

DESCRIPTION

Title of Invention

COMPOSITION, COATED FOOD PRODUCT, COATED FOOD PRODUCT MANUFACTURING METHOD, COATING FORMATION METHOD, AND FOOD PRODUCT SHIPPING METHOD

Technical Field

[0001]

The present invention relates to a composition, a coated food product, a coated food product manufacturing method, a coating formation method, and a food product shipping method. This application claims priority based on Japanese Patent Application No. 2020-173408 filed in Japan on October 14, 2020, Japanese Patent Application No. 2021-045131 filed in Japan on March 18, 2021, and Japanese Patent Application No. 2021-141435 filed in Japan on August 31, 2021, and the contents thereof are incorporated herein.

Background Art

[0002]

In recent years, packaging materials that can maintain the freshness of food products during distribution or storage, which are represented by modified atmosphere (MA) packaging, attract attention. Then, from the viewpoint of reducing the environmental load, there is a trend toward the progress of so-called mono-materialization in which packaging materials to be used are also made of a single material so that they are easily recycled or discarded after use.

Further, a technique of maintaining the freshness of food products has been suggested, in which a quality preserving agent is directly applied to food products such as fruits and vegetables without using packaging materials (see Patent PTLs 1 and 2).

Further, for the purpose of preventing pericarp damage of fruits and vegetables, a pericarp damage preventive agent for fruits and vegetables, which contains a surfactant with an HLB of 5 or less as an active ingredient, has been suggested (see PTL 3).

Citation List

Patent Literature

[0003]

PTL 1: JP 2018-134115A

PTL 2: JP 2005-530502A

PTL 3: JP 8-56564A

Summary of Invention

Technical Problem

[0004]

However, methods disclosed in PTLs 1 and 2 were not necessarily sufficient for exhibiting the freshness retention performance because the freshness retention period is short, or used ingredients are compositions that are not good for a human body.

Therefore, an object of the present invention is to propose a composition which can maintain the freshness of food products, a coated food product, a coated food product manufacturing method, a coating formation method, and a food product shipping method.

[0005]

Further, in the liquid formulation disclosed in PTL 3, the liquid stability was insufficient, and thus in some cases, gelation occurred during preparation of the liquid formulation, or over time.

Therefore, another object of the present invention is to improve the liquid stability of a composition.

[0006]

Further, when the liquid formulation disclosed in PTL 3 was applied to food products such as fruits and vegetables, in some cases, it took a long time to dry, and the productivity became poor. Further, in some cases, traces of application were seen, and the surface of a coated food product was whitened, and then the appearance of the coating film became unsatisfactory sometimes.

Therefore, another object of the present invention is to obtain a composition which has a fast drying speed when applied to the surface of a food product, and improves the appearance after application.

Solution to Problem

[0007]

The present inventors have thought that transpiration from a food product during distribution or storage is one of causes of freshness reduction, and then have investigated various coatings with a high water vapor barrier property. Then, they have found that the above problem can be solved by applying a coating containing a specific surfactant to the food product.

Then, they have found that the above problem can be solved by a composition containing a specific surfactant and a water-based solvent because it has a good liquid stability or makes it difficult for traces of application to occur on the food product.

[0008]

That is, the present invention has the following aspects.

[1] A composition containing a sugar-based surfactant and a water-based solvent, in which a main component of the sugar-based surfactant is a sugar fatty acid ester, and in 100% by mass of the sugar fatty acid ester, a content of a sugar fatty acid ester having three or less fatty acid ester groups is 50 to 98% by mass, and a content of a sugar fatty acid ester having five or more fatty acid ester groups is 2 to 50% by mass.

[2] A composition containing a sugar-based surfactant and a water-based solvent, in which in the composition, a surface tension at 25°C is 34 mN/m or less.

[3] A coated food product having a coating containing a sugar-based surfactant, in which the coating covers only a portion of the food product.

[4] A method of manufacturing a coated food product, in which the method includes: applying a composition containing a sugar-based surfactant and a water-based solvent to a portion of the food product, or applying a sugar-based surfactant with no solvent to a portion of the food product.

