more of 2-phenylethanol, 9 ppm (w/v) or more of isobutyl alcohol, and 10 ppm (w/v) or more of HEMF (4-Hydroxy-2(or5)-ethyl-5 (or2)-methyl-3(2H)-furanone) with respect to a total nitrogen concentration of 1.0% (w/v).

(2) The soy sauce-like liquid seasoning described in (1) above, which contains 50 ppm (w/v) or less of sodium ions.

(3) A method for producing the soy sauce-like liquid seasoning of (1) or (2) above, the method comprising the steps of:

1. inoculating raw material grains of primarily soybean or wheat with a *koji* mold to prepare a solid *koji*, and adding water or saline to heat and hydrolyze a *moromi* having a salt concentration of less than 4% (w/v);

2. pasteurizing the *moromi* obtained in the step 1; and

3. inoculating the pasteurized *moromi* obtained in the step 2 with yeast, and fermenting the *moromi* with the yeast in a container adapted to reduce entry of harmful microorganisms.

EFFECT OF THE INVENTION

[0012]

According to the present invention, a salt-free or low-salt soy sauce-like liquid seasoning having a desirable taste and aroma with no contamination by harmful microorganisms can be obtained.

Also, the salt-free liquid seasoning produced by the present invention has an extremely low sodium ion concentration, and a desirable flavor, and can be used as a soy sauce-like liquid seasoning suited for people suffering from, for example, high-blood pressure, or renal disease.

EMBODIMENTS FOR CARRYING OUT THE INVENTION

[0013]

The present invention is described below in detail.

In the present invention, a soy sauce *moromi* having a salt concentration of less than 4% (w/v) is prepared by mixing water or saline into a solid *koji* prepared from raw material grains. The *moromi* is then heated and hydrolyzed at 25 to 57°C for 0 to 48 hours. Preferably, 70 to 80°C hot water or saline is mixed into a solid *koji*, and the mixture is stirred intermittently or continuously in a tank while maintaining the *moromi*

at 50 to 57°C, and hydrolyzed with enzyme for 15 to 30 hours, as in Japanese Patent No. 3827300.

[0014]

As used herein, "raw material grains" refers to, for example, protein materials such as whole soybean, defatted soybean, soy protein, wheat gluten, green pea, broad pea, and red pea, and starch materials such as wheat, barley, rye, wheat bran, rice, rice bran, corn, and starch pulp. These may be used alone or in combination.

[0015]

The solid *koji* used herein is obtained by inoculating a protein material prepared by using an ordinary method or a mixture of the protein material and a starch material with a *koji* mold such as *Aspergillus sojae*, and *Aspergillus oryzae*, and conducting solid culturing for 2 to 3 days (*koji*-making).

When mixing protein and starch materials, these are mixed at a weight ratio of preferably 1:0.25 to 4 when, for example, a liquid seasoning similar to a regular soy sauce is desired. However, the combination ratio of these materials are not particularly limited.

[0016]

The water or saline used for brewing is used in amounts that are sufficient to soak *koji*. Typically, the amount of water or saline is preferably 1 to 4 times the weight of *koji* by volume (v/w). At the time of thermal hydrolysis, an edible acid, an enzyme agent, or activated carbon may be added to improve mold resistance, hydrolysis efficiency, and flavor, as will be described later. For the purpose of reducing bubbling during yeast fermentation, an emulsion-type silicone defoaming agent may be added in a final concentration of 0.01 to 0.5% (w/v).

[0017]

At the time of thermal hydrolysis, an enzyme agent may be added in a final concentration of 0.001 to 1% (w/v) to promote *moromi* hydrolysis. Examples of the enzyme agent include protease (endoprotease, exoprotease), cellulase, and pectinase.

[0018]

The thermal hydrolysis is followed by heat pasteurization of the soy sauce *moromi* having a salt concentration of less than 4% (w/v). The heat pasteurization method is not particularly limited, and may be any of, for example, UHT (ultra high temperature heating method), HTST (high temperature short time method sterilization), retort, pressurized tank, steam injection, steam infusion, autoclave, plate heater, surface scrape,

concentration of these aroma components can be measured by, for example, GC-MS (gas chromatography-mass spectrometry), or GC-FID (gas chromatography-flame ionization detection).

[0030]

It is known that HEMF, an important aroma component of soy sauce, reduces its concentration in low-salt brewing process (J. Agric. Food Chem. Vol 44, 3273-3275, 1996). The soy sauce-like liquid seasoning of the present invention, however, has the same levels of HEMF concentration as a regular soy sauce, and has the soy sauce-like flavor.

[0031]

The salt-free soy sauce-like liquid seasoning of the present invention, which is obtained without using any salt in the water used in the brewing step, has a sodium ion concentration of 50 ppm (w/v) or less. The salt-free soy sauce-like liquid seasoning of the present invention differs from known salt-free soy sauce-like liquid seasonings in this respect, and has a lower sodium concentration than known salt-free soy sauce-like liquid seasonings. The sodium ion concentration can be measured by using methods such as atomic absorption spectrometry and ICP emission spectrometry.

[0032]

The following describes the present invention in greater detail using Examples. It should be noted that the technical scope of the present invention is in no way limited by the following Examples.

EXAMPLES

[0033]

1. Production of Salt-Free Liquid Seasoning

Preparation of Soy Sauce *Koji*

Defatted processed soybean (50%, w/w), and roasted smashed wheat (50%, w/w) were mixed to prepare a soy sauce *koji*. The defatted processed soybeans were used after being soaked with water (130%, w/w) and boiled. The raw material was inoculated with a seed starter of *Aspergillus sojae*, and was processed for 42 hours using an ordinary method to obtain a soy sauce *koji* (*koji*-making).

[0034]

Moromi Preparation

4: Slightly high intensity/slightly desirable palatability

5: High intensity/desirable palatability

[0062]

Table 9 shows the results of the sensory evaluation test for the salt-free liquid seasonings. The scores presented in the table are the mean values of the eight panelists. The samples of Examples 2-1 and 2-2 as the products of the present invention had improved *umami* and palatability than the desalted soy sauce. It was confirmed that the samples of Examples 3-1 and 3-2 also had an improved soy sauce-like taste due to increased HEMF. On the other hand, it was confirmed that the alcohol-added sample and the commercially available salt-free soy sauce had a strong alcohol taste, and tended to be unpleasant. The products of the present invention had a soy sauce-like aroma due to the high total nitrogen concentration and the high glutamic acid concentration, and the same levels of alcohol concentration as a brewed soy sauce. These contributed to the improved palatability.

[0063]

[Table 9]

	Average score					Comment
	Saltiness	*Umami*	Bitterness	Soy sauce-like taste	Palatability	
Desalted soy sauce	-	-	-	-	-	Plain taste with harshness
Ex. 1-4	2.8	3.0	3.0	2.8	3.1	Mild soy sauce aroma, desirable flavor
Ex. 2-1	3.0	3.6	3.4	2.8	3.6	Elegant aroma, desirable flavor
Ex. 2-2	3.3	3.6	3.3	2.6	3.5	Elegant *sake*-like flavor
Ex. 3-1	3.3	3.4	3.4	3.4	3.5	Strong soy sauce-like aroma, desirable flavor
Ex. 3-2	3.4	3.1	3.6	3.5	3.8	Sharp soy sauce-like aroma, desirable flavor
Ex. 2-1 + alcohol (8.5%)	2.8	3.0	3.5	2.0	2.0	Strong alcohol taste, no soy sauce-like flavor
Commercially available salt-free soy sauce	3.0	2.8	4.1	1.9	1.5	Strong alcohol taste with bitterness

[0064]

The same sensory evaluation was conducted for the low-salt liquid seasonings, specifically, for the sample of Example 2-4 (3% salt), and for a sample prepared by adding salt to a desalted soy sauce in a final concentration of 3% (N = 8). By the presence of a small quantity of salt, the sample of Example 2-4 containing 3% salt had

greatly improved saltiness, *umami*, soy sauce-like taste and palatability, and was evaluated as a more-balanced liquid seasoning compared with the desalted soy sauce to which salt was added to have the same salt concentration.

[0065]

These results confirmed that the soy sauce-like liquid seasoning of the present invention, despite being salt-free or low-salt, has an excellent flavor, and more desirable palatability than the desalted soy sauce, the commercially available salt-free soy sauce, and the soy sauce prepared by adding salt or alcohol to the desalted soy sauce.

[0066]

Experimental Production of Salt-Free Liquid Seasoning

(A) High-Temperature Hydrolysis with Acetic Acid - Pasteurization of *Moromi* Solution - Yeast Fermentation

A soy sauce *koji* (7.8 kg) containing defatted processed soybeans (50%, w/w) and roasted smashed wheat (50%, w/w) was charged into a 30-L jar fermenter with 12 L of 75°C hot water and 100 mL of acetic acid. The mixture was stirred at 55°C for 24 hours for hydrolysis. The hydrolyzed *moromi* was filtered through filter paper to separate liquid from solid, and the filtrate (*moromi* solution) was heat pasteurized at 121°C for 3 minutes. To the pasteurized *moromi* solution was added 1 L of glucose, and 1×10^6 cells/mL of soy sauce yeast (*Zygosaccharomyces rouxii*), and the mixture was fermented at a *moromi* temperature of 30°C for 7 days.

[0067]

(B) High-Temperature Hydrolysis with Lactic Acid - Pasteurization of *Moromi* Solution - Yeast Fermentation

The same soy sauce *koji* used in (A) (7.8 kg) was charged into a 30-L jar fermenter with 12 L of 75°C hot water and 100 mL of lactic acid. The mixture was stirred at 55°C for 24 hours for hydrolysis. The hydrolyzed *moromi* was filtered through filter paper to separate liquid from solid, and the filtrate (*moromi* solution) was heat pasteurized at 121°C for 3 minutes. To the pasteurized *moromi* solution was added 1 L of glucose, and 1×10^6 cells/mL of soy sauce yeast (*Zygosaccharomyces rouxii*), and the mixture was fermented at a *moromi* temperature of 30°C for 7 days.

[0068]

(C) High-Temperature Hydrolysis with Lactic Acid - *Moromi* Pasteurization - Yeast Fermentation

The same soy sauce *koji* used in (A) (7.8 kg) was charged into a 30-L jar fermenter with 12 L of 75°C hot water and 100 mL of lactic acid. The mixture was stirred at 55°C for 24 hours for hydrolysis. The hydrolyzed *moromi* was heat pasteurized at 121°C for 3 minutes while being stirred in the jar fermenter. To the pasteurized *moromi* was added 1 L of glucose, and 1×10^6 cells/mL of soy sauce yeast (*Zygosaccharomyces rouxii*), and the mixture was fermented at a *moromi* temperature of 30°C for 7 days.

[0069]

Results

Table 10 shows the analytical values and the results of flavor evaluation of these liquid seasoning samples. There was no large difference between the analytical values of the samples. However, the samples were greatly different in terms of flavor. The acetic acid hydrolysis sample (A) had a notable acid odor, and the taste was too plain. The *moromi* solution pasteurized sample (A, B) had an off-flavor including an oxidation odor and a deterioration odor. The sample of (C) had *umami* with a flavor that most closely resembled a soy sauce.

[0070]

[Table 10]

Sample	pH	TN (%, w/v)	Glu (%, w/v)	Alcohol (%, w/v)	Flavor evaluation
(A) Acetic acid-Pasteurization of *moromi* solution	4.98	1.72	1.26	5.78	- Acid odor and deterioration odor are present - Acid taste with little soy sauce-like taste
(B) Lactic acid-Pasteurization of *moromi* solution	5.02	1.74	1.37	4.67	- Bitterness and acid odor/deterioration odor are present - Sharp flavor
(C) Lactic acid-*Moromi* pasteurization	5.03	1.90	1.51	5.55	- Soy sauce-like flavor - Strong *umami*

[0071]

These results confirmed that the liquid seasoning of the present invention produced by yeast fermentation without solid-liquid separation had a flavor greatly

CLAIMS

1. A soy sauce-like liquid seasoning having a salt concentration of less than 4% (w/v) and an alcohol concentration of less than 7% (w/v), and comprising, with respect to a total nitrogen concentration of 1.0% (w/v),

- 20 ppm (w/v) or more of isoamyl alcohol,
- 6 ppm (w/v) or more of 2-phenylethanol,
- 9 ppm (w/v) or more of isobutyl alcohol, and
- 10 ppm (w/v) or more of HEMF (4-Hydroxy-2(or5)-ethyl-5(or2)-methyl-3(2H)-furanone).

2. The soy sauce-like liquid seasoning according to claim 1, which contains 50 ppm (w/v) or less of sodium ions.

3. A method for producing the soy sauce-like liquid seasoning of claim 1 or 2, the method comprising the steps of:

1. inoculating raw material grains of primarily soybean or wheat with a *koji* mold to prepare a solid *koji,* and adding water or saline to heat and hydrolyze a *moromi* having a salt concentration of less than 4% (w/v);

2. pasteurizing the *moromi* obtained in the step 1 before solid-liquid separation; and

3. inoculating the pasteurized *moromi* obtained in the step 2 with yeast, and fermenting the *moromi* with the yeast in a container adapted to reduce contamination of harmful microorganisms.