysaccharide (hereinafter referred to as "polysaccharide-containing lactic acid bacterium producing substance") as an active ingredient. In other words, polysaccharide-containing lactic acid bacteria producing substances are used as a composition for inhibiting erythema formation or as a portion of such a component. The term "composition" as used herein includes preparations of pharmaceuticals, supplements, food additives, and the like, foods or drinks (excluding animals and plants per se), and food or drink compositions (including processed food or drink) that animals (including humans) can ingest.

[0007]

As a result of intensive investigation by the inventors of the present invention, it has been clarified that the composition for inhibiting erythema formation according to the first aspect of the present invention sufficiently inhibits the formation of skin erythema.

[0008]

In addition, it is preferable that in the composition for inhibiting erythema formation, the polysaccharide-containing lactic acid bacteria producing substance is produced by a combination of *Lactobacillus delbrueckii* subsp. *Bulgaricus* and *Streptococcus thermophilus*. Note that *Lactobacillus delbrueckii* subspecies *bulgaricus* is specifically at least one of *Lactobacillus delbrueckii* subspecies *bulgaricus* OLL1247 (Deposit number: NITE BP-01814) and *Lactobacillus delbrueckii* subspecies *bulgaricus* 2038 bacterium; *Streptococcus thermophilus* is specifically at least one of *Streptococcus thermophilus* OLS 3078 bacterium (Deposit number: NITE BP - 01697) and *Streptococcus thermophilus* 1131.

[0009]

In addition, the composition for inhibiting erythema formation preferably contains sphingolipid as an active ingredient.

[0010]

In addition, the composition for inhibiting erythema formation preferably further contains collagen peptide as an active ingredient.

[0011]

Incidentally, it is preferable that the composition for inhibiting erythema formation reduces the erythema intensity of the skin of an intake person by one or more when ingested daily for 4 weeks or more. Note that when polysaccharide-containing lactic acid bacteria producing substances and sphingolipids are added to the composition for inhibiting the formation of erythema as an active ingredient, its intake is 200 µg or more per day for polysaccharide and 4 mg or more per day for sphingolipid. In addition, when polysaccharide-containing lactic acid bacteria producing substances, sphingolipids and collagen peptides are added to the composition for inhibiting erythema formation as an active ingredient, the intake is 200 µg or more per day for polysaccharide and 4 mg or more, 4 mg or more per day for sphingolipid, and 400 mg or more per day for collagen peptide.

[0012]

In addition, it is preferable that the composition for inhibiting erythema formation described above increases the minimum erythema amount of the skin of the intake person when ingested daily for 4 weeks or more. The minimum erythema amount is preferably increased by one or more, more preferably by two or more, even more preferably by three or more, still more preferably by four or more. Note that when polysaccharide-containing lactic acid bacteria producing substances and sphingolipids are added to the composition for inhibiting the formation of erythema as an active ingredient, its intake is 200 µg or more per day for polysaccharide and 4 mg or more per day for sphingolipid. In addition, when polysaccharide-containing lactic acid bacteria producing substances, sphingolipids and collagen peptides are added to the composition for inhibiting erythema formation as an active ingredient, the intake is 200 µg or more per day for polysaccharide, 4 mg or more per day for sphingolipid, and 400 mg or more per day for collagen peptide.

[0013]

In addition, it is preferable that ingesting the composition for inhibiting erythema formation daily for 4 weeks or more causes the pigmentation strength of the skin of an intake person to increase. The pigmentation strength is preferably increased by one or more, and more preferably by two or more. Note that when polysaccharide-containing lactic acid bacteria producing substances and sphingolipids are added to the composition for inhibiting the formation of erythema as an active ingredient, its intake is 200 µg or more per day for polysaccharide and 4 mg or more per day for sphingolipid. In addition, when polysaccharide-containing lactic acid bacteria producing substances, sphingolipids and collagen peptides are added to the composition for inhibiting erythema formation as an active ingredient, its intake is 200 µg or more per day for polysaccharide, 4 mg or more per day for sphingolipid, and 400 mg or more per day for collagen peptide.

[0014]

The method according to the second aspect of the present invention is a method of using a lactic acid bacteria producing substance containing polysaccharide as a composition for inhibiting erythema formation. In other words, it is to provide a lactic acid bacteria producing substance containing polysaccharide for use as a composition for inhibiting erythema formation.

[0015]

A method for inhibiting erythema formation according to the third aspect of the present invention is a method for inhibiting erythema formation by orally ingesting a composition for inhibiting erythema formation as described above so that an ingestion amount of polysaccharide is 200 μg or more per day for at least 7 days. However, the act of treating humans is excluded. Note that an ingestion period is preferably one week or more, more preferably two weeks or more, still preferably three weeks or more, particularly preferably four weeks or more.

[0016]

In the method for producing a composition for inhibiting erythema formation according to the fourth aspect of the present invention, a composition for inhibiting erythema formation is produced by supplying milk raw material to lactic acid bacteria producing polysaccharide. In other words, here, the polysaccharide-containing lactic acid bacteria producing substance is used to produce a composition for inhibiting the formation of erythema.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

FIG. 1 is a bar graph showing erythema scores of each sample according to Experimental Example 1.

FIG. 2 is a bar graph showing Δa^* values of each sample according to Experimental Example 1.

FIG. 3 is a bar graph showing erythema scores of each sample according to Experimental Example 2.

FIG. 4 is a bar graph showing erythema scores of each sample according to Experimental Example 3.

DESCRIPTION OF EMBODIMENTS

[0018]

A composition for inhibiting the formation of erythema according to the embodiment of the present invention is an orally ingested composition for inhibiting the

formation of erythema by sunburn (ultraviolet irradiation), which contains a polysaccharide-containing lactic acid bacteria producing substance (hereinafter referred to as "polysaccharide-containing lactic acid bacteria producing substance") as an active ingredient. Note that it is preferable that the composition for inhibiting the formation of erythema contains sphingolipid, as an active ingredient, in addition to the polysaccharide-containing lactic acid bacteria producing substance; it is more preferable that sphingolipid and collagen peptide are contained. Hereinafter, the active ingredients of the composition for inhibiting the formation of erythema will be described in detail; subsequently, the form of the composition for inhibiting the formation of erythema will be described, and then optional components in each form will be described in detail. Subsequently, the method of efficient ingestion of the composition for inhibiting the formation of erythema and its effect will be described in detail.

[0019]

(1) Polysaccharide-containing lactic acid bacteria producing substance

In the embodiment of the present invention, the polysaccharide-containing lactic acid bacteria producing substance contains a polysaccharide-containing lactic acid fermented product (hereinafter referred to as "polysaccharide-containing lactic acid bacteria fermented product"), a polysaccharide-containing lactic acid bacteria culture (hereinafter referred to as "polysaccharide-containing lactic acid bacteria culture"), metabolites of lactic acid bacteria containing polysaccharide, and the like.

[0020]

Note that the term "lactic acid bacteria" as used herein is a generic term for microorganisms that assimilate glucose to produce lactic acid of 50% or more in terms of sugar yield; it is a coccus or bacillus of gram-positive bacteria for physiological properties, has no mobility, has no sporulation ability, is negative for catalase and has other properties. Lactic acid bacteria have been eaten in various places throughout the world via fermented milk and the like, and it is ascertained that the microorganisms are highly safe. Up to now, lactic acid bacteria have been classified into eleven genres: *Lactococcus*, *Lactobacillus*, *Leuconostoc*, *Pediococcus*, *Streptococcus*, *Weissella*, *Tetragenococcus*, *Oenococcus*, *Enterococcus*, *Vagococcus* and *Carnobacterium*. In the embodiment of the present invention, all of these lactic acid bacteria can be used; it is particularly preferable that among them, *Lactobacillus delbrueckii* subsp. *bulgaricus* and *Streptococcus thermophilus* are mixed to be used. Note that it is preferable that *Lactobacillus delbrueckii* subsp. *bulgaricus* mentioned here is at least one of *Lactobacillus delbrueckii* subsp. *bulgaricus* OLL1247 (Deposit number: NITE BP-01814) and *Lactobacillus delbrueckii* subsp. *bulgaricus* 2038; it is preferable that *Streptococcus thermophilus* is at least of *Streptococcus thermophilus* OLS3078 (Deposit

number: NITE BP - 01697) and *Streptococcus thermophilus* 1131. Here, *Lactobacillus delbrueckii* subsp. *bulgaricus* OLL1247 was deposited on March 6, 2014 (the date of deposit) by NITE Patent Microorganisms Depository, National Institute of Technology and Evaluation (#122, 2-5-8 Kazusakamatari, Kisarazu-shi, Chiba prefecture, Japan) as a deposit number NITE BP-01814 under the Budapest Treaty. In addition, *Streptococcus thermophilus* OLS3078 was deposited on August 23, 2013 (the date of deposit) by NITE Patent Microorganisms Depository, National Institute of Technology and Evaluation (#122, 2-5-8 Kazusakamatari, Kisarazu-shi, Chiba prefecture, Japan) as a deposit number NITE BP-01697 under the Budapest Treaty. In addition, *Lactobacillus delbrueckii* subsp. *bulgaricus* 2038 and *Streptococcus thermophilus* 1131 can be obtained by isolating from Bulgaria yoghurt LB81 (registered trademark) made by Meiji Co., Ltd.

[0021]

The "fermented lactic acid fermented product" mentioned here means the culture itself obtained by fermentation with lactic acid bacteria. The fermented lactic acid bacteria fermented product includes a fermented product of lactic acid bacteria and a treated product thereof, for example, a culture filtrate or a culture supernatant fluid obtained by filtering and centrifuging a culture (fermented product of lactic acid bacteria) or sterilizing it through membrane separation, a concentrate obtained by concentrating a culture filtrate, a culture supernatant fluid, a fermented product of lactic acid bacteria, or the like using evaporator, pasted products, diluted products, or dried matter (obtained by freezing, heating, depressurizing or the like). In preparing the processed product, one or more of the above-described process steps such as filtration, centrifugation, sterilization process such as membrane separation, precipitation, concentration, paste formation, dilution, drying and the like can be carried out solely or in combination. In addition, examples of the culture medium include skim milk medium and MRS medium to which yeast extract is added.

[0022]

It is particularly preferable that a lactic acid bacteria producing substance is a milk fermented product or a milk culture of lactic acid bacteria. Examples of milk fermented products and milk cultures include fermented milk (yoghurt) and polysaccharide. Fermented milk (yoghurt) is a fermented food prepared by mixing lactic acid bacteria and yeast in milk and fermenting them, and is eaten widely due to its good taste and cosmetic and health advantages. Fermented milk (yoghurt) can preferably be its supernatant. Skim milk, culture medium of whey decomposed matter and the like as well as a thickener or a gelling agent of pectin, guar gum, xanthan gum, carrageenan, processed starch or the like are added to the fermented milk.

[0023]

Examples of milk include animal milk such as milk and processed products thereof (for example, skimmed milk, whole milk powder, skim milk powder, condensed milk, casein, whey, fresh cream, compound cream, butter, buttermilk powder, cheese or the like), vegetable milk such as soymilk derived from soybeans. Note that the milk may be sterilized or may not be sterilized.

[0024]

Incidentally, examples of a raw material for fermented milk include what is called a fermented milk raw material mix. The fermented milk raw material mix is a mixture containing raw milk and other ingredients. This fermented milk raw material mix is obtained by heating and dissolving raw materials commonly used in the production of fermented milk such as raw milk, water, other optional components (for example, saccharines, sweetener, acidulant, mineral, vitamin, perfume or the like) and by mixing them subsequently. The raw milk may contain water, raw milk, pasteurized milk, skimmed milk, whole milk powder, skimmed milk powder, full fat concentrated milk, defatted concentrated milk, buttermilk, butter, cream, cheese or the like. Also, raw milk may contain whey protein concentrate (WPC), whey protein isolate (WPI), α -lactalbumin (α -La), β -lactoglobulin (β -Lg) or the like.

[0025]

As in the conventional method, fermented milk is produced through a step of preparing a raw material mix, a step of sterilizing (heating and sterilizing) the raw material mix, a step of cooling the raw material mix, a step of adding a starter, a step of fermenting, a step of cooling fermented milk and the like. In the step of preparing the raw material mix, raw materials are mixed (blended). Note that in the above step, ordinary conditions used for producing fermented milk may be appropriately adopted. In addition, it is preferable that the step of sterilizing (heating and sterilizing) the raw material mix, the step of cooling the raw material mix, the step of adding the starter, the step of fermenting and the step of cooling the fermented milk are performed in this order.

[0026]

As a medium for culturing lactic acid bacteria, a commonly used medium can be used. In other words, any medium can be used as long as it contains the main carbon source as well as a nitrogen source, inorganic matter and other nutrients. As the carbon source, lactose, glucose, sucrose, fructose, starch hydrolyzate, molasses or the like can be used depending on the assimilability of the used bacteria. As the nitrogen source, organic nitrogen-containing substances such as casein hydrolyzate, whey protein hydrolyzate, α -lactalbumin, β -lactoglobulin, glycomacropeptide, soy protein hydrolyzate and the like can be used. In addition, meat extract, fish meat extract, yeast extract and the like can be used as a growth promoting agent.

[0027]

Lactic acid bacteria are preferably cultured in an anaerobic condition; however, it is usually preferable to culture in a microaerophilic condition used in liquid static culture or the like. As a culturing method under an anaerobic condition, a known method such as a method of culturing under a carbon gas phase can be adopted, but other methods may be adopted. Generally, the culture temperature is preferably within a range from 30 °C to 47 °C inclusive, more preferable within a range from 35 °C to 46 °C inclusive, and still more preferably within a range from 37 °C to 45 °C inclusive. The pH of the medium in the culture of lactic acid bacteria is preferably maintained within a range from 6 to 7 inclusive, but other pH ranges may be used as long as the bacterium grows. The incubation time of lactic acid bacteria or the like is usually preferably within a range from one hour to 48 hours inclusive, more preferably within a range from 8 hours to 36 hours, and still more preferably within a range from 10 hours to 24 hours inclusive.

[0028]

Typically, fermented milk (yoghurt) has a non-fat milk solid content of 8 wt% or more, and the number of lactic acid bacteria or a yeast number is within a range from 10^6 /ml to 10^{11} /ml inclusive.

[0029]

(2) Sphingolipid

In the embodiment of the present invention, sphingolipid is a generic term for lipids having a sphingoid base; it has been clarified that sphingolipid constitutes cell membranes of eukaryotic organisms, and has the effect of improving the barrier function of the skin by oral ingestion. Examples of this sphingolipid include those derived from nature, those derived from milk such as cow milk, goat milk, ewe milk, horse milk, those derived from egg yolk, those derived from cereals such as soybeans, rice, maize and the like, those derived from konjac, and those derived from beet. Among these sphingolipids, those derived from milk are preferable, and more specifically, those derived from cow milk are preferable. This sphingolipid contains sphingomyelin, ceramide, glucosylceramide, galactosylceramide. In an embodiment of the present invention, the sphingolipid is preferably at least one selected from a group consisting of sphingomyelin, ceramide, glucosylceramide and galactosylceramide. The sphingolipid is preferably sphingophospholipid, more preferably sphingomyelin. These sphingolipids can be prepared by a method commonly used for natural raw materials, but commercially available products may be used.

[0030]

Sphingomyelin is one type of milk-derived sphingolipid; it has been clarified that oral ingestion of sphingomyelin achieves effects of improving or preventing the deterioration

of skin conditions (deterioration of the barrier function of the skin, drying of the skin, reduction of moisture content of the stratum corneum, atopic dermatitis and the like).

[0031]

In addition, this sphingomyelin is a substance composed of ceramide and phosphocholine, which is hydrolyzed to ceramide and phosphocholine with sphingomyelinase. In addition, ceramide is hydrolyzed to sphingoid bases and fatty acids with ceramidase. Most of the fatty acids are absorbed in the epithelial cells of the small intestine, whereas some of the sphingoid bases are resynthesized to sphingomyelin, ceramide or the like. Note that it is reported that sphingomyelin is degraded with intestinal bacteria.

[0032]

In general, examples of sphingomyelin, particularly molecular species contained in milk-derived sphingomyelin, include sphingomyelin molecular species in which phosphocholine or phosphoethanolamine is bonded to a ceramide structure in which "sphingosine or dihydrosphingosine having a carbon chain number within a range from 16 to 18 inclusive" is amide-bonded to "fatty acid having a carbon chain number within a range from 14 to 26 inclusive".

[0033]

It has been clarified that simultaneously ingesting fermented milk (yoghurt) with sphingomyelin can increase an amount of sphingomyelin absorbed into a living body; that is, it has been clarified that the absorption of sphingomyelin improves. It has been also clarified that absorption of ceramide improves at this time. Ingesting lactic acid bacteria producing substances promotes absorption of sphingolipids. Furthermore, efficiently absorbing sphingolipids including sphingomyelin into a living body makes it possible to achieve various beneficial effects and advantages in addition to the effect of improving the barrier function of the skin.

[0034]

As described above, ceramide is a substance formed by combining sphingoid bases and fatty acid, and is hydrolyzed to sphingoid bases and fatty acid with ceramidase. Examples of molecular species contained in ceramide include a molecular species in which "sphingosine, dihydrosphingosine, sphingadienine, phytosphingosine or hydroxysphingenin having a carbon chain including number of carbons within a range from 16 to 18 inclusive" is amide-bonded to "fatty acid or hydroxy fatty acid having a carbon chain including number of carbons within a range from 14 to 26 inclusive".

[0035]

Glucosylceramide is a substance in which glucose is bonded to a ceramide composed of sphingoid bases and fatty acid, and is hydrolyzed to ceramide and glucose by a

glucoceramide degrading enzyme. Examples of the molecular species contained in glucosylceramide include a Glucosylceramide molecular species in which glucose is bonded to a ceramide structure in which "sphingosine, dihydrosphingosine, sphingadienine, phytosphingosine or hydroxysphingenin having a carbon chain including number of carbons within a range from 16 to 18 inclusive" is, for example, amide-bonded to "fatty acid or hydroxy fatty acid having a carbon chain including number of carbons within a range from 14 to 26 inclusive".

[0036]

Galactosylceramide is a substance in which galactose is bound to a ceramide composed of sphingoid bases and fatty acid, and is hydrolyzed to ceramide and galactose by a galactosylceramide decomposing enzyme. Examples of the molecular species contained in galactosylceramide include a galactosylceramide molecular species in which galactose is bonded to a ceramide molecular species in which "sphingosine, dihydrosphingosine, sphingadienine, phytosphingosine or hydroxysphingenin having a carbon chain including number of carbons within a range from 16 to 18 inclusive" is, for example, amide-bonded to "fatty acid or hydroxy fatty acid having a carbon chain including number of carbons within a range from 14 to 26 inclusive".

[0037]

The content of the sphingolipid in the composition for inhibiting the formation of erythema according to the embodiment of the present invention is preferably within a range from 7 pts.mass (mass parts) to 120,000 pts.mass inclusive with respect to 100 pts.mass of polysaccharide, more preferably within a range from 15 pts.mass to 2500 pts.mass inclusive, still more preferably within a range from 35 pts.mass to 500 pts.mass inclusive, in particular more preferably within a range from 90 pts.mass to 250 pts.mass inclusive.

[0038]

(3) Collagen peptide

In the embodiment of the present invention, collagen peptide means peptide having an average molecular weight of about 10,000 or less, which is obtained by hydrolyzing collagen to lower its molecular weight. As such collagen peptide, commercially available collagen peptides can be used, or they can be produced according to known methods (see, for example, JP-A 2006-241013). Examples of methods for producing collagen peptide include a method of hydrolyzing collagen contained in fish, cow, pig, chicken or the like, or gelatin which is heat-denatured collagen. Note that collagen peptides are easily soluble in cold water and are soluble with a high concentration; thus, it is superior, in handling properties, in comparison with gelatins and thickened polysaccharides which are difficult to dissolve in water and are difficult to dissolve with a high concentration when hot water is not used.

Also, collagen peptide can be added to raw material with the collagen peptide in the form of power, or it can be added as a solution by dissolving it in water; however, it is preferable to add collagen peptide as a solution to uniformly mix it.

[0039]

In the composition for inhibiting the formation of erythema according to the embodiment of the present invention, it is preferable to use collagen peptide that has a molecular weight within a range from about 1000 to about 8000 and that is derived from fish skin, fish scales, pig skin and chicken legs.

[0040]

The content of collagen peptide in the composition for inhibiting the formation of erythema according to the embodiment of the present invention is preferably within a range from 700 pts.mass to 2.5 million pts.mass inclusive with respect to 100 pts.mass of polysaccharide, more preferably within a range from 1500 pts.mass to 250,000 pts.mass inclusive, still more preferably within a range than 3500 pts.massparts to 50,000 pts.mass inclusive, in particular more preferably within a range from 9000 pts.mass to 25000 pts.mass inclusive.

[0041]

(4) Form of Composition for Inhibiting Formation of Erythema and Optional Component

The composition for inhibiting the formation of erythema according to the embodiment of the present invention can be used in the form of preparations of pharmaceuticals, supplements, food additives, and the like, foods or drinks (excluding animals and plants per se), and food or drink compositions (including processed food or drink).

[0042]

In the embodiment of the present invention, the preparation is prepared as an oral preparation in accordance with a routine procedure using an additive which is acceptable for formulation. This preparation may take the form of a solid preparation such as a tablet, a powder, a fine granule, a granule, a capsule, a pill, a sustained release tablet, and the like; it may also take the form of a liquid preparation such as a solution, a suspension, an emulsion and the like. Examples of additives that are acceptable for formulation include excipients, stabilizers, preservatives, wetting agents, emulsifiers, lubricants, sweeteners, colorants, fragrances, buffers, antioxidants, pH conditioners and the like. Note that specific examples of the food additives include processed seasonings, flavor seasonings, seasonings such as cooking mixes, and the like.

[0043]

In addition, in the embodiment of the present invention, the foods or drinks and the food or drink composition are those processed for eating and drinking of human beings and

animals; they should not be particularly limited as long as they take orally ingestible forms such as solutions, suspensions, emulsions, powders, solid moldings and the like. Specific examples of food or drink products and food or drink compositions include dairy products such as milk drinks (including processed milk), yoghurts, lactic acid bacteria beverages, fermented milk, ice creams, creams, cheeses, and the like; drinks such as soft drinks, fruit juice drinks, vegetable drinks, soy milk drinks, coffee drinks, tea beverages, jelly drinks, powder beverages such as cocoa and smoothie, or sports powdered beverages such as smoothies, nutritionally enhanced powder beverages, cosmetic powder foods, powder soups, ingredients of steamed breads, concentrated beverages, alcoholic beverages, and the like; flour products such as bread, pasta, noodles, cake mix, flour for fried chicken seasoning, bread crumbs, and the like; confectionery, like dessert confectionery, such as chocolate, gums, candies, cookies, gummies, snacks, Japanese confectionery, jelly, puddings, and the like; retort foods for curry, basta sauce, potato, stew, or Japanese-style food; oils and fats such as modified fat, butter, margarine, spread, mayonnaise and the like; instant foods such as freeze-dried foods; agricultural canned; processed agricultural products such as jam, marmalade, pickles, cooked beans; cereal, hodgepodge, and the like; processed marine products; processed meat products; and frozen foods such as pizza, doria, gratin, household dish, fried foods and the like; liquid foods, furthermore, animal feeds, tablets, cosmetics used in the oral cavity, and the like.

[0044]

Note that in the embodiments of the present invention, the food or drink products and the food or drink compositions includes functional foods, health nutritional foods, health foods, foods for specified health use, functional display foods, nutritional functional foods, foods for sick people, modified milk powder for infants, milk powder for pregnant women or lactating women, or stuff such as foods or drinks with a disease risk reduction indication. Here, the disease risk reduction indication is an indication of foods or drinks that may reduce disease risk, and is a prescribed indication or an acknowledged indication based on or with reference to the standard specified by FAO/WHO Joint Food Standards Committee (Codex Committee).

[0045]

In the embodiment of the present invention, optional ingredients can be added to the foods or drinks and food or drink compositions as necessary. Non-limited examples of such optional ingredients include sweeteners, acidulants, juices of vegetables, fruits or seeds and extracts thereof, nutrients such as vitamins, minerals, amino acids and the like, lactic acid bacteria (excluding essential lactic acid bacteria according to the embodiment of the present invention), useful microorganisms such as bifidobacteria and propionic acid bacteria and

fermentation products thereof, saccharides having functionalities such as oligosaccharides, existing functional materials such as royal jelly, glucosamine, astaxanthin, polyphenols, perfumes, pH-adjusting agents, diluting agents, acidulants, colorants, emulsifiers, preservatives and the like, which are usually mixed with foods or drinks.

[0046]

<Efficient method of intake of a composition for inhibiting the formation of erythema and its effect>

It is preferable that the composition for inhibiting the formation of erythema according to the embodiment of the present invention is ingested orally for at least 7 days so that the intake amount of polysaccharide is 200 μg or more per day. Ingesting this composition for inhibiting the formation of erythema as described above decreases the erythema intensity by one or more and increases the minimum erythema amount and pigmentation intensity. Note that when polysaccharide-containing lactic acid bacteria producing substances and sphingolipids are added to the composition for inhibiting the formation of erythema as an active ingredient, its intake is 200 μg or more per day for polysaccharide and 4 mg or more per day for sphingolipid. In addition, when polysaccharide-containing lactic acid bacteria producing substances, sphingolipids and collagen peptides are added to the composition for inhibiting the formation of erythema as an active ingredient, the intake is 200 μg or more per day for polysaccharide, 4 mg or more per day for sphingolipids, and 400 mg or more per day for collagen peptide.

[0047]

Note that the intake of polysaccharide is not particularly limited as long as it does not harm the human body; however, it is preferably within a range from 200 μg per day to 60,000 μg per day inclusive, more preferably within a range from 300 μg per day to 45,000 μg per day inclusive, still more preferably within a range from 400 μg per day to 30,000 μg per day inclusive, and in particular more preferably within a range from 500 μg per day to 15,000 μg per day inclusive (note that a notation of “mass per day or more” is identical to a notation “mass or more per day”, and a notation of “mass per day or less” is identical to a notation “mass or less per day”) from the viewpoint of cost-effectiveness. In addition, an intake of sphingolipids and collagen peptides can be derived from the range definition of the content with respect to 100 pts.mass of the above-mentioned polysaccharide at a stage when the intake of the polysaccharide is determined; more specifically, the intake of sphingolipids is preferably within a range from 4 mg per day to 500 mg per day inclusive, more preferably within a range from 6 mg per day to 400 mg per day inclusive, still more preferably within a range from 8 mg per day to 300 mg per day inclusive, and in particular preferably within a range from 10 mg per day to 200 mg per day inclusive. The intake of collagen peptide is

preferably within a range from 400 mg per day to 20000 mg per day inclusive, more preferably within a range from 600 mg per day to 15000 mg per day inclusive, still more preferably within a range from 800 mg per day to 10000 mg per day inclusive, in particular more preferably within a range from 1000 mg per day to 5000 mg per day inclusive.

[0048]

Note that a necessary dose of each of the above-mentioned active ingredients is based on a human body administration experiment; however, a necessary dose to human body can be obtained by converting a necessary dose in an animal experiment (for example, a mouse experiment) using the following formula based on the Food Safety Commission material.

[0049]

$$(\text{Necessary dose to human body (converted value)}) = (\text{Necessary dose for animal}) \times (\text{Lower limit of female human body weights: 40 kg}) \div (\text{safety factor: 100})$$

<Experimental example>

The present invention will now be described in more detail by showing experiment examples. Note that the present invention should not be limited to the following experimental examples.

[0050]

- Working Example 1 -

In this experimental example, the influence of polysaccharide on skin erythema formation under ultraviolet irradiation was examined. More specifically, the hairless mouse was irradiated with ultraviolet rays to form erythema on the skin, and the influence of the polysaccharide on this condition was verified.

[0051]

(1-1) Preparation of yoghurt A

After *Lactobacillus delbrueckii* subsp. *bulgaricus* OLL 1247 and *Streptococcus thermophilus* OLS 3078 were inoculated on a medium containing 10% by weight of skimmed milk powder and the medium were inoculated, they were fermented and heated at 43 ° C for 3 hours. The yoghurt A obtained as described above contained 110 µg/g of polysaccharide.

[0052]

Note that the content of polysaccharide in the yoghurt A was measured in accordance with the phenol sulfuric acid method (Hodge et al., "Methods in carbohydrate chemistry", Vol. 1, page 338 (1962)). More specifically, it is as follows.

[0053]

First, 1 g of trichloroacetic acid was added to 10 g of yoghurt A and thoroughly stirred. Next, after the trichloroacetic acid added yoghurt A was centrifuged under

conditions of 10,000 rpm, 10 minutes, and 4 °C, its supernatant was transferred to another tube. Next, 99.5% of ethanol whose volume is twice that of the supernatant was added to the supernatant, and then the ethanol-added supernatant was left overnight in a freezer, resulting in a precipitate in the tube. After this precipitate was centrifuged under conditions of 10,000 rpm, 10 minutes, and 4 °C, 3 mL of ultrapure water was added to the obtained precipitate to obtain a polysaccharide extract solution. After 500 µL of a phenol reagent (5% (w/v)) was added to 500 µL of the polysaccharide extract solution and the mixture was stirred, 2.5 mL of concentrated sulfuric acid was further added to the mixed solution; immediately after that, the mixed solution was stirred for 10 seconds. Subsequently, the mixed solution was left at room temperature for 20 minutes or more, and an absorbance at 490 nm of the mixed solution was measured with a spectrophotometer. Note that after preparing a control solution as follows, an absorbance at 490 nm of the control solution was measured in the same manner as described above. After 500 µL of a phenol reagent (5% (w/v)) was added to 500 µL of a standard glucose solution and the mixture was stirred, 2.5 mL of concentrated sulfuric acid was added to the mixed solution; immediately after that, the mixture was stirred for 10 seconds. Subsequently, the mixture was left at room temperature for 20 minutes or more.

[0054]

(1-2) Preparation of polysaccharide extract

A portion of the yoghurt A was separated, and three times the amount of ethanol was added to the supernatant and was frozen and stored. Subsequently, its supernatant was centrifuged, thereby obtaining a precipitate. This precipitate was then lyophilized to obtain a polysaccharide extract. Note that 70 mg of polysaccharide extract was contained in 11.3 g of yoghurt A.

[0055]

(1-3) Skin Erythema Formation by Ultraviolet Irradiation

After twenty-four hairless mice (Hos: HR-1, female, 8 weeks old, Japan SLC, Inc.) were acclimated for 4 days, the hairless mice were divided into groups each consisting of 8 mice and water, yoghurt A, and polysaccharide extract (hereinafter collectively referred to as "sample") were orally administered to hairless mice belonging to each group for 10 days. Note that the yoghurt A was administered at 11.3 g/kg body-weight/day, and the polysaccharide extract group was administered at 70 mg/kg body-weight/day. After 7 days from the start of administration of each sample, the hairless mice were irradiated with ultraviolet rays for 50 seconds with an illuminance of 0.4 mW/cm² (note that as a ultraviolet-ray irradiating apparatus, GL 20 SE manufactured by Sankyo Denki Co., Ltd. (wavelength region: 280 nm to 400 nm, peak wavelength: 306 nm) was used. The amount of ultraviolet ray at this time is 20 mJ/cm² (= 0.4 mW/cm² × 50 seconds)). After 3 days from

ultraviolet irradiation, the extent of erythema on the back skin of each hairless mouse was scored (for the scoring method, see the description below). Hereinafter, for convenience of explanation, a group of hairless mice (corresponding to a comparative example) to which water was administered is referred to as a "control group", a group of hairless mice (corresponding to the working example) orally administered with yoghurt A at 11.3 g/kg body-weight/day is referred to as "yoghurt group A", and a group of hairless mice (corresponding to the working example) orally administered with a polysaccharide extract at 70 mg/kg body-weight/day is referred to as "polysaccharide extract group".

[0056]

(1-4) Evaluation

(1-4-1) Evaluation by scoring

The degree of erythema on the skin of the hairless mice of each group described above was visually scored. The score was evaluated at five grades from 1 to 5 as follows:

5: high (symptoms were observed at 50% or more of the body surface area irradiated with ultraviolet rays, indicating vivid red color.);

4: moderate (symptoms are observed at 30% or more of the body surface area irradiated with ultraviolet rays, indicating clear red color.);

3: mild (symptoms are observed at 10% or more of the body surface area irradiated with ultraviolet rays, indicating pale red color.);

2: slight (slight reddening symptoms are confirmed on the body surface irradiated with ultraviolet rays.); and

1: none (normal color tone).

In other words, the lower the score value is, the higher the effect of inhibiting erythema is. Note that the results of this experimental example are as shown in FIG. 1, and the score values of the yoghurt group A and the polysaccharide extract group were significantly low as compared with the score value of the control group. In other words, the yoghurt A and the polysaccharide extract showed an effect of inhibiting the formation of erythema by irradiation with ultraviolet rays.

[0057]

(1-4-2) Evaluation by Δa^* value

The degree of erythema of the skin of the hairless mice of each group was evaluated by determining the $L^*a^*b^*$ values from the skin image. More specifically, a value (Δa^* value) obtained by subtracting the a^* value at a spot not irradiated with ultraviolet rays from the a^* value at a spot irradiated with ultraviolet rays was determined for each hairless mouse. In other words, the lower the value (Δa^* value) is, the higher the effect of inhibiting erythema is. Note that the results of this experimental example are as shown in FIG. 2, and the Δa^*

values of the yoghurt group A and the polysaccharide extract group were significantly low as compared with that of the control group. In other words, the yoghurt A and the polysaccharide extract showed an effect of inhibiting the formation of erythema by irradiation with ultraviolet rays.

[0058]

- Experimental Example 2 -

In this experimental example, the influence of polysaccharide content in lactic acid bacteria fermented products on skin erythema formation under ultraviolet irradiation was examined. More specifically, the hairless mouse was irradiated with ultraviolet rays to form erythema on the skin, and the influence of the amount of polysaccharide in the lactic acid bacteria fermented products on this condition was examined.

[0059]

(2-1) Preparation of yoghurt B

After inoculating a medium containing 10% by weight of skim milk with *Lactobacillus delbrueckii* subsp. *bulgaricus* 2038 and *Streptococcus thermophilus* 1131, the medium was fermented and heated at 43 °C for 3 hours. The yoghurt B obtained as described above contained 42 µg/g of polysaccharide. The content of polysaccharide in yoghurt B was measured by the phenol sulfuric acid method shown in Experimental Example 1.

[0060]

(2-2) Skin Erythema Formation by Ultraviolet Irradiation

After twenty-four hairless mice (Hos: HR-1, female, 8 weeks old, Japan SLC, Inc.) were acclimated for 4 days, the hairless mice were divided into groups each consisting of 8 mice and water, yoghurt A prepared in Experimental Example 1 and the above-mentioned yoghurt B (hereinafter collectively referred to as "sample") were orally administered to hairless mice belonging to each group for 10 days. Note that both yoghurt A and yoghurt B were administered at 11.3 g/kg body-weight/day. After 7 days from the start of administration of each sample, the hairless mice were irradiated with ultraviolet rays for 50 seconds with an illuminance of 0.4 mW/cm² (note that as a ultraviolet-ray irradiating apparatus, GL 20 SE manufactured by Sankyo Denki Co., Ltd. (wavelength region: 280 nm to 400 nm, peak wavelength: 306 nm) was used. The amount of ultraviolet ray at this time is 20 mJ/cm² (= 0.4 mW/cm² × 50 seconds)). After 3 days from ultraviolet irradiation, the extent of erythema on the back skin of each hairless mouse was scored in the same manner as in Experimental Example 1. Hereinafter, for convenience of explanation, a group of hairless mice (corresponding to a comparative example) to which water was administered is referred to as a "control group", a group of hairless mice (corresponding to the working example)

orally administered with yoghurt A at 11.3 g/kg body-weight/day is referred to as "yoghurt group A", and a group of hairless mice (corresponding to the working example) orally administered with yoghurt B at 11.3 g/kg body-weight/day is referred to as "yoghurt group B".
[0061]

(2-3) Evaluation result

The results of this experimental example are as shown in FIG. 3, and the score values were significantly lower in the order of yoghurt group B and yoghurt group A than in the control group. In other words, it was revealed that the yoghurt having a higher polysaccharide content has a higher ability to inhibit the formation of erythema.

[0062]

- Experimental Example 3 -

In this Experimental Example, the influence of "lactic acid bacteria fermented products, sphingomyelin, collagen peptide-containing compositions" on skin erythema formation under ultraviolet irradiation was examined. More specifically, the hairless mouse was irradiated with ultraviolet rays to form erythema on the skin, and the influence of "lactic acid bacteria fermented products, sphingomyelin, collagen peptide-containing compositions" on this condition was examined.

[0063]

(3-1) Skin Erythema Formation by Ultraviolet Irradiation

After twenty-four hairless mice (Hos: HR-1, female, 8 weeks old, Japan SLC, Inc.) were acclimated for 4 days, the hairless mice were divided into groups each consisting of 8 mice and "water", "a mixture of sphingomyelin and collagen peptide" and "a mixture of yoghurt, sphingomyelin and collagen peptide" (hereinafter collectively referred to as "sample") were orally administered to hairless mice belonging to each group for 10 days. Note that the "mixture of sphingomyelin and collagen peptide" was administered such that sphingomyelin (PC700 manufactured by Fonterra Co., sphingomyelin content 16.5 mass%) was 10 mg/kg body-weight/day and collagen peptide (IQUOS manufactured by Nitta Gelatin Inc., origin: fish scales, molecular weight: 3000 to 5000, collagen peptide content 88.0 mass%) was 1.0 g/kg body-weight/day; the "mixture of yoghurt, sphingomyelin and collagen peptide" was administered such that yoghurt (Meiji Bulgaria yoghurt fat zero, lactic acid bacteria starter: *Lactobacillus delbrueckii* subspecies *bulgaricus* 2038 and *Streptococcus thermophilus* 1131, polysaccharide content 80 µg/g) was 11.3 g/kg body-weight/day and sphingomyelin (PC 700 manufactured by Fonterra Co., sphingomyelin content 16.5 mass%) was 10 mg/kg body-weight/day and collagen peptides (IQUOS manufactured by Nitta Gelatin Co., origin: fish scales, molecular weight: 3000 to 5000, collagen peptide content 88.0 mass%) was 1.0 g/kg body-weight/day. After 7 days from the start of administration of each

sample, the hairless mice were irradiated with ultraviolet rays for 50 seconds with an illuminance of 0.4 mW/cm^2 (note that as a ultraviolet-ray irradiating apparatus, GL 20 SE manufactured by Sankyo Denki Co., Ltd. (wavelength region: 280 nm to 400 nm, peak wavelength: 306 nm) was used. The amount of ultraviolet ray at this time is $20 \text{ mJ/cm}^2 (= 0.4 \text{ mW/cm}^2 \times 50 \text{ seconds})$). After 3 days from ultraviolet irradiation, the extent of erythema on the back skin of each hairless mouse was scored in the same manner as in Experimental Example 1. Hereinafter, for convenience of explanation, a group of hairless mice (corresponding to a comparative example) to which water was administered is referred to as a "control group", a group of hairless mice (corresponding to the working example) to which the mixture of sphingomyelin and collagen peptide group was administered such that sphingomyelin is 10 mg/kg body-weight/day and collagen peptide is 1.0 g/kg body-weight/day is referred to as "sphingomyelin & collagen peptide group", and a group of hairless mice (corresponding to the working example) to which the mixture of yoghurt, sphingomyelin and collagen peptide group was administered such that yoghurt is 11.3 g/kg body-weight/day, sphingomyelin is 10 mg/kg body-weight/day and collagen peptide is 1.0 g/kg body-weight/day is referred to as "yoghurt & sphingomyelin & collagen peptide group".

[0064]

(3-2) Evaluation result

The results of this experiment are as shown in FIG. 4, and the score values were significantly lower in the order of sphingomyelin & collagen peptide group, yoghurt & sphingomyelin & collagen peptide group than in the control group. In other words, it has been clarified that ingestion with yoghurt, sphingomyelin and collagen peptide mixed inhibits the formation of erythema more effectively than ingestion with sphingomyelin and collagen peptide mixed

[0065]

- Experimental Example 4 -

In this experimental example, the influence of sphingomyelin & collagen peptide-containing yoghurt on human skin erythema formation under ultraviolet irradiation was examined. More specifically, a person was irradiated with ultraviolet rays to form erythema on the skin, and the influence of sphingomyelin & collagen peptide-containing yoghurt on this condition was examined.

[0066]

(4-1) Inhibition of skin erythema formation by ultraviolet irradiation

First, 22 healthy female human aged 30 to 40 years old were treated as subjects and the minimum erythema dose (MED) of the subjects was measured. Next, four spots at the back of each of the subjects were irradiated with ultraviolet rays whose amount was 1.5 times

the amount of MED in a circular shape having a diameter of about 8 mm (irradiation with ultraviolet rays of 0.42 mW/cm² for 60 to 120 seconds (the irradiation time is dependent upon minimum erythema amount of the subjects)); 24 hours after the end of ultraviolet ray irradiation, a* values of the subjects' ultraviolet irradiation spots and a* values of ultraviolet non-irradiation spots were measured. Subsequently, 12 subjects out of 22 subjects ingested sphingomyelin & collagen peptide-containing yoghurt for four weeks such that yoghurt (yoghurt B prepared in Experimental Example 2, polysaccharide content of 42 µg/g) was 190 g/day, sphingomyelin (PC 700 manufactured by Fonterra Co., sphingomyelin content 16.5% by mass) was 10 mg/day, and collagen peptide (IQUOS manufactured by Nitta Gelatin Co., Ltd., origin: fish scale, molecular weight: 3000 to 5000, collagen peptide content 88.0% by mass) was 1.0 g/day. Subsequently, they were irradiated with ultraviolet rays with the same illuminance as before ingestion for the same time as before ingestion. The a* value of the ultraviolet non-irradiated spots of the subjects and the a* value of the ultraviolet irradiated spots of the subjects were measured 24 hours after the end of ultraviolet irradiation. In addition, the remaining 10 subjects were irradiated with ultraviolet rays of the same illuminance as before ingestion without ingesting sphingomyelin & collagen peptide-containing yoghurt for the same time as before ingestion. The a* value of the ultraviolet non-irradiated spots of the subjects and the a* value of the ultraviolet irradiated spots of the subjects were measured 24 hours after the end of ultraviolet irradiation. Hereinafter, for convenience of explanation, a group of subjects who did not ingest sphingomyelin & collagen peptide-containing yoghurt (corresponding to a comparative example) is referred to as a "non-ingestion group" and a group of subjects who ingested sphingomyelin & collagen peptide-containing yoghurt (corresponding to the working examples) is referred to as "ingestion group".

[0067]

(4-2) Evaluation method and evaluation result

Using a spectrophotometer (CM-2600d manufactured by Minolta Co., Ltd.), an erythema intensity after 24 hours elapsed from the end of ultraviolet irradiation in each group before ingestion and 4 weeks after ingestion was measured; that is, the erythema intensity was measured by subtracting "a value (Δa^* value) obtained by subtracting the a* value of non-ultraviolet irradiation spot before ingestion from the a* value of ultraviolet irradiation spot before ingestion" from "a value (Δa^* value) obtained by subtracting the a* value of non-ultraviolet irradiation spot after ingestion from the a* value of ultraviolet irradiation spot after ingestion", which corresponds to the following formula:

(Erythema intensity) = {(a* value of ultraviolet irradiation spot after ingestion) - (a* value of ultraviolet non-irradiation spot after ingestion)} - {(a* value of ultraviolet irradiation

spot before ingestion) - (a* value of ultraviolet non-irradiation spot before ingestion)}.

The results of this experimental example are as shown in Table 1. The long-term ingestion of sphingomyelin & collagen peptide-containing yoghurt significantly decreased the Δa^* value as compared with that before ingestion. In other words, it has been clarified that long-term ingestion of sphingomyelin & collagen peptide-containing yoghurt inhibits the formation of erythema caused by ultraviolet rays in humans.

[0068]

[table 1]

	Δa^* values before ingestion after 24 hours elapse from the end of ultraviolet irradiation Mean $\pm$ SEM	Δa^* values after ingestion after 24 hours elapse from the end of ultraviolet irradiation Mean $\pm$ SEM	Erythema intensity (difference between Δa^* values before and after ingestion) Mean $\pm$ SEM
Non-ingestion group	7.57 $\pm$ 0.38	7.56 $\pm$ 0.50	-0.01 $\pm$ 0.72
Ingestion group	7.40 $\pm$ 0.49	6.25 $\pm$ 0.55*	-1.15 $\pm$ 0.41

* : A significant difference ($P < 0.05$) to before ingestion exists (paired t-test)

- Example 5 -

In this experimental example, the influence of sphingomyelin & collagen peptide-containing yoghurt on human skin erythema formation under ultraviolet irradiation was examined. More specifically, a person was irradiated with ultraviolet rays to form erythema on the skin, and then MED was measured. The influence of sphingomyelin & collagen peptide containing-yoghurt on this condition was examined.

[0069]

(5-1) Measurement of MED

First, 22 healthy female human aged 30 to 40 years were treated as subjects, and the subjects were irradiated with ultraviolet rays on their backs. Note that ultraviolet irradiation was carried out in accordance with SPF measurement method standard (Japan Federation of Cosmetic Industries Association SPF measurement method reference <2011 revised edition>). More specifically, using a high-performance ultraviolet irradiator, six spots at the back of each of the subjects were irradiated with ultraviolet rays having an irradiation increment width of 1.2 times in a circular shape having a diameter of about 8 mm (specifically, irradiated with ultraviolet rays having an illuminance of 0.24 mW/cm², 0.29 mW/cm², 0.35 mW/cm², 0.42 mW/cm², 0.50 mW/cm², or 0.60 mW/cm² for 60 seconds); Erythema on the skin of each subject was visually evaluated in accordance with the SPF measurement method standard 24 hours after the end of the ultraviolet irradiation and the MED was measured. Subsequently,

12 subjects out of 22 subjects ingested sphingomyelin & collagen peptide-containing yoghurt for four weeks such that yoghurt (yoghurt B prepared in Experimental Example 2, polysaccharide content of 42 µg/g) was 190 g/day, sphingomyelin (PC 700 manufactured by Fonterra Co., sphingomyelin content 16.5% by mass) was 10 mg/day, and collagen peptide (IQUOS manufactured by Nitta Gelatin Co., Ltd., origin: fish scale, molecular weight: 3000 to 5000, collagen peptide content 88.0% by mass) was 1.0 g/day. Subsequently, they were irradiated with ultraviolet rays with the same illuminance as before ingestion for the same time as before ingestion. Erythema on the skin of each subject was visually evaluated 24 hours after the end of the ultraviolet irradiation and the MED of each of the subjects was measured. In addition, the remaining 10 subjects were irradiated, at each of the spots at the back of each of the subjects, with ultraviolet rays of the same illuminance as before ingestion without ingesting sphingomyelin & collagen peptide-containing yoghurt for the same time as before ingestion. Erythema on the skin of each subject was visually evaluated 24 hours after the end of the ultraviolet irradiation and the MED of each of the subjects was measured. Hereinafter, for convenience of explanation, a group of subjects who did not ingest sphingomyelin & collagen peptide-containing yoghurt (corresponding to a comparative example) is referred to as a "non-ingestion group" and a group of subjects who ingested sphingomyelin & collagen peptide-containing yoghurt (corresponding to the working example) is referred to as "ingestion group".

[0070]

(5-2) Evaluation result

The results of this experimental example are as shown in Table 2. In the non-ingestion group, MED did not change before and after the experiment, whereas in the ingestion group the MED significantly increased as compared with that before ingestion. In other words, it has been clarified that orally ingesting sphingomyelin & collagen peptide-containing yoghurt increases the minimum amount of ultraviolet rays for forming erythema, thus inhibiting the formation of erythema caused by ultraviolet rays. This means that the subject's resistance to ultraviolet radiation has increased.

[0071]

[Table 2]

	MED before ingestion Mean $\pm$ SEM	MED after ingestion Mean $\pm$ SEM	MED change amount before and after ingestion Mean $\pm$ SEM
Non-ingestion group	27.47 $\pm$ 1.60	27.38 $\pm$ 1.36	-0.08 $\pm$ 0.82
Ingestion group	25.95 $\pm$ 1.35	30.22 $\pm$ 1.49*	4.27 $\pm$ 1.06[†]

* : A significant difference ($P < 0.05$) to before ingestion exists (Wilcoxon sign rank test)

[†] : A significant difference ($P < 0.05$) to non-ingestion group exists (Wilcoxon rank sum test)

- Example 6 -

In this experimental example, the influence of sphingomyelin & collagen peptide-containing yoghurt on human skin pigmentation formation under irradiation with ultraviolet rays was examined. More specifically, pigments were deposited on the skin by ultraviolet irradiation to humans, and the influence of sphingomyelin & collagen peptide-containing yoghurt on this condition was examined.

[0072]

(6-1) Inhibition of pigmentation by ultraviolet irradiation

First, 22 healthy female human aged 30 to 40 years old were treated as subjects and the minimum erythema dose (MED) of the subjects was measured. Next, four spots at the backs of the each of subjects were irradiated with ultraviolet rays whose amount was 1.5 times the amount of MED in a circular shape having a diameter of about 8 mm (irradiation with ultraviolet rays of 0.42 mW/cm² for 60 to 120 seconds (the irradiation time is dependent upon minimum erythema amount of the subjects)); seven days after the end of ultraviolet ray irradiation, L* values of the subjects' ultraviolet irradiation spots and L* values of ultraviolet non-irradiation spots were measured. Subsequently, 12 subjects out of 22 subjects ingested sphingomyelin & collagen peptide-containing yoghurt for four weeks such that yoghurt (yoghurt B prepared in Experimental Example 2, polysaccharide content of 42 μ g/g) was 190 g/day, sphingomyelin (PC 700 manufactured by Fonterra Co., sphingomyelin content 16.5% by mass) was 10 mg/day, and collagen peptide (IQUOS manufactured by Nitta Gelatin Co., Ltd., origin: fish scale, molecular weight: 3000 to 5000, collagen peptide content 88.0% by mass) was 1.0 g/day. Subsequently, they were irradiated with ultraviolet rays with the same illuminance as before ingestion for the same time as before ingestion. The L* value of the ultraviolet non-irradiated spot of the subjects and the L* value of the ultraviolet irradiated spot of the subjects were measured seven days after the end of ultraviolet irradiation. In addition, the remaining 10 subjects were irradiated with ultraviolet rays of the same illuminance as before ingestion without ingesting sphingomyelin & collagen peptide-containing yoghurt for

the same time as before ingestion. The L* value of the ultraviolet non-irradiated spot of the subjects and the L* value of the ultraviolet irradiated spot of the subjects were measured seven days after the end of ultraviolet irradiation. Hereinafter, for convenience of explanation, a group of subjects who did not ingest sphingomyelin & collagen peptide-containing yoghurt (corresponding to a comparative example) is referred to as a "non-ingestion group" and a group of subjects who ingested sphingomyelin & collagen peptide-containing yoghurt (corresponding to the working example) is referred to as "ingestion group".

[0073]

(6-2) Evaluation method and evaluation result

Using a spectrophotometer (CM-2600d manufactured by Minolta Co., Ltd.), a pigmentation intensity after seven days elapsed from the end of ultraviolet irradiation in each group before ingestion and 4 weeks after ingestion was measured; that is, the pigmentation intensity was measured by subtracting "a value (ΔL^* value) obtained by subtracting the L* value of non-ultraviolet irradiation spot before ingestion from the L* value of ultraviolet irradiation spot before ingestion" from "a value (ΔL^* value) obtained by subtracting the L* value of non-ultraviolet irradiation spot after ingestion from the L* value of ultraviolet irradiation spot after ingestion", which corresponds to the following formula:

$$(\text{Pigmentation intensity}) = \{(\text{L}^* \text{ value of ultraviolet irradiation spot after ingestion}) - (\text{L}^* \text{ value of ultraviolet non-irradiation spot after ingestion})\} - \{(\text{L}^* \text{ value of ultraviolet irradiation spot before ingestion}) - (\text{L}^* \text{ value of ultraviolet non-irradiation spot before ingestion})\}.$$

The results of this experimental example are as shown in Table 3. In the non-ingestion group, ΔL^* value did not change before and after the experiment, whereas in the ingestion group the ΔL^* value after ingestion significantly increased as compared with the ΔL^* value before ingestion and also significantly increased as compared with that of non-ingestion group. In addition, the pigmentation intensity significantly increased in the ingestion group as compared with the non-ingestion group. In other words, it has been clarified that long-term drinking of sphingomyelin & collagen peptide-containing yoghurt inhibits ultraviolet-induced pigmentation.

[0074]

[Table 3]

	ΔL^* values before ingestion after seven days elapse from the end of ultraviolet irradiation Mean $\pm$ SEM	ΔL^* values after ingestion after seven days elapse from the end of ultraviolet irradiation Mean $\pm$ SEM	Pigmentation intensity (difference between ΔL^* values before and after ingestion) Mean $\pm$ SEM
Non-ingestion group	-6.78 ± 0.71	-6.97 ± 0.67	-0.17 ± 0.92
Ingestion group	-7.12 ± 0.59	$-4.64 \pm 0.72^{* \dagger}$	$2.27 \pm 0.49^{\dagger}$

* : A significant difference ($P < 0.05$) to before ingestion exists (paired t-test)

$\dagger$: A significant difference ($P < 0.05$) to non-ingestion group (Student t-test)

- Experimental Example 7 -

In this experimental example, the influence of sphingomyelin & collagen peptide-containing yoghurt on human skin erythema formation under ultraviolet irradiation was examined. More specifically, a person was irradiated with ultraviolet rays to form erythema on the skin to measure MED, and the influence of sphingomyelin & collagen peptide-containing yoghurt on this condition was examined.

[0075]

(7-1) Measurement of MED

First, 37 healthy female human aged 30 to 50 years were treated as subjects, and the subjects were irradiated with ultraviolet rays on their backs. Note that ultraviolet irradiation was carried out in accordance with SPF measurement method standard (Japan Federation of Cosmetic Industries Association SPF measurement method reference <2011 revised edition>). More specifically, using a high-performance ultraviolet irradiator, six spots at the back of each of the subjects were irradiated with ultraviolet rays having an irradiation increment width of 1.2 times in a circular shape having a diameter of about 8 mm (specifically, irradiated with ultraviolet rays having an illuminance of 0.24 mW/cm², 0.29 mW/cm², 0.35 mW/cm², 0.42 mW/cm², 0.50 mW/cm², or 0.60 mW/cm² for 60 seconds); Erythema on the skin of each subject was visually evaluated in accordance with the SPF measurement method standard 24 hours after the end of the ultraviolet irradiation and the MED was measured. Subsequently, 18 subjects out of 37 subjects ingested sphingomyelin & collagen peptide-containing yoghurt for five weeks such that yoghurt (yoghurt A prepared in Experimental Example 1, polysaccharide content of 110 μ g/g) was 92 g/day, sphingomyelin (PC 700 manufactured by Fonterra Co., sphingomyelin content 16.5% by mass) was 10 mg/day, and collagen peptide (IQUOS manufactured by Nitta Gelatin Co., Ltd., origin: fish scale, molecular weight: 3000 to 5000, collagen peptide content 88.0% by mass) was 1.0 g/day. Meanwhile, 19 subjects

ingested, at a pace of one day for 5 weeks, an isocalorie milk beverage (control food) obtained by adjusting, with lactic acid, a pH of skim milk powder (manufactured by Meiji Co., Ltd.), to which 2 mg of sphingomyelin is added, to the same pH as that of sphingomyelin & collagen peptide-containing yoghurt (note that the constant food contains no collagen peptide, and the amount of ingestion of sphingomyelin per day is 2 mg). Subsequently, the subjects were irradiated, on each spot of their backs, with ultraviolet rays of the same illuminance as before ingestion for the same time as before ingestion; erythema on the skin of each subject was visually evaluated and the MED was measured. For convenience of the explanation below, the group of subjects who ingested the control foods (corresponding to the comparative example) is referred to as the "control food group" and the group of subjects who ingested the sphingomyelin & collagen peptide-containing yoghurt (corresponding to the working example) is referred to as "test food group".

[0076]

(7-2) Evaluation result

The results of this experimental example are as shown in Table 4. As compared to the control food group, the amount of change in MED after ingestion was significantly raised in the test food group. In other words, it has been clarified that orally ingesting sphingomyelin & collagen peptide-containing yoghurt increases the minimum amount of ultraviolet rays for forming erythema, thus inhibiting the formation of erythema caused by ultraviolet rays. This means that the subject's resistance to ultraviolet radiation has increased.

[0077]

[Table 4]

	MED before ingestion Mean $\pm$ SEM	MED after ingestion Mean $\pm$ SEM	MED change amount before and after ingestion Mean $\pm$ SEM
Control food group	22.2 $\pm$ 0.6	25.0 $\pm$ 1.2*	2.8 $\pm$ 1.1
Test food group	21.3 $\pm$ 0.6	27.8 $\pm$ 1.3*	6.5 $\pm$ 1.1[†]

* : A significant difference ($P < 0.05$) to before ingestion exists (Wilcoxon sign rank test)

[†] : A significant difference ($P < 0.05$) to control food group exists (Wilcoxon rank sum test)

Deposit number

[0078]

NITE BP-01697

NITE BP-01814

CLAIMS

1. A composition for inhibiting erythema formation, comprising a lactic acid bacteria producing substance containing polysaccharide as an active ingredient.
2. The composition for inhibiting erythema formation according to claim 1, wherein the lactic acid bacteria producing substance is produced by a combination of *Lactobacillus delbrueckii* subsp. *bulgaricus* and *Streptococcus thermophilus*.
3. The composition for inhibiting erythema formation according to claim 2, wherein
the *Lactobacillus delbrueckii* subsp. *bulgaricus* is at least one of *Lactobacillus delbrueckii* subspecies *bulgaricus* OLL1247 (Deposit number: NITE BP-01814) and *Lactobacillus delbrueckii* subspecies *bulgaricus* 2038, and the *Streptococcus thermophilus* is at least one of *Streptococcus thermophilus* OLS3078 (Deposit number: NITE BP-01697) and *Streptococcus thermophilus* 1131.
4. The composition for inhibiting erythema formation according to any one of claims 1 to 3, comprising sphingolipid as an active ingredient.
5. The composition for inhibiting erythema formation according to any one of claims 1 to 4, comprising collagen peptide as an active ingredient.
6. The composition for inhibiting erythema formation according to any one of claims 1 to 5, reducing an erythema intensity by 1 or more.
7. The composition for inhibiting erythema formation according to any one of claims 1 to 6, increasing a minimum erythema amount.
8. The composition for inhibiting erythema formation according to any one of claims 1 to 7, increasing a pigmentation intensity.
9. A method of using a lactic acid bacteria producing substance containing polysaccharide as a composition for inhibiting erythema formation.
10. A method for inhibiting erythema formation by orally ingesting a composition for inhibiting erythema formation according to any one of claims 1 to 8 so that an ingestion

amount of polysaccharide is 200 µg or more per day for at least 7 days (provided that the act of treating humans is excluded).

11. A lactic acid bacterial producing substance containing polysaccharide for use as a composition for inhibiting erythema formation.

12. Use of a lactic acid bacteria producing substance containing polysaccharide for producing a composition for inhibiting erythema formation.

13. A method for producing a composition for inhibiting erythema formation by supplying milk raw material to lactic acid bacteria producing polysaccharide.