In an aspect, to produce a plant-based oil-in-water emulsion, a plant-derived oil or fat can be preferably used as the oily material of the present invention.

The lower limit of the amount of the oil or fat in the oily material of the present invention is preferably 1 mass% or more, more preferably 3 mass% or more. More preferably, the lower limit can be 5 mass% or more, 10 mass% or more, 20 mass% or more, 30 mass% or more, 40 mass% or more, 45 mass% or more, 50 mass% or more, 55 mass% or more, 60 mass% or more, 65 mass% or more, or 70 mass% or more. The upper limit of the amount of the oil or fat in the oily material of the present invention is preferably 99 mass% or less, more preferably 97 mass% or less. The upper limit can be further preferably 95 mass% or less, 93 mass% or less, 91 mass% or less, or 90 mass% or less. The lower limit values and the upper limit values can be freely combined. Examples thereof include from 1 to 99 mass%, from 20 to 95 mass%, and from 50 to 95 mass%.

[0012]

(Free fatty acid)

The oily material of the present invention contains a free fatty acid. By containing the free fatty acid, the effect of improving the oil taste can be obtained. The lower limit of the amount of free fatty acid in the oily material of the present invention is preferably 1 mass% or more, more preferably 2 mass% or more. The lower limit can be further preferably 3 mass% or more, 5 mass% or more, or 7 mass% or more. The upper limit of the amount of free fatty acid in the oily material of the present invention is preferably 99 mass% or less, more preferably 95 mass% or less. The upper limit can be further preferably 90 mass% or less, 70 mass% or less, 50 mass% or less, 40 mass% or less, 35 mass% or less, 30 mass% or less, 25 mass% or less, or 20 mass% or less. The lower limit values and the upper limit values can be freely combined. Examples thereof include from 1 to 99 mass%, from 1 to 50 mass%, from 2 to 40 mass%, from 3 to 30 mass%, and from 5 to 20 mass%.

In the present invention, examples of the free fatty acid include polyunsaturated fatty acids such as lauric acid, myristic acid, palmitic acid, oleic acid, linoleic acid, stearic acid, eicosapentaenoic acid, docosahexaenoic acid, arachidonic acid, and γ-linolenic acid. Among these, oleic acid, linoleic acid, palmitic acid, and stearic acid are preferable, and oleic acid and linoleic acid are more preferable from the viewpoint of the effect of improving the oil taste and suppressing bitterness. One of these free fatty acids can be used alone or two or more thereof can be used in combination.

The free fatty acid may be a chemically synthesized product or a hydrolysate of an edible oil or fat. The free fatty acid may be a mixture of another oily material and a free fatty acid.

In the case of a hydrolysate of an edible oil or fat, the origin of the edible oil or fat is not limited, and examples thereof include oil or fat such as soybean oil, rapeseed oil, corn oil, safflower oil, rice oil, cottonseed oil, sunflower oil, high oleic sunflower oil, sesame oil, olive oil, peanut oil, palm oil, palm kernel oil, coconut oil, lard, beef tallow, fish oil, and medium chain fatty acid oil. As the hydrolysis method, enzymatic hydrolysis, chemical hydrolysis,

[0033]

(Measurement of emulsion particle size)

As a sample, an oil-in-water emulsion or an oil-in-water emulsion-containing aqueous food product was diluted with ion-exchanged water such that the oily material was 0.03%. The particle size of the oil droplets in water was measured as the Z-average (nm), calculated using a Zetasizer Nano-ZS (MODEL ZEN3600, available from Malvern Panalytical Ltd.). The measurement was performed three times at 25°C using 2 g of the sample in a glass cell with a 1-cm optical path. The average of the three measurements was taken as the average emulsion particle size. The setting conditions were as follows.

RI (Material) 1.47, Absorption (Material) 0, Temperature (Dispersant) 25 (°C), Viscosity (Dispersant) 0.887 (cp), RI (Dispersant) 1.33, Equilobration time 60 (sec), Number of runs 10, Run duration 10, Number of measurements 1, Dela between measurements 0 (sec).

[0034]

(Examples 1 to 10, Comparative Examples 1 to 14) (Preparation of oil-in-water emulsion)

The oil-in-water emulsion was prepared according to Tables 1 to 3 as follows. That is:

a) Preparation of oil phase: one or a plurality of materials corresponding to the respective formulations of oil phases shown in Tables 1 to 3 were mixed and set to 80°C. The oil phases were prepared by mixing the one or a plurality of materials for 5 minutes using a homomixer (HOMOGENIZING MIXER MARK II, Model 2.5, available from PRIMIX Corporation).

b) Preparation of aqueous phase: Materials corresponding to the respective formulations of aqueous phases shown in Tables 1 to 3 were dissolved in water at 80°C. The aqueous phases were prepared by mixing the materials for 5 minutes using the homomixer.

c) Each of the oil phases prepared in step a) was added to each of the aqueous phases of step b), and the respective mixtures were preliminarily emulsified at 80°C for 5 minutes to have an emulsion particle size of from 10 to 60 μm using the homomixer.

d) An oil-in-water emulsion was prepared by treating the mixture in step c) with a high-pressure homogenizer (Microfluidizer available from Microfluidics International Corporation) at the pressure and the number of treatment described in Tables 1 to 3.

The oil-in-water emulsions of Comparative Examples 2 to 6, 8, 10 to 12, and 14 had an emulsion particle size of more than 100 nm.

[0035]

(Evaluation of oil-in-water emulsion)

The obtained oil-in-water emulsion was diluted with water to obtain a 1% solution, and evaluated from the viewpoint of oil taste and bitterness.

[0036]

(Evaluation criteria for oil taste)

Six skilled panelists performed each evaluation on a reference example (evaluation score = 1 point) of the additive-free group, and evaluated with the average value of the evaluation

Aqueous Phase	Soy protein material	10	10	10
	Glycerin	60	60	60
	Water	20	20	20
Total		100	100	100
Emulsification pressure (MPa)		150	150	150
Number of passing		5	5	5
Emulsion particle size (nm)		56	51	57
Oil taste (score)		5.0	3.5	3.0
Bitterness (score)		4.5	3.5	3.5
Overall evaluation		Acceptable	Acceptable	Acceptable

[0049]

As shown in Table 5, when fatty acids other than oleic acid were used as well, the evaluation of the oil taste and bitterness was favorable.

[0050]

(Examples 16 to 17) Influence of oxidation degradation due to light irradiation

For the oil-in-water emulsions of Examples 14 to 15, the influence of oxidation degradation was examined in the same manner as in Example 11. The results are shown in Table 6.

[0051]

(Table 6)

		Example 16	Example 17
		Oil-in-water emulsion of Example 14	Oil-in-water emulsion of Example 15
Before light irradiation	Oil taste (score)	3.5	3.0
	Bitterness (score)	3.5	3.5
	Oxidation odor (score)	5.0	5.0
After light irradiation	Oil taste (score)	3.5	3.0
	Bitterness (score)	3.5	3.5
	Oxidation odor (score)	5.0	5.0
	Overall evaluation	Acceptable	Acceptable

[0052]

(Examples 18 to 20)

Oil-in-water emulsions were prepared based on the formulations in Table 7 and evaluated in the same manner as in Example 1. The evaluation results are shown in Table 7. As shown in Table 7, when vitamin E or ascorbyl palmitate was added, the evaluation of the oil taste and bitterness was favorable.

Formulation (%)	Example 25	Example 26	Example 27	Comparative Example 15	Comparative Example 16	Example 28	Comparative Example 17	Comparative Example 18	Comparative Example 19	Comparative Example 20	Example 29
Bouillon (western-style soup stock)	2	2	2	2	2	2	2	2	2	2	2
Oil-in-water emulsion of Example 2	1	-	-	-	-	-	-	-	-	-	-
Oil-in-water emulsion of Example 8	-	0.33	-	-	-	-	-	-	-	-	-
Oil-in-water emulsion of Example 14	-	-	2	-	-	-	-	-	-	-	-
Oil-in-water emulsion of Comparative Example 1	-	-	-	1	-	-	-	-	-	-	-
Oil-in-water emulsion of Comparative Example 2	-	-	-	-	1	-	-	-	-	-	-
Oil-in-water emulsion of Example 5	-	-	-	-	-	1	-	-	-	-	-
Oil-in-water emulsion of Comparative Example 3	-	-	-	-	-	-	1	-	-	-	-
Oil-in-water emulsion of Comparative Example 4	-	-	-	-	-	-	-	1	-	-	-
Oil-in-water emulsion of Comparative Example 5	-	-	-	-	-	-	-	-	1	-	-
Oil-in-water emulsion of Comparative Example 9	-	-	-	-	-	-	-	-	-	1	-
Oil-in-water emulsion of Example 19	-	-	-	-	-	-	-	-	-	-	1
Hot water	97	97.67	96	97	97	97	97	97	97	97	97
Total	100	100	100	100	100	100	100	100	100	100	100
Oil taste (score)	5.0	4.0	4.0	1.5	1.5	3.7	1.5	1.5	3.0	1.5	5.0
Bitterness (score)	5.0	4.5	4.0	5.0	5.0	5.0	5.0	5.0	1.5	2.5	4.5
Overall evaluation	Acceptable	Acceptable	Acceptable	Unacceptable	Unacceptable	Acceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable	Acceptable

[0062]

As understood from Examples and Comparative Examples in Table 10, it can be said, for food products as well, that the oil taste can be strongly perceived and bitterness is suppressed by

Claims

[Claim 1]

An oil-in-water emulsion comprising an oily material, a readily water-soluble substance, water, and a protein material, the oil-in-water emulsion having an emulsion particle size of 100 nm or less and satisfying requirements (A) and (B) described below:

(A) the oily material containing at least a free fatty acid;

(B) the protein material having properties including: a viscosity of 10000 Pa·s or less as measured at 25°C after a 20 mass% aqueous solution, based on crude protein content, is heated at 80°C for 30 minutes; and a 0.22 M TCA solubilization percentage of from 30% to 95%.

[Claim 2]

The oil-in-water emulsion according to claim 1, wherein the free fatty acid is one or two or more selected from oleic acid, linoleic acid, palmitic acid, and stearic acid.

[Claim 3]

The oil-in-water emulsion according to claim 1 or 2, wherein the oil-in-water emulsion contains the oily material in an amount of from 0.5 to 35 mass%, the readily water-soluble substance in an amount of from 1 to 80 mass%, the water in an amount of from 5 to 70 mass%, and the protein material in an amount of from 30 to 1200 mass% based on crude protein content relative to the oily material, and in (A), the oily material contains the free fatty acid in an amount of from 1 to 99 mass%.

[Claim 4]

The oil-in-water emulsion according to claim 3, wherein the oil-in-water emulsion contains the oily material in an amount of from 0.5 to 35 mass%, the readily water-soluble substance in an amount of from 1 to 80 mass%, the water in an amount of from 5 to 70 mass%, and the protein material in an amount of from 30 to 1200 mass% based on crude protein content relative to the oily material, and in (A), the oily material contains the free fatty acid in an amount of from 1 to 99 mass% and an oil or fat in an amount of from 1 to 99 mass%.

[Claim 5]

The oil-in-water emulsion according to any one of claims 1 to 4, wherein the protein material has an NSI of 80 or more.

[Claim 6]

The oil-in-water emulsion according to claim 1 or 2, having a water content of 65 mass% or less.

[Claim 7]

The oil-in-water emulsion according to claim 1 or 2, the oily material further containing an L-ascorbyl fatty acid ester.

[Claim 8]

The oil-in-water emulsion according to claim 1 or 2, wherein the oil-in-water emulsion is a plant-based oil-in-water emulsion.

[Claim 9]

A method for producing an oil-in-water emulsion having an emulsion particle size of 100 nm or less, the method comprising: mixing from 0.5 to 35 mass% of an oily material containing a free fatty acid with a solution containing a protein material in an amount of from 30 to 1200 mass% based on crude protein content relative to the oily material, from 1 to 80 mass% of a readily water-soluble substance, and from 5 to 70 mass% of water; and applying a shear force to a mixture obtained thereby.

[Claim 10]

The method for producing an oil-in-water emulsion according to claim 9, wherein the protein material has: a viscosity of 10000 mPa·s or less as measured at 25°C after a 20 mass% aqueous solution, based on crude protein content, is heated at 80°C for 30 minutes; a 0.22 M TCA solubilization percentage of from 30 to 95%; and an NSI of 80 or more.

[Claim 11]

A food or beverage product comprising the oil-in-water emulsion according to claim 1 or 2.

[Claim 12]

An oil flavoring agent for a food or beverage product, the oil flavoring agent comprising the oil-in-water emulsion according to claim 1 or 2.