[5] A method of manufacturing a coated food product, in which the method includes: applying a composition containing a sugar-based surfactant and a water-based solvent to the food product, or applying a sugar-based surfactant with no solvent to the food product; and removing a part of the applied composition or sugar-based surfactant.

[6] In the composition described in [2], a main component of the sugar-based surfactant is a sugar fatty acid ester.

[7] In the composition described in [1], saturated fatty acids account for 50% by mass or more in fatty acids constituting the sugar fatty acid ester.

[8] In the composition described in [1] or [6], in fatty acids constituting the

sugar fatty acid ester, a mass ratio of saturated fatty acids to unsaturated fatty acids is 50/50 to 99/1.

[9] In the composition described in any one of [1], [2], and [6] to [8], among non-volatile components of the composition, a content of the sugar-based surfactant is 60% by mass or more.

[10] In the composition described in any one of [1], [2], and [6] to [9], the water-based solvent is water or a mixture of water and alcohol.

[11] The composition described in any one of [1], [2], and [6] to [10] is used for coating fruits and vegetables.

[12] In the coated food product described in [3], the sugar-based surfactant is a sucrose fatty acid ester.

[13] In the coated food product described in [12], a lipophilic group of the sugar-based surfactant is a saturated fatty acid.

[14] In the coated food product described in [12] or [13], when a total amount of the sugar-based surfactant is 100% by mass, a content of a sugar fatty acid ester having three or less fatty acid ester groups is 50% by mass or more.

[15] In the coated food product described in any one of [12] to [14], an HLB of the sugar-based surfactant is 5 or more.

[16] In the coated food product described in any one of [12] to [15], an average film thickness of the coating is 0.1 μm to 10 μm .

[17] In the coated food product described in any one of [12] to [16], a crystal melting peak temperature of the coating is 40°C to 80 °C.

[18] In the coated food product described in any one of [12] to [17], the food product is a fruit or vegetable.

[19] In the coated food product manufacturing method described in [4] or [5], the application method is an immersion method or a jetting method.

[20] A method of forming a coating, in which the method includes: applying a composition containing a sugar-based surfactant and a water-based solvent to a portion of a food product, or applying a sugar-based surfactant with no solvent to a portion of a food product.

[21] In the coating formation method described in [20], the application method is an immersion method or a jetting method.

[22] A method of forming a coating, in which the method includes: applying a composition containing a sugar-based surfactant and a water-based solvent to a food product, or applying a sugar-based surfactant with no solvent to a food

product, in which after the composition or the sugar-based surfactant is applied to the food product, a part of the applied composition or sugar-based surfactant is removed.

[23] A method of shipping a food product, in which the method includes: (A) conveying the food product; (B) forming a coating on the food product; and (C) inspecting the coated food product by using an evaluation device, and in (B), the coating is formed by the method described in any one of [20] to [22].

[24] In the food product shipping method described in [23], the inspection step (C) includes at least one inspection selected from the group consisting of appearance inspection, sugar content inspection, and size inspection.

Advantageous Effects of Invention

[0009]

The composition according to one aspect of the present invention has good liquid stability, and thus when this is applied to a food product, a sufficient freshness retention performance can be secured.

Further, the composition according to another aspect of the present invention has a fast drying speed when applied to food products such as fruits and vegetables, and thus the appearance after application is also improved.

Then, the coated food product of the present invention can keep the freshness for a long period of time because it has a coating with a high water vapor barrier property, and thus the transpiration from the food product can be suppressed. The coating also has an oxygen barrier property, and thus, can also suppress aging caused by respiration especially in fruits and vegetables.

Further, in the present invention, since a coating having a freshness retention performance is directly provided to the food product, plastic packaging materials are not required unlike in the past. Then, a filmless state may be achieved, which greatly contributes to the reduction of the environmental load.

Brief Description of Drawings

[0010]

Fig. 1 is an image diagram of a method of shipping fruits and vegetables in the present invention.

Description of Embodiments

[0011]

<Composition (1)>

A composition (hereinafter, also simply referred to as "a composition (1)") according to a first embodiment of the present invention contains a sugar-based surfactant and a water-based solvent. A film obtained from the composition (1) is excellent in the water vapor barrier property, and thus is suitable for coating a food product. Further, the film also has an oxygen barrier property, and thus is particularly suitable for coating fruits and vegetables. Preferably, from the film obtained from the composition (1), the water-based solvent is removed as described below.

Hereinafter, the composition (1) will be described in detail.

[0012]

[Sugar-based surfactant]

The sugar-based surfactant is a nonionic surfactant with sugar as a hydrophilic group.

The sugar-based surfactant of the composition (1) preferably has crystallinity from the viewpoint of suppressing the stickiness of the obtained coating, and being able to improve the water vapor barrier property and the oxygen barrier property.

[0013]

In the sugar-based surfactant of the composition (1), from the viewpoint of suppressing the stickiness of the obtained coating, the content of a component that becomes a solid at room temperature (20 to 25°C) is preferably 60% by mass or more, more preferably 70% by mass or more, further preferably 80% by mass or more, still further preferably 90% by mass or more. The sugar-based surfactant may contain only the component that becomes a solid at room temperature (20 to 25°C), and thus, the above ratio should be 100% by mass or less.

[0014]

Examples of the sugar-based surfactant include sugar fatty acid esters obtained through ester-bonding of sugar and fatty acid, and alkyl glycosides obtained through glycoside-bonding of sugar and higher alcohol. Among these, the sugar fatty acid esters are preferred.

The lipophilic group of the sugar-based surfactant in the composition (1) is preferably saturated fatty acid. Therefore, in the sugar fatty acid esters, it is preferable that the constituent fatty acids of the sugar fatty acid esters contain

saturated fatty acids as described below. The details of the saturated fatty acids are as described below.

[0015]

(Sugar fatty acid esters)

The sugar fatty acid esters of the composition (1) are not particularly limited as long as they can be used for food products, but examples thereof include sucrose fatty acid esters, sorbitan fatty acid esters, and glucose esters. Among these, sucrose fatty acid esters are preferred.

It is not necessary to use only one type of sugar-based surfactant, and two or more types may be used in combination. In a case where two or more types are combined, it is preferable that when the total amount of the sugar-based surfactants is 100% by mass, the sucrose fatty acid esters account for 60% by mass or more. This ratio is more preferably 70% by mass or more, further preferably 80% by mass or more, still further preferably 90% by mass or more from the viewpoint of suppressing the stickiness of the obtained coating, and being able to improve the water vapor barrier property and the oxygen barrier property. As for the sugar-based surfactant, the sucrose fatty acid esters may be used alone, and thus, the above ratio should be 100% by mass or less.

[0016]

The constituent fatty acids of the sugar fatty acid esters are preferably edible oil.

The number of carbon atoms of the constituent fatty acid of the sugar fatty acid esters is not particularly limited, but is preferably 12 to 22, more preferably 12 to 18, further preferably 14 to 18. When the number of carbon atoms falls within the above range, the stickiness of the obtained coating may be suppressed.

The constituent fatty acids of the sugar fatty acid esters in the composition (1) may be saturated or unsaturated fatty acids, but from the viewpoint of easily becoming a solid at room temperature (20 to 25°C), and suppressing the stickiness of the obtained coating, the saturated fatty acids are preferred.

More specifically, lauric acid, myristic acid, pentadecyl acid, palmitic acid, palmitoleic acid, margaric acid, stearic acid, oleic acid, etc. may be exemplified. Among these, lauric acid, myristic acid, palmitic acid, and stearic acid, which are saturated fatty acids having 12 to 18 carbon atoms, are preferred, and myristic acid, palmitic acid, and stearic acid, which are saturated fatty acids having 14 to 18 carbon atoms, are more preferred. Among these saturated fatty acids, one type

may be used alone, or two or more types may be used in combination.

The constituent fatty acids of the sugar fatty acid esters do not have to be all the same, as long as the above suitable constituent fatty acids account for 60% by mass or more in the constituent fatty acids of the sugar fatty acid esters. This ratio is preferably 70% by mass or more, more preferably 80% by mass or more, further preferably 90% by mass or more from the viewpoint of suppressing the stickiness of the obtained coating. The upper limit is not particularly limited, but should be 100% by mass or less.

The composition of the constituent fatty acids of the sugar fatty acid esