

DESCRIPTION

Title of Invention: FOOD/BEVERAGE ARTICLE

5 **Technical Field**

[0001] The present invention relates to a food/beverage article containing an oxygen-containing heterocyclic compound.

10 **Background Art**

[0002] Low fungus-resistant food/beverage articles such as low-salt soy sauce and ready-to-use Japanese seasoned soup stock containing a small amount of salt have been distributed due to an increase in the health orientation of consumers and the like in recent years. If such low fungus-resistant food/beverage articles are contaminated with lactic acid bacteria, the food/beverage articles are deteriorated, resulting in, for example, pH change due to the generation of lactic acid or the decarboxylation of amino acids, and the deformation of the containers due to the generation of carbonic acid gas, and thus the qualities of products are markedly spoiled disadvantageously (for example, Non Patent Literature 1). Also, if low fungus-resistant food/beverage articles are contaminated with flat sour bacteria, the contents are acidified due to acid production and the qualities of products are markedly spoiled disadvantageously (for example, Non Patent Literature 2).

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Citation List

Non Patent Literature

[0003]

Non Patent Literature 1

JOURNAL OF THE BREWING SOCIETY OF JAPAN, 2008,
5 Vol. 103, No. 2, p. 94-99

Non Patent Literature 2

B. coagulans, edited by Tateo Fujii, Fundamentals of Food
Microbiology, KODANSHA LTD., 2015, p. 15

10 **Summary of Invention****Technical Problem**

[0004] Examples of means for suppressing the deterioration of
food/beverage articles due to contamination with lactic acid bacteria
and/or flat sour bacteria include synthetic preservative addition, an
15 increase in the amount of salt and/or alcohol, and acidification by
reducing the pH. It cannot, however, be said that any method
described above is desirable in view of health orientation and the savor
of food.

[0005] An object of the present invention is to provide a food/beverage
20 article that is unlikely to be deteriorated due to lactic acid bacteria
and/or flat sour bacteria contamination without depending on these
methods.

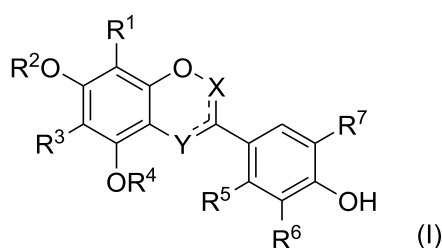
Solution to Problem

25 [0006] As a result of earnest studies to solve the above-mentioned
problem, the present inventors have consequently found that an

oxygen-containing heterocyclic compound such as licoricidin represented by the following formula (I) exhibits antimicrobial activity to lactic acid bacteria and/or flat sour bacteria, and completed the present invention based on the finding.

5 [0007] Specifically, the present invention provides a food/beverage article comprising: one or more compounds represented by the following formula (I):

[Chemical Formula 1]



10 wherein, R^1 and R^3 each independently represent a hydrogen atom or a C_{2-6} alkenyl group, R^2 and R^4 each independently represent a hydrogen atom or a C_{1-4} alkyl group, R^5 and R^7 each independently represent a hydrogen atom or a hydroxyl group, R^6 represents a hydrogen atom or a C_{2-6} alkenyl group, X represents a direct bond, $-CH_2-$, $-CH=$, or $-C(=O)-$,
 15 Y represents $-CH_2-$, $-CH=$, or $-C(=O)-$, and a bond represented by the following formula:

[Chemical Formula 2]



20 represents a single bond or a double bond (hereinafter also referred to as a "compound (I)"), wherein the total of the concentrations of the compounds is 1 ppm or more. Since the food/beverage article of the present invention contains the compound (I) at 1 ppm or more, the food/beverage article exhibits antimicrobial activity to lactic acid

bacteria and/or flat sour bacteria, and is unlikely to be deteriorated due to lactic acid bacteria and/or flat sour bacteria contamination.

[0008] It is preferable that the compound (I) be at least one selected from the group consisting of licoricidin, gancaonin I, 8-(γ,γ -dimethylallyl)-wighteone, glycycomarin, glyasperin C, glycyrin, isoangustone A, and licoarylcomarin.

[0009] The food/beverage article of the present invention may be liquid seasoning or food. The above-mentioned liquid seasoning may be soy sauce, soup stock, Japanese seasoned soup stock, sauce, dressing, or cooking vinegar, and the above-mentioned food may be lightly-pickled vegetables.

[0010] The present invention provides an antimicrobial agent to lactic acid bacteria and/or flat sour bacteria, comprising: the compound (I) as an active ingredient.

[0011] The present invention provides a method for suppressing the proliferation of lactic acid bacteria and/or flat sour bacteria in the food/beverage article, comprising: adjusting the total of the concentrations of the compounds (I) in the food/beverage article to 1 ppm or more.

Advantageous Effects of Invention

[0012] According to the present invention, a food/beverage article is unlikely to be deteriorated due to lactic acid bacteria and/or flat sour bacteria contamination can be provided. According to the present invention, a novel antimicrobial agent to lactic acid bacteria and/or flat sour bacteria can be provided. According to the present invention, a

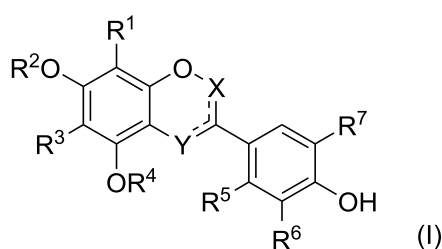
method for suppressing the proliferation of lactic acid bacteria and/or flat sour bacteria in the food/beverage article can be provided.

Description of Embodiments

[0013] Hereinafter, preferred embodiments of the present invention will be described in detail. However, the present invention is not limited to the following embodiments.

[0014] A food/beverage article according to the present embodiment contains a compound represented by the following formula (I) at 1 ppm or more:

[Chemical Formula 3]



wherein, R^1 and R^3 each independently represent a hydrogen atom or a C_{3-6} alkenyl group, R^2 and R^4 each independently represent a hydrogen atom or a C_{1-4} alkyl group, R^5 and R^7 each independently represent a hydrogen atom or a hydroxyl group, R^6 represents a hydrogen atom or a C_{2-6} alkenyl group, X represents a direct bond, $-CH_2-$, $-CH=$, or $-C(=O)-$, Y represents $-CH_2-$, $-CH=$, or $-C(=O)-$, and a bond represented by the following formula:

[Chemical Formula 4]



represents a single bond or a double bond.

[0015] The " C_{1-4} alkyl group" used herein means a linear or branched

alkyl group having 1 to 4 carbon atoms. Examples of the C₁₋₄ alkyl group include a methyl group, an ethyl group, a propyl group, an isopropyl group, a butyl group, an isobutyl group, a sec-butyl group, and a tert-butyl group.

5 [0016] The "C₂₋₆ alkenyl group" used herein means a linear or branched alkenyl group having 2 to 6 carbon atoms. Examples of the C₂₋₆ alkenyl group include a vinyl group, a propen-1-yl group, a propen-2-yl group, a 1-butenyl group, a 2-butenyl group, a 3-butenyl group, a 1-methyl-1-propenyl group, a 2-methyl-1-propenyl group, a 1-pentenyl group, a 2-pentenyl group, a 3-pentenyl group, a 4-pentenyl group, a 10 5-pentenyl group, a 1-methyl-1-butenyl group, a 2-methyl-1-butenyl group, a 3-methyl-1-butenyl group, a 4-methyl-1-butenyl group, a 1-methyl-2-butenyl group, a 2-methyl-2-butenyl group, a 3-methyl-2-butenyl group, a 4-methyl-2-butenyl group, a 1-methyl-3-butenyl group, a 2-methyl-3-butenyl group, a 15 3-methyl-3-butenyl group, a 4-methyl-3-butenyl group, a 1,2-dimethyl-1-propenyl group, a 1,1-dimethyl-2-propenyl group, a 1-hexenyl group, a 2-hexenyl group, a 3-hexenyl group, a 4-hexenyl group, a 5-hexenyl group, and a 6-hexenyl group.

20 [0017] In above-mentioned formula (I), R¹ is preferably a hydrogen atom, a 3-methyl-2-butenyl group, or a 1,1-dimethyl-2-propenyl group.

[0018] In above-mentioned formula (I), R² is preferably a hydrogen atom or a methyl group.

[0019] In above-mentioned formula (I), R³ is preferably a hydrogen atom or a 3-methyl-2-butenyl group.

25 [0020] In above-mentioned formula (I), R⁴ is preferably a hydrogen

atom or a methyl group.

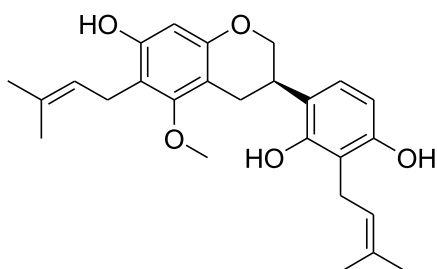
[0021] In above-mentioned formula (I), R⁶ is preferably a hydrogen atom or a 3-methyl-2-butenyl group.

[0022] The compound (I) may have isomers such as stereoisomers and tautomers. Those isomers are also included in the scope of the present invention.

[0023] Specific examples of the compound (I) include licoricidin, gancaonin I, 8-(γ,γ -dimethylallyl)-wighteone, glycycomarin, glyasperin C, glycyrin, isoangustone A, and licoarylcomarin.

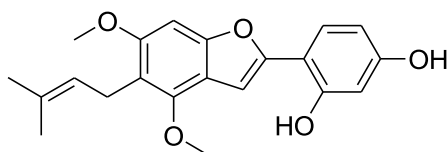
[0024] Licoricidin is also called 4-[(R)-7-hydroxy-5-methoxy-6-(3-methyl-2-butenyl)chroman-3-yl]-2-(3-methyl-2-butenyl)-1,3-benzenediol, and is a known compound represented by the following formula:

[Chemical Formula 5]



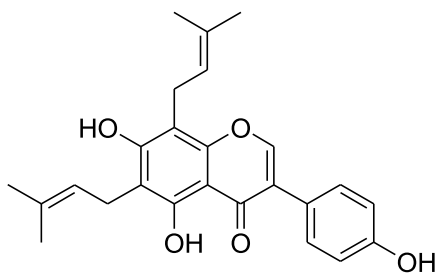
[0025] Gancaonin I is also called 5-(3-methyl-2-butenyl)-2-(2,4-dihydroxyphenyl)-4,6-dimethoxybenzofuran, and is a known compound represented by the following formula:

[Chemical Formula 6]



[0026] 8-(γ,γ -Dimethylallyl)-wighteone is also called 6,8-bis(3-methyl-2-butenyl)-3-(4-hydroxyphenyl)-5,7-dihydroxy-4H-1-benzopyran-4-one, and is a known compound represented by the following formula:

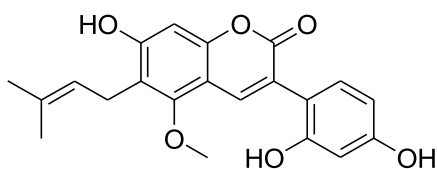
5 [Chemical Formula 7]



[0027] Glycycoumarin is also called 3-(2,4-dihydroxyphenyl)-7-hydroxy-5-methoxy-6-(3-methyl-2-butenyl)-2H-1-benzopyran-2-one, and is a known compound represented by the following formula:

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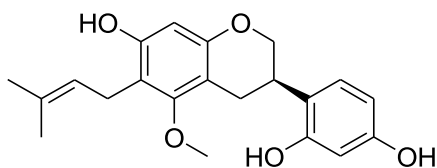
[Chemical Formula 8]



[0028] Glyasperin C is also called (3R)-3 β -(2,4-dihydroxyphenyl)-5-methoxy-6-(3-methyl-2-butenyl)-3,4-dihydro-2H-1-benzopyran-7-ol, and is a known compound the following formula:

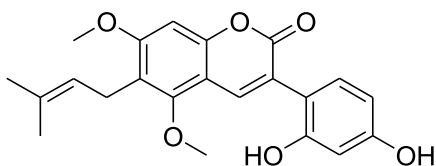
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[Chemical Formula 9]



[0029] Glycyrrin is also called 3-(2,4-dihydroxyphenyl)-5,7-dimethoxy-6-(3-methyl-2-butenyl)-2H-1-benzopyran-2-one, and is a known compound represented by the following formula:

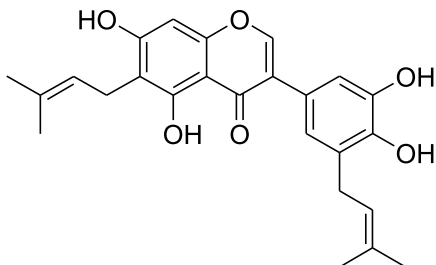
5 [Chemical Formula 10]



[0030] Isoangustone A is also called 3-[3,4-dihydroxy-5-(3-methyl-2-butenyl)phenyl]-5,7-dihydroxy-6-(3-methyl-2-butenyl)-4H-chromen-4-one, and is a known compound represented by the following formula:

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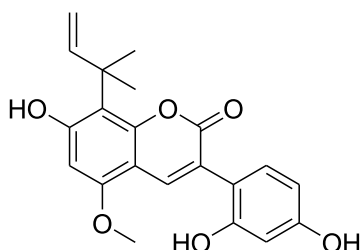
[Chemical Formula 11]



[0031] Licoaryl coumarin is also called 3-(2,4-dihydroxyphenyl)-7-hydroxy-5-methoxy-8-(2-methyl-3-butene-2-yl) coumarin, and is a known compound represented by the following formula:

15

[Chemical Formula 12]



[0032] The compound (I) may be synthesized by a method known to those skilled in the art, or may be a commercially available product. Licoricidin, gancaonin I, 8-(γ,γ -dimethylallyl)-wighteone, glycycomarin, glyasperin C, glycyrin, isoangustone A, and licoarylcomarin are known to be compounds contained in licorice oily extract. Accordingly, in the food/beverage article according to the present embodiment, licorice oily extract containing the compound (I) can also be used as it is, or the compound (I) contained in licorice oily extract can be isolated therefrom before use.

[0033] The food/beverage article according to the present embodiment may contain only one compound (I), or may contain two or more compounds (I). When the food/beverage article according to the present embodiment contains two or more compounds (I), the concentration of the compounds (I) means the total concentration of the concentrations of the compounds.

[0034] In the food/beverage article according to the present embodiment, the concentration of the compound (I) is 1 ppm or more, in terms of the lower limit. This enables suppression of the deterioration of the food/beverage article due to lactic acid bacteria and/or flat sour bacteria contamination. The concentration of the compound (I) can be suitably set to the range of 1 ppm or more according to the use of the food/beverage article, the salt concentration, the alcohol concentration,

the pH, and the like, and the concentration of the compound (I) may be, for example, 5 ppm or more, may be 10 ppm or more, may be 25 ppm or more, or may be 50 ppm or more in view of further enhancing the antimicrobial activity to lactic acid bacteria and/or flat sour bacteria.

5 [0035] In the food/beverage article according to the present embodiment, the upper limit of the concentration of the compound (I) is not particularly limited, and the concentration of the compound (I) may be, for example, 10000 ppm or less in view of dissolving the compound (I) in the target food/beverage article adequately.

10 [0036] For example, the concentration of the compound (I) can be measured by liquid chromatography and tandem mass spectrometry (LC/MS/MS).

[0037] The food/beverage article according to the present embodiment may be any food/beverage article without particular limitation, as long as it is a food/beverage article containing the compound (I) at 1 ppm or more. Examples of the food/beverage article according to the present embodiment include liquid seasonings such as soy sauce, soup stock, Japanese seasoned soup stock, sauce, soup, Worcester sauce, and dressing; semisolid seasonings such as miso and mayonnaise; pickled Japanese plums; pickles; and delicatessen. It is preferable that the food/beverage article according to the present embodiment be liquid seasoning or food, since the deterioration due to lactic acid bacteria and/or flat sour bacteria contamination can be further suppressed. Soy sauce, soup stock, Japanese seasoned soup stock, sauce, dressing, or cooking vinegar is preferable among the liquid seasonings. Lightly-pickled vegetables are preferable among the foods.

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[0038] Although the salt concentration of the food/beverage article according to the present embodiment is not particularly limited, the salt concentration may be, for example, 12% (w/v) or less, 8% (w/v) or less, 4% (w/v) or less, or 0% (w/v) (unsalted), in view of enhancing the antimicrobial activity to lactic acid bacteria and/or flat sour bacteria without increasing the amount of salt.

[0039] For example, the salt concentration can be measured by a known method such as potentiometric titration, the Mohr method, or atomic absorption spectrophotometry.

[0040] Although the alcohol concentration of the food/beverage article according to the present embodiment is not particularly limited, the alcohol concentration may be, for example, 10% (v/v) or less, 5% (v/v) or less, or 0% (v/v), in view of enhancing the antimicrobial activity to lactic acid bacteria and/or flat sour bacteria without increasing the amount of alcohol.

[0041] For example, the alcohol concentration can be measured by gas chromatography.

[0042] Although the pH of the food/beverage article according to the present embodiment is not particularly limited, the pH may be, for example, 3.0 or more, 4.0 or more, or 4.2 or more, and may be 7.0 or less, 6.0 or less, or 5.8 or less, since the savor of the food/beverage article is good.

[0043] The food/beverage articles according to the present embodiment can be produced by, for example, adding licorice oily extract containing the compound (I) or the compound (I) to a food/beverage article as a base (preferably liquid seasoning or food) to a concentration of 1 ppm

or more, and, if necessary, diluting or concentrating (e.g., deaeration, heating, drying, heating and deaeration at reduced pressure) the resultant and adding various additives, for example.

[0044] As confirmed in the following Examples, the compound (I) exhibits antimicrobial action on lactic acid bacteria and/or flat sour bacteria. Therefore, one aspect of the present invention provides an antimicrobial agent to lactic acid bacteria and/or flat sour bacteria containing the compound (I) as an active ingredient.

[0045] The antimicrobial agent according to the present embodiment can be used for various harmful lactic acid bacteria (lactic acid bacteria encompassed by, for example, *Lactobacillus*, *Streptococcus*, and *Lactococcus*) and flat sour bacteria (for example, *Bacillus coagulans*).

[0046] The antimicrobial agent according to the present embodiment may be any of forms such as a solid (for example, powder), liquid (for example, a solution or a suspension), and a paste. The antimicrobial agent may be any dosage form such as powder, granules, a tablet, a capsule, a solution, a suspension, or a syrup. The above-mentioned various formulations can be prepared by mixing Licoricidin with additives (a vehicle, a binder, a lubricant, a disintegrator, an emulsifier, a surfactant, a base, a solubilizer, a suspending agent, and the like) and molding the resulting mixture, as needed.

[0047] The antimicrobial agent according to the present embodiment can be used by adding it to any food/beverage article. Examples of such a food/beverage article include liquid seasonings such as soy sauce, soup stock, Japanese seasoned soup stock, sauce, soup, Worcestershire sauce, dressing, and cooking vinegar; semisolid seasonings such as miso

and mayonnaise; pickled Japanese plums; pickles; and delicatessen.

[0048] As confirmed in the following Examples, the compound (I) exhibits the action of suppressing the proliferation of lactic acid bacteria and/or flat sour bacteria. Therefore, one aspect of the present invention provides a method for suppressing the proliferation of lactic acid bacteria and/or flat sour bacteria in a food/beverage article, comprising: adjusting the total of the concentrations of the compounds (I) in the food/beverage article to 1 ppm or more.

Examples

[0049] Hereinafter, the present invention will be described by way of Examples more specifically. However, the present invention is not limited by the following Examples.

[0050] [Test Example 1: antimicrobial action of edible plant extracts on lactic acid bacteria]

(Preparation of extract)

To pulverized leaves, stems, or roots of commercially available edible plants (described in Tables 1 and 2) was added sterilized water in the same amount as that of the pulverized material, and the mixture was stirred and mixed with a vortex and left to stand at room temperature for 1 hour. To this mixture was added ethanol in 3 times the volume of the sterilized water, and extraction was performed in an incubator under the conditions of 50°C and 120 rpm (reciprocal shaking) for 3 hours to obtain 75% ethanol extraction liquid. This extraction liquid was centrifuged at 3000 rpm for 10 minutes to obtain extracts.

(Preparation of soy sauce)

Commercially available low-salt soy sauce (produced by Kikkoman Corporation) was two-fold diluted with sterilized water. The pH of the dilution was adjusted to 4.8 with sodium hydroxide, and the mixture was heat-disinfected to prepare test low-salt soy sauce.

5 (Evaluation of antimicrobial action)

First, 11.3 mL of test low-salt soy sauce, 0.7 mL of the extract, and lactic acid bacteria (*Lactobacillus rennini* and *Lactobacillus acidipiscis*) were added to a test tube to a final concentration of around 10^5 cfu/mL, and a SILICOSEN was put in the test tube. The mixture was left to stand at 30°C for anaerobic culture. The proliferation of lactic acid bacteria produces precipitate of bacterial cells; accordingly, the precipitate produced on the bottom of the test tube was observed over time. The number of days until the generation of the precipitation started in the test, to which the extract was added, was compared with that in a control (mixture to which an aqueous 75% ethanol solution was added instead of the extract), to evaluate the antimicrobial action. The results are shown in Tables 1 and 2.

[0051] [Table 1]

Edible plant	Difference in the number of days until precipitation	Edible plant	Difference in the number of days until precipitation	Edible plant	Difference in the number of days until precipitation
Kachiwari (pumpkin)	No difference	White cucumber (cucumber)	No difference	Borage	No difference
Ogato (pumpkin)	No difference	Spontaneous odama (tomato)	No difference	Coriander	No difference
Kamikochi (cucumber)	No difference	Bonita (tomato)	No difference	Artichoke	No difference
Bateshirazu (cucumber)	No difference	Broccoli	No difference	Crimson clover	No difference
Myoko (tomato)	No difference	Red cabbage	No difference	Nigella	No difference
Heart-heart (tomato)	No difference	White radish sprout	No difference	Nagaokana	No difference
Chako (cherry tomato)	No difference	Tsumamina	No difference	Osakashirona	No difference
Brazil cook (cooking tomato)	No difference	Turnip	No difference	Hiroshimana	No difference
Shin-etsu mizunasu	No difference	Buckwheat	No difference	Katsuona	No difference
Native aonasu	No difference	Water spinach	Difference of less than 3 days	Kumamotokyona	No difference

Manganji-amato	No difference	Rocket	Difference of less than 3 days	Yamashiona	Difference of 3 to 6 days
Kurokodama-suika	No difference	Basil	No difference	Mibuna	No difference
Tenchoha (makuwa)	No difference	Mustard	Difference of less than 3 days	Bashona	No difference
Chikumano-gosun (carrot)	Difference of less than 3 days	White sesame	No difference	Kobutakana	Difference of 3 to 6 days
Eruwan (leaf lettuce)	No difference	Nozawana	No difference	Kalonji/ Nigella	No difference
Erugo (butterhead lettuce)	No difference	Green pea	No difference	Kumquat seed	No difference
Shimamura kidney bean	No difference	Black mappe	No difference	Bitter melon seed	No difference
Koshigaya kidney bean	No difference	Alphalpa	No difference	Pomegranate seed	No difference
Mochitto-corn	No difference	Perilla	No difference	Prune seed	No difference
Kiso purple turnip	No difference	Endive	No difference	Coriander	No difference
Shinkaiaona (komatsuna)	No difference	Kale	No difference	Basil	Difference of less than 3 days
Yasaiegoma	No difference	Soup celery	Difference of 7 days or more	Cayenne pepper	No difference
Fukkura (rucola)	Difference of 3 to 6 days	Fennel	Difference of less than 3 days	Parsley	No difference
Curled mallow	No difference	Mike-takana	No difference	Habanero	No difference
Kawashima kakina	No difference	Green mappe	No difference	Paprika	No difference
Amaranth	No difference	Bean sprout	No difference	Fenugreek	No difference
Black-eyed pea	No difference	Papaya	No difference	Fennel	No difference
Spontaneous green pepper	No difference	Koryan-mai mochi	No difference	Bhut Jolokia	No difference
Cherry tomato	No difference	Red rice	No difference	Fried onion	No difference
Miyashige (daikon)	No difference	Black rice	No difference	Marjoram	No difference
Radish	No difference	Linseed	No difference	Onion powder	No difference
Beet	No difference	Amaranth	No difference	Red pepper/ chili	No difference
Green coin (tatsoi)	No difference	Perilla	No difference	Lemon grass	Difference of less than 3 days
Anton (squash)	No difference	Quinoa	No difference	Kiwi fruit seed extract	No difference
Y-star (squash)	No difference	Poppy seed	No difference	Cacao extract	No difference
Celery	Difference of less than 3 days	Chicory	Difference of less than 3 days	Perilla seed extract	No difference
White Lisbon (long Welsh onion)	No difference	Winter melon (seed)	Difference of less than 3 days	Chinese chive seed extract	No difference
Leek (Welsh onion)	No difference	Pino green	No difference	Broccoli sprout	No difference
Chinese chive	No difference	Green spinach	No difference	Yuzu seed extract	No difference
Coriander	No difference	Red beet	No difference	Kanka extract	Difference of 3 to 6 days
Italian parsley	Difference of less than 3 days	Red Asian mustard	Difference of 3 to 6 days	Japanese butterbur extra	No difference
Rocket (rucola)	Difference of less than 3 days	Tatsoi	No difference	Buckwheat leaf extract	No difference
Rocky wild (rucola)	Difference of less than 3 days	Choy sum	No difference	Satsuma orange extract	No difference
Sage	No difference	Aonaga daikon	No difference	Fermented rice germ extract	No difference

Time	No difference	Koshin daikon	No difference	Black rice extract	No difference
Sweet basil	No difference	Benimaru daikon	No difference	Red rice extract	No difference
Sweet marjoram	No difference	Napa cabbage	No difference	Papaya peel	No difference
Lemon basil	No difference	Purple-stem mustard	No difference	Dragon fruit peel	No difference
Lemon balm	No difference	Shiroziku Pak choi	No difference	Prune peel	No difference
Petra (basil)	No difference	Sweet marjoram	No difference	Yuzu seed	No difference
Bouquet (dill)	Difference of 7 days or more	Chervil	No difference	Karin seed	No difference
Nasturtium	Difference of 3 to 6 days	Chive	No difference	Sicklefruit fenugreek	No difference
German chamomile	No difference	Peppermint	No difference	Ginger (herb tea)	Difference of 7 days or more
Naga-san (pumpkin)	No difference	Watercress	No difference	Stevia leaf (herb tea)	Difference of less than 3 days

[0052] [Table 2]

Edible plant	Difference in the number of days until precipitation	Edible plant	Difference in the number of days until precipitation	Edible plant	Difference in the number of days until precipitation
Dandelion leaf (herb tea)	No difference	Wild herb tea senna tea	No difference	Bok choy	No difference
Dandelion root (herb tea)	No difference	Wild herb tea Chinese wolfberry fruit	No difference	Water spinach	No difference
Peppermint (herb tea)	Difference of 7 days or more	Komatsuna powder	No difference	Cardamon	Difference of 7 days or more
Horsetail (herb tea)	Difference of less than 3 days	Lemon powder	No difference	Korean red pepper	No difference
Watercress (raw, aboveground portion)	Difference of less than 3 days	Purple sweet potato powder	No difference	Caraway	Difference of 7 days or more
Rape (raw, aboveground portion)	No difference	Lotus root powder	No difference	Mustard seed/brown	No difference
Dropwort (raw, aboveground portion)	No difference	Corn powder	No difference	Mustard seed/yellow	No difference
Nettle (herb tea)	No difference	Yuzu powder	No difference	Mustard/yellow	No difference
Mallow blue (herb tea)	No difference	Bamboo peel	No difference	Ginkgo (herb tea)	Difference of 7 days or more
Yuzu ichimi	Difference of 3 to 6 days	Hard rush	No difference	Safflower (herb tea)	No difference
Ginger (powder)	Difference of 7 days or more	Cherry leaf, green	No difference	Rosemary	No difference
Turmeric (powder)	No difference	Cherry life, brown	No difference	Bird's eye	Difference of less than 3 days
Poppy sheet	No difference	Veitch's bamboo, domestic, dark green	No difference	Kesshoku	No difference
Bee pollen	No difference	Veitch's bamboo, Chinese, green	No difference	<i>Atractylodes rhizome</i>	Difference of 7 days or more
Vanilla bean (whole)	No difference	Okra powder	No difference	Dong quai	No difference
Chinese wolfberry fruit	No difference	Edamame powder	No difference	Astragalus root	No difference
Gardenia fruit (whole)	No difference	Horsetail tea	No difference	Byakushi	Difference of less than 3 days
Parsley	No difference	Tomato powder	No difference	Dried magnolia leaf	No difference
Udo (raw, aboveground)	Difference of 7	Garlic powder	No difference	Radish	No difference

portion)	days or more				
Coriander (raw, whole grass)	Difference of less than 3 days	Dandelion coffee	No difference	Garland chrysanthemum	No difference
Fennel (raw, aboveground portion)	Difference of less than 3 days	Black soybean flour	No difference	Green onion sprout	No difference
Sweet basil (freeze-dried)	Difference of 7 days or more	Jew's mallow powder	No difference	Japanese honewort	Difference of 7 days or more
Kaffir lime (whole)	No difference	Jerusalem artichoke powder	No difference	Pink radish	No difference
Lemon grass (whole)	No difference	Kintoki ginger powder	Difference of 3 to 6 days	Green radish	No difference
Orange flower (herb tea)	No difference	Green barley powder	No difference	Vitamin-na	No difference
Lavender (herb tea)	Difference of less than 3 days	lees of linseed oil, undried	No difference	Onion	No difference
Verbena (herb tea)	No difference	Sweet potato powder	No difference	Ginger mince	Difference of 7 days or more
Coconut long	No difference	Cabbage powder	No difference	Tamarind	No difference
Blue poppy seed	No difference	Yacon leaf powder	Difference of less than 3 days	Tarragon/Estragon	Difference of 7 days or more
Mango powder	Difference of less than 3 days	Red beefsteak plant powder	Difference of less than 3 days	Citrus unshiu peel	Difference of less than 3 days
Ginger powder	Difference of 7 days or more	Ashitaba powder	No difference	Dill weed	Difference of less than 3 days
Wild herb tea jack bean	No difference	Ginger powder	Difference of 3 to 6 days	Dill seed	Difference of 7 days or more
Wild herb tea field horsetail	No difference	Yacon potato powder	No difference	Dry onion	No difference
Wild herb tea mulberry leaf	Difference of 3 to 6 days	Shitake powder	No difference	Nutmeg	Difference of 3 to 6 days
Wild herb tea aloe	No difference	Celery powder	Difference of 3 to 6 days	Red jujube	No difference
Burdock powder	No difference	Wild turmeric powder	Difference of 7 days or more	Kinshinsai	No difference
Sprouted brown rice powder	No difference	Cleavers	No difference	Broccoli powder	No difference
Spinach powder	No difference	Hibiscus	Difference of 3 to 6 days	Lemon peel	Difference of 7 days or more
Carrot powder	No difference	Skull cap	No difference	Japanese pepper	No difference
Pumpkin powder	No difference	Sweet clover	No difference	Purple shallot (red onion)	No difference
Wild herb tea persimmon leaf	No difference	Spinach	No difference	Ashitaba powder	Difference of less than 3 days
Wild herb tea corn	No difference	Broccoli	No difference	Black rice powder	No difference
Wild herb tea five-leaf ginseng	No difference	Superior (lettuce)	No difference	Angelica	No difference
Wild herb tea pu-erh tea	No difference	Swiss chard	No difference	German chamomile	Difference of 3 to 6 days
Wild herb tea simon tea	No difference	California red (paprika)	No difference	Yam powder	No difference
Wild herb tea reishi	No difference	Red chicory	Difference of less than 3 days	Kale powder	No difference
Wild herb tea loquat leaf	No difference	Oresh (endive)	No difference	Mulberry leaf powder	No difference
Wild herb tea plantain	No difference	Tokyo bekana (mustard greens)	No difference	Gymnema sylvestre powder	No difference

Wild herb tea mugwort	No difference	Green romaine	No difference	Dried immature orange powder	No difference
Wild herb tea lotus leaf	No difference	Red romaine	No difference	Licorice powder	Difference of 7 days or more
Wild herb tea Veitch's bamboo	No difference	Green oak	No difference		
Wild herb tea dokudami	No difference	Red oak	No difference		
Wild herb tea roasted green tea	No difference	Baby purple	No difference		
Wild herb tea buckwheat tea	No difference	Chirimen mustard	Difference of 3 to 6 days		

[0053] [Test Example 2: Sensory evaluation]

For 19 extracts the antimicrobial action of which was found (the difference from the control was 7 days or more in the number of days until the proliferation) in Test Example 1, whether the extract was suitable as an ingredient in view of fragrance and taste was sensory evaluated using the following evaluation criterion by a trained evaluator. The results are shown in Table 3. In the cell of "portion used" in the table, 1 indicates seed (seed coat) or fruit (fruit coat), 2 indicates leaves, stems, flowers, or trunks, and 3 indicates roots.

Evaluation Criterion

○: Suitable as an ingredient

△: Less suitable as an ingredient

×: Absolutely not suitable as an ingredient

-: Not evaluated

[0054] [Table 3]

Material	Portion used	Fragrance	Taste	Overall rating
Bouquet (Dill)	1	△	—	×
Japanese honewort	1	△	—	×
Soup celery	1	△	—	×
Ginger mince	3	○	△	△
Tarragon/Estragon	2	○	△	△
Dill seed	1	△	—	×

Cardamon	1	×	–	×
Caraway	1	△	–	×
Ginkgo (Herb tea)	2	△	–	×
Ginger (Herb tea)	3	○	△	△
Peppermint (Herb tea)	2	△	–	×
Ginger (powder)	3	○	△	△
Udo (raw, aboveground portion)	2	△	–	×
Sweet basil (freeze-dried)	2	×	–	×
Lemon peel	1	△	–	△
Ginger powder	3	○	△	△
<i>Atractylodes rhizome</i>	2	△	–	×
Wild turmeric powder	3	△	–	×
Licorice powder	3	○	○	○

[0055] It was estimated from Table 3 that the extract of licorice powder was the most suitable as an ingredient in the overall rating. The extract was added to commercially available low-salt soy sauce (produced by Kikkoman Corporation) to 100 ppm and subjected to sensory evaluation in terms of fragrance and taste by a panel consisting of five trained evaluators. As a result, it was confirmed that the flavor of the low-salt soy sauce was not impaired, and that the extract was suitable as an ingredient.

[0056] [Test Example 3: Identification of a substance in licorice powder having antimicrobial action on lactic acid bacteria]

(Preparation of extract)

To 1 kg of licorice powder (NIPPON FUNMATSU YAKUHI Co., LTD.) was added 5 L of chloroform (KANTO CHEMICAL CO., INC.), and the mixture was stirred at room temperature for 2 hours and then filtered using a folded filter paper (5C). This filtrate was concentrated to dryness using an evaporator to obtain 11 g of an extract.

(Fraction of substance having antimicrobial action)

A column (3 L) was filled with silica gel (Disogel IR-60-40/63A Cat. 1002A). Around 11 g of the above-mentioned obtained extract was dissolved in around 30 ml of chloroform, and the mixture was fractionated into 13 fractions (A to M in order of elution) with the following solvents sequentially while monitoring by TLC analysis at a flow rate of 40 ml/minute and at 220 nm.

1) Hexane (6 L)

2) Hexane:ethyl acetate = 4:1 (10 L)

3) Hexane:ethyl acetate = 3:1 (12 L)

4) Hexane:ethyl acetate = 2:1 (10 L)

(Evaluation of antimicrobial action of fractions)

Each fraction was added to a plate count agar with BCP (Nissui) to 200 µg/mL, 67 µg/mL, 22 µg/mL, or 7 µg/mL. Then, 1 platinum loop of a bacterial suspension of lactic acid bacteria (*Lactobacillus rennini* and *Lactobacillus acidipiscis*, 10^6 to 10^7 cfu/mL) was applied. The bacteria were subjected to anaerobic culture at 30°C for 8 days, and the effect of suppressing the proliferation of lactic acid bacteria was evaluated. In the evaluation, the antimicrobial unit of each of the fractions was calculated using the following expression (1), and the ratio of contribution to the antimicrobial action was calculated from the obtained antimicrobial unit of the fraction using the following expression (2). The results are shown in Table 4.

Expression (1): Antimicrobial unit of a fraction = $100/\text{concentration at which the fraction exhibits antimicrobial action} \times \text{fraction volume}$

Expression (2): Rate of contribution to antimicrobial action (%)

$$= (\text{antimicrobial unit of the fraction} / \text{antimicrobial unit of all fractions}) \times 100$$

[0057] [Table 4]

Fraction	Amount of fraction (g)	Active concentration ($\mu\text{g/mL}$)	Antimicrobial unit of fraction	Contribution rate (%)
A	0.3	>200	-	-
B	1.3	>200	-	-
C	0.2	>200	-	-
D	0.82	>200	-	-
E	0.73	>200	-	-
F	0.2	22	0.91	14.5
G	0.31	200	0.16	2.5
H	0.21	200	0.11	1.7
I	0.86	22	3.91	62.2
J	0.33	200	0.16	2.6
K	0.41	200	0.2	3.3
L	0.61	200	0.31	4.9
M	1.06	200	0.53	8.4

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[0058] As clear from Table 4, it was observed that the fractions F and I each had strong antimicrobial action, and it was strongly estimated that the main antimicrobial component of licorice powder was contained especially in the fraction I. Then, the ^{13}C -NMR spectrum was measured to identify the antimicrobial component contained in the fraction I. Consequently, the antimicrobial component was estimated to be licoricidin, and when the ^{13}C -NMR spectrum of the antimicrobial component was compared with the ^{13}C -NMR spectrum of the preparation (produced by ChemFaces), it was confirmed that both match each other. When the antimicrobial component was subjected to TOF (time-of-flight) mass spectrometry, it was confirmed that the

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antimicrobial component exhibits the peak of $[M+H]^+$ at an m/z of 425, as with licoricidin.

[0059] [Test Example 4: Antimicrobial action of licoricidin on lactic acid bacteria in liquid seasoning (1)]

5 (1) Production of liquid seasonings

(Production of soy sauce)

Commercially available whole soybean soy sauce (produced by Kikkoman Corporation) was electrodialyzed and then concentrated under reduced pressure to obtain soy sauce at a salt concentration of 0% (w/v) and an alcohol concentration of 0% (v/v). Then, salt and/or alcohol was added to the above-mentioned obtained soy sauce, and the mixture was heat-treated to produce soy sauces at salt concentrations and alcohol concentrations shown in the following Table 5. The pHs of the soy sauces were 4.9 to 5.0.

15 [0060] [Table 5]

Salt concentration (%(w/v))	Alcohol concentration (%(v/v))
0	0
	5
	10
4	0
	5
	10
8	0
	5
	10
12	0
	5
	10

[0061] (Production of bonito stock)

Bonito stocks was produced using materials shown in the following Table 6. Specifically, components contained in dried bonito was extracted with alcohol and water; sugar, salt, and seasonings were blended with the obtained extract; and the resulting mixture was heated to produce bonito stock. The salt concentration of the obtained bonito stock was 0.2% (w/v), the alcohol concentration was 0.15% (v/v), and the pH was 6.1.

[0062] [Table 6]

Ingredient	Amount blended
Dried bonito	7.5 g
Sugar	3.2 g
Salt	2.0 g
Seasonings (amino acids and the like)	4.0 g
Alcohol	1.5 mL
Water	993 mL
Total	1000 mL

[0063] (Production of sauce)

Sauce was produced using materials shown in the following Table 7. Specifically, Koikuchi soy sauce (produced by Kikkoman Corporation), granulated sugar, potato starch, and water were blended in amounts shown in following Table 7, and the resulting mixture was heated to produce sauce. The salt concentration of the obtained sauce was 5.3% (w/v), the alcohol concentration was 0.8% (v/v), and the pH was 5.0.

[0064] [Table 7]

Ingredient	Amount blended (g)
Koikuchi soy sauce	354.6
Granulated sugar	121

Dogtooth violet starch	20
Water	504.4
Total	1000

[0065] (Production of Japanese seasoned soup stock)

Japanese seasoned soup stock was produced using materials shown in following Table 8. Specifically, the components contained in dried bonito was extracted with water; Koikuchi soy sauce (produced by Kikkoman Corporation), sugar, and salt were blended with the obtained extract; and the resulting mixture was heated to produce Japanese seasoned soup stock. The salt concentration of the obtained Japanese seasoned soup stock was 3% (w/v), the alcohol concentration was 0.4% (v/v), and the pH was 5.5.

[0066] [Table 8]

Ingredient	Amount blended
Koikuchi soy sauce	105 mL
Dried bonito	31.3 g
Sugar	40 g
Salt	13.6 g
Water	888 mL
Total	1000 mL

[0067] (2) Evaluation of antimicrobial action

Licoricidin (produced by ChemFaces) was added to each of the liquid seasonings produced in the above-mentioned (1) to concentrations of 1 ppm, 5 ppm, 10 ppm, 25 ppm, and 50 ppm. Lactic acid bacteria described in the following Table 9 were then added to 10^6 to 10^7 cells/mL and cultured at 30°C for 7 days. After the culture, the number of lactic acid bacteria was measured using the GAM agar medium "Nissui". Liquid seasoning to which licoricidin was not

added was used as a control group, and the antimicrobial activity was evaluated in comparison with the number of lactic acid bacteria in the control group. The evaluation was performed using the criterion shown below. The results are shown in Tables 10 to 16.

5 (Evaluation criterion)

A: The bacterial count decreases to less than 10% of the bacterial count of the control group.

B: The bacterial count decreases to 10% or more and less than 50% of the bacterial count of the control group.

10 C: The bacterial count decreases to 50% or more and less than 100% of the bacterial count of control group.

D: The bacterial count is the same as the bacterial count of the control group.

[0068] [Table 9]

Lactic acid bacteria	Species name	Species culture collection ID
A	<i>Lactobacillus rennini</i>	DSM 20253
B	<i>Lactobacillus rennini</i>	DSM 17732
C	<i>Lactobacillus acidipiscis</i>	NBRC 102163
D	<i>Lactobacillus acidipiscis</i>	NBRC 102164

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[0069] [Table 10]

Soy sauce; Lactic acid bacteria A						
Salt concentration (%(w/v))	Alcohol concentration (%(v/v))	Licoricidin concentration (ppm)				
		1	5	10	25	50
0	0	D	B	B	A	A
	5	C	B	B	A	A
	10	C	C	C	A	A
4	0	B	A	A	A	A
	5	C	A	A	A	A

	10	A	A	A	A	A
8	0	C	A	A	A	A
	5	B	A	A	A	A
12	0	D	A	A	A	A
	5	A	A	A	A	A

In soy sauce at a salt concentration of 8% (w/v) or more and an alcohol concentration of 10% (w/v) in control groups, bacteria did not grow. If the Licoricidin concentration was 0.1 ppm, the antimicrobial activity was not found under all the test conditions.

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[0070] [Table 11]

Soy sauce; Lactic acid bacteria B						
Salt concentration (%(w/v))	Alcohol concentration (%(v/v))	Licoricidin concentration (ppm)				
		1	5	10	25	50
0	0	B	B	B	A	A
4	0	B	A	A	A	A
8	0	C	A	A	A	A
12	0	A	A	A	A	A

[0071] [Table 12]

Soy sauce; Lactic acid bacteria C						
Salt concentration (%(w/v))	Alcohol concentration (%(v/v))	Licoricidin concentration (ppm)				
		1	5	10	25	50
0	0	C	C	B	A	A
4	0	C	A	A	A	A
8	0	D	A	A	A	A
12	0	B	A	A	A	A

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[0072] [Table 13]

Soy sauce; Lactic acid bacteria D						
Salt concentration (%(w/v))	Alcohol concentration (%(v/v))	Licoricidin concentration (ppm)				
		1	5	10	25	50
0	0	C	C	B	A	A
4	0	D	A	A	A	A
8	0	C	A	A	A	A
12	0	D	A	A	A	A

[0073] [Table 14]

Bonito stock					
Lactic acid bacteria	Licoricidin concentration (ppm)				
	1	5	10	25	50
A	C	A	A	A	A
B	C	A	A	A	A
C	C	A	A	A	A
D	A	A	A	A	A

[0074] [Table 15]

Sauce					
Lactic acid bacteria	Licoricidin concentration (ppm)				
	1	5	10	25	50
A	D	D	A	A	A
B	D	A	A	A	A
C	B	B	A	A	A
D	C	C	A	A	A

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[0075] [Table 16]

Japanese seasoned soup stock					
Lactic acid bacteria	Licoricidin concentration (ppm)				
	1	5	10	25	50
A	D	B	A	A	A
B	C	A	A	A	A
C	D	A	A	A	A
D	D	A	A	A	A

[0076] It was confirmed that licoricidin exhibited antimicrobial activity to various lactic acid bacteria under the conditions of various salt concentration and various alcohol concentrations.

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[0077] [Test Example 5: Antimicrobial action of licoricidin on lactic acid bacteria in liquid seasoning (2)]

(Production of soy sauce)

Commercially available whole soybean soy sauce (produced by Kikkoman Corporation) was electrodialed and then concentrated under reduced pressure to obtain soy sauce at a salt concentration of 0% (w/v) and an alcohol concentration of 0% (v/v). Then, salt and/or alcohol was added to the above-mentioned obtained soy sauce, and hydrochloric acid or an aqueous sodium hydroxide solution was then added to adjust the pH to a desired pH. Germfree purified water was added, and the mixture was then heat-treated to produce soy sauce at the salt concentration, the alcohol concentration, and the pH shown in the following Table 17.

(Evaluation of antimicrobial action)

Licoricidin (produced by ChemFaces) was added to each of the obtained soy sauces to concentrations of 1 ppm, 5 ppm, 10 ppm, 25 ppm, and 50 ppm. Lactic acid bacteria (*Lactobacillus rennini* (DSM 20253)) were then added to 10^6 to 10^7 cells/mL and cultured at 30°C for 7 days. After the culture, the number of lactic acid bacteria was measured using the GAM agar medium "Nissui". Soy sauce to which licoricidin was not added was used as a control group, and the antimicrobial activity was evaluated in comparison with the number of lactic acid bacteria in the control group. The evaluation was performed using the same criterion as in Test Example 4. The results are shown in Tables 18 and 19.

[0078] [Table 17]

Salt concentration (%(w/v))	Alcohol concentration (%(v/v))	pH
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0	0	4.2, 4.6, 5.0, 5.4, 5.8
	5	4.2, 4.6, 5.0, 5.4, 5.8
4	0	4.2, 4.6, 5.0, 5.4, 5.8
	5	4.2, 4.6, 5.0, 5.4, 5.8

[0079] [Table 18]

Salt concentration 0% (w/v)						
pH	Alcohol concentration (%(v/v))	Licoricidin concentration (ppm)				
		1	5	10	25	50
4.2	0	B	B	A	A	A
	5	B	A	A	A	A
4.6	0	C	B	A	A	A
	5	C	A	A	A	A
5.0	0	D	B	B	A	A
	5	C	B	B	A	A
5.4	0	D	D	C	C	C
	5	B	A	A	A	A
5.8	0	D	D	D	D	D
	5	B	A	A	A	A

[0080] [Table 19]

Salt concentration 4% (w/v)						
pH	Alcohol concentration (%(v/v))	Licoricidin concentration (ppm)				
		1	5	10	25	50
4.2	0	B	A	A	A	A
	5	C	A	A	A	A
4.6	0	D	D	A	A	A
	5	B	A	A	A	A
5.0	0	B	A	A	A	A
	5	C	A	A	A	A
5.4	0	B	A	A	A	A
	5	C	A	A	A	A
5.8	0	D	A	A	A	A
	5	D	D	A	A	A

[0081] [Test Example 6: Antimicrobial action of oxygen-containing

heterocyclic compounds on lactic acid bacteria in liquid seasoning (1)]
(Production of soy sauce)

Commercially available whole soybean soy sauce (produced by Kikkoman Corporation) was electrodialed and then concentrated under reduced pressure to produce soy sauce at a salt concentration of 0% (w/v) and an alcohol concentration of 0% (v/v). Then, salt and/or alcohol was added to the above-mentioned obtained soy sauce, and the mixture was then heat-treated to produce soy sauce at a salt concentration of 4% (w/v) and an alcohol concentration of 5% (v/v).

(Evaluation of antimicrobial action)

The test substance described in Table 20 was added to the above-mentioned produced soy sauce to concentrations of 1 to 100 ppm. Lactic acid bacteria (*Lactobacillus rennini* (DSM 20253)) were then added to 10^6 to 10^7 cells/mL and cultured at 30°C for 7 days. After the culture, the number of lactic acid bacteria was measured using the GAM agar medium "Nissui". Soy sauce to which licoricidin was not added was used as a control group, and the antimicrobial activity was evaluated in comparison with the number of lactic acid bacteria in the control group. The evaluation was performed using the criterion shown below. The results are shown in Table 20.

(Evaluation criterion)

A: The bacterial count decreases to less than 10% of the bacterial count of the control group.

B: The bacterial count decreases to 10% or more and less than 50% of the bacterial count of control group.

C: The bacterial count decreases to 50% or more and less than

100% of the bacterial count of the control group.

D: The bacterial count is the same as the bacterial count of the control group.

-: Not evaluated

5 [0082] [Table 20]

Test substance (manufacturer)	Test substance concentration (ppm)					
	1	5	10	25	50	100
Licoricidin (ChemFaces)	D	A	A	A	A	-
Gancaonin I (ChemFaces)	C	A	A	A	A	A
8-(γ,γ -dimethylallyl)-wighteone (ALB Technology Limited)	C	A	A	A	A	A
Glycycoumarin (ChemFaces)	D	B	B	A	A	A
Glyasperin C (ChemFaces)	B	B	B	A	A	A
Glycyrin (ChemFaces)	D	B	B	A	A	A
Isoangustone A (ChemFaces)	B	A	A	A	A	A
Licoarylcoumarin (ChemFaces)	D	C	C	B	B	A

[0083] It was confirmed that the oxygen-containing heterocyclic compounds other than licoricidin had antimicrobial activity, as with licoricidin.

10 [0084] [Test Example 7: Antimicrobial action of oxygen-containing heterocyclic compounds on lactic acid bacteria in liquid seasoning (2)]
(Evaluation of antimicrobial action)

15 The test substance described in Table 21 was added to the soy sauce produced in Test Example 6 to concentrations of 0.1 ppm, 0.5 ppm, 1 ppm, 5 ppm, 25 ppm, and 50 ppm. Lactic acid bacteria

(*Lactobacillus fructivores* (NBRC 13954)) were then added to 10^4 to 10^5 cells/mL and cultured at 30°C for 7 days. After the culture, the number of lactic acid bacteria was measured using Difco Lactobacilli MRS Agar. Soy sauce to which the test substance was not added was used as a control group, and the antimicrobial activity was evaluated in comparison with the number of lactic acid bacteria in the control group. The evaluation was performed using the following criterion. The results are shown in Table 21.

(Evaluation criterion)

10 A: The bacterial count decreases to less than 10% of the bacterial count of a control group.

B: The bacterial count decreases to 10% or more and less than 50% of the bacterial count of the control group.

15 C: The bacterial count decreases to 50% or more and less than 100% of the bacterial count of the control group.

D: The bacterial count is the same as the bacterial count of the control group.

[0085] [Table 21]

Test substance (manufacturer)	Test substance concentration (ppm)					
	0.1	0.5	1	5	25	50
Licoricidin (ChemFaces)	B	B	B	B	A	A
Gancaonin I (ChemFaces)	B	C	B	C	B	A
8-(γ,γ -dimethylallyl)-wighteone (ALB Technology Limited)	B	B	B	A	A	A
Glycycoumarin (ChemFaces)	B	B	B	B	A	A
Glyasperin C (ChemFaces)	B	B	B	B	B	A

Glycyrrin (ChemFaces)	B	B	B	B	B	B
Isoangustone A (ChemFaces)	B	B	C	B	A	A
Licoarylcoumarin (ChemFaces)	B	B	B	C	B	B

[0086] It was confirmed that the oxygen-containing heterocyclic compounds other than licoricidin had antimicrobial activity, as with licoricidin.

- 5 [0087] [Test Example 8: Antimicrobial action of licoricidin on flat sour bacteria in liquid seasoning]
(Production of Japanese seasoned soup stock)

Japanese seasoned soup stock was produced by using materials shown in the following Table 22. Specifically, components contained in dried bonito was extracted with water; Koikuchi soy sauce (produced by Kikkoman Corporation), sugar, and salt were blended with the obtained extract; and the resulting mixture was heated to produce Japanese seasoned soup stock. The salt concentration of the obtained Japanese seasoned soup stock was 3% (w/v), the alcohol concentration was 0.4% (v/v), and the pH was 5.2.

[0088] [Table 22]

Ingredient	Amount blended
Koikuchi soy sauce	105 mL
Dried bonito	31.3 g
Sugar	40 g
Salt	13.6 g
Water	888 mL
Total	1000 mL

[0089] (Evaluation of antimicrobial action)

Licoricidin (produced by ChemFaces) was added to the produced Japanese seasoned soup stock to concentrations of 1 ppm, 5 ppm, 10 ppm, 25 ppm, and 50 ppm. Flat sour bacteria (*Bacillus coagulans* (IFO12714)) were then added to 10^4 to 10^5 cells/mL and cultured at 45°C for 7 days. Japanese seasoned soup stock to which licoricidin was not added was used as a control, and the antimicrobial activity was evaluated by comparing the pHs. The evaluation was performed using the following criterion. The results are shown in Table 23.

(Evaluation criterion)

A: There is no change in pH as compared with the control.

B: The pH decreases as compared with the control.

[0090] [Table 23]

Licoricidin (ChemFaces) (ppm)	0 (Control)	1	5	10	25	50
pH	4.1	4.1	4.1	5.3	5.3	5.2
Evaluation	-	B	B	A	A	A

[0091] It was confirmed that licoricidin exhibited antimicrobial activity to flat sour bacteria.

[0092] [Test Example 9: Antimicrobial action of licoricidin on lactic acid bacteria in liquid seasonings and food (3)]

(1) Production of liquid seasonings and food

(Production of Liquid dressing)

Liquid dressing was produced by using materials shown in the following Table 24. Specifically, Koikuchi soy sauce (produced by Kikkoman Corporation), table vinegar, mirin, granulated sugar, kelp

stock, and water were blended in amounts shown in the following Table 24, and the resulting mixture was heated to produce liquid dressing. The salt concentration of the obtained liquid dressing was 2.6% (w/v), the alcohol concentration was 0.8% (v/v), the pH was 4.2.

5 [0093] [Table 24]

Ingredient	Amount blended (g)
Koikuchi soy sauce	18.72
Table vinegar	2.54
Mirin	2.9
Granulated sugar	5
Kelp stock	16
Water	54.84
Total	100

[0094] (Production of lightly-pickled vegetables)

Seasoning liquid for lightly-pickled vegetables were produced by using materials shown in the following Table 25. Specifically, Usukuchi soy sauce (produced by Kikkoman Corporation), table vinegar, corn syrup, isomerized sugar, salt, granulated sugar, sodium glutamate (MSG), lemon fruit juice, kelp stock, and water were blended in amounts shown in the following Table 25, and the mixture was heated to produce seasoning liquid for lightly-pickled vegetables. Chinese cabbages were fully soaked therein to produce lightly-pickled vegetables. The salt concentration of the obtained seasoning liquid for lightly-pickled vegetables was 3.1% (w/v), the alcohol concentration was 0.01% (v/v), and the pH was 4.4.

[0095] [Table 25]

Ingredient	Amount blended
Usukuchi soy sauce	0.3 mL
Table vinegar	0.5 mL

Corn syrup	15 g
Isomerized sugar	2 g
Salt	3 g
Granulated sugar	4 g
MSG	0.4 g
Lemon fruit juice	0.68 g
Kelp stock	3.2 mL
Water	83.45 mL
Total	100 mL

[0096] (Production of cooking vinegar)

Cooking vinegar was produced by using materials shown in the following Table 26. Specifically, table vinegar, salt, granulated sugar, lemon fruit juice, sodium glutamate (MSG), and water in amounts shown in following Table 26 were blended, and the mixture was heated to produce cooking vinegar. The salt concentration of the obtained cooking vinegar was 1.5% (w/v), the alcohol concentration was 0% (v/v), and the pH was 3.8.

[0097] [Table 26]

Ingredient	Amount blended
Table vinegar	0.1 mL
Salt	1.5 g
Granulated sugar	10 g
Lemon fruit juice	5.1 g
MSG	0.4 g
Water	87.3 mL
Total	100 mL

[0098] (2) Evaluation of antimicrobial action

Licoricidin (produced by ChemFaces) was added to each of the above-mentioned produced liquid dressing, lightly-pickled vegetables, and cooking vinegar to concentrations of 1 ppm, 5 ppm, 10 ppm, 25

ppm, and 50 ppm. Lactic acid bacteria (*Lactobacillus rennini* (DSM 20253)) were then added to 10^6 to 10^7 cells/mL. The bacteria were cultured in the liquid dressing and the lightly-pickled vegetables at 30°C for 7 days, and the bacteria were cultured in the cooking vinegar at 30°C for 3 days. After the culture, the number of lactic acid bacteria was measured using the GAM agar medium "Nissui". The liquid dressing, the lightly-pickled vegetables, and the cooking vinegar to which licoricidin was not added were used as respective control groups, and the antimicrobial activity was evaluated in comparison with the number of lactic acid bacteria in the control group. The evaluation was performed using the same criterion as in Test Example 4. The results are shown in Table 27.

(Evaluation criterion)

A: The bacterial count decreases to less than 10% of the bacterial count of the control group.

B: The bacterial count decreases to 10% or more and less than 50% of the bacterial count of the control group.

C: The bacterial count decreases to 50% or more and less than 100% of the bacterial count of control group.

D: The bacterial count is the same as the bacterial count of the control group.

[0099] [Table 27]

Evaluation sample	Licoricidin concentration (ppm)				
	1	5	10	25	50
Liquid dressing	A	A	A	A	A
Lightly-pickled vegetables	B	C	A	A	A
Cooking vinegar	A	A	A	A	A

[0100] It was confirmed that licoricidin exhibited antimicrobial activity to lactic acid bacteria in the various liquid seasonings and the food.

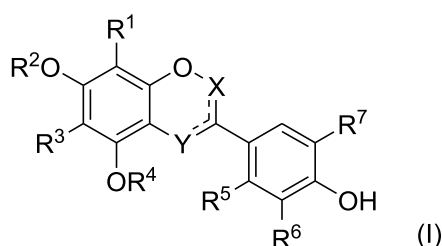
CLAIMS

[Claim 1]

A food/beverage article comprising:

5 one or more compounds represented by formula (I):

[Chemical Formula 1]



10 wherein, R^1 and R^3 each independently represent a hydrogen atom or a C_{2-6} alkenyl group, R^2 and R^4 each independently represent a hydrogen atom or a C_{1-4} alkyl group, R^5 and R^7 each independently represent a hydrogen atom or a hydroxyl group, R^6 represents a hydrogen atom or a C_{2-6} alkenyl group, X represents a direct bond, $-CH_2-$, $-CH=$, or $-C(=O)-$, Y represents $-CH_2-$, $-CH=$, or $-C(=O)-$, and a bond represented by the following formula:

15 [Chemical Formula 2]



represents a single bond or a double bond,

wherein a total of concentrations of the compounds is 1 ppm or more.

[Claim 2]

20 The food/beverage article according to claim 1, wherein the compound is at least one selected from the group consisting of licoricidin, gancaonin I, 8-(γ,γ -dimethylallyl)-wighteone, glycy coumarin, glyasperin C, glycyrin, isoangustone A, and licoaryl coumarin.

[Claim 3]

The food/beverage article according to claim 1 or 2, wherein the food/beverage article is liquid seasoning or food.

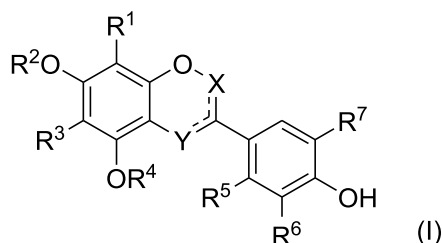
[Claim 4]

5 The food/beverage article according to claim 3, wherein the liquid seasoning is soy sauce, soup stock, Japanese seasoned soup stock, sauce, dressing, or cooking vinegar, and the food is lightly-pickled vegetables.

[Claim 5]

10 An antimicrobial agent to lactic acid bacteria and/or the flat sour bacteria comprising, as an active ingredient, a compound represented by formula (I):

[Chemical Formula 3]



15 wherein, R^1 and R^3 each independently represent a hydrogen atom or a C_{2-6} alkenyl group, R^2 and R^4 each independently represent a hydrogen atom or a C_{1-4} alkyl group, R^5 and R^7 each independently represent a hydrogen atom or a hydroxyl group, R^6 represents a hydrogen atom or a C_{2-6} alkenyl group, X represents a direct bond, $-CH_2-$, $-CH=$, or $-C(=O)-$,
 20 Y represents $-CH_2-$, $-CH=$, or $-C(=O)-$, and a bond represented by the following formula:

[Chemical Formula 4]



represents a single bond or a double bond.

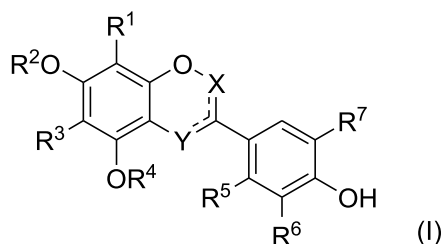
[Claim 6]

The antimicrobial agent according to claim 5, wherein the compound is licoricidin, gancaonin I, 8-(γ,γ -dimethylallyl)-wighteone, glycy coumarin, glyasperin C, glycyrin, isoangustone A, or licoaryl coumarin.

[Claim 7]

A method for suppressing proliferation of lactic acid bacteria and/or flat sour bacteria in a food/beverage article, comprising: adjusting a total of concentrations of compounds represented by formula (I) in the food/beverage article to 1 ppm or more:

[Chemical Formula 5]



wherein, R^1 and R^3 each independently represent a hydrogen atom or a C_{2-6} alkenyl group, R^2 and R^4 each independently represent a hydrogen atom or a C_{1-4} alkyl group, R^5 and R^7 each independently represent a hydrogen atom or a hydroxyl group, R^6 represents a hydrogen atom or a C_{2-6} alkenyl group, X represents a direct bond, $-CH_2-$, $-CH=$, or $-C(=O)-$, Y represents $-CH_2-$, $-CH=$, or $-C(=O)-$, and a bond represented by the following formula:

[Chemical Formula 6]



represents a single bond or a double bond.

[Claim 8]

The method according to claim 7, wherein the compound is licoricidin, gancaonin I, 8-(γ,γ -dimethylallyl)-wighteone, glycy coumarin, glyasperin C, glycyrin, isoangustone A, or licoaryl coumarin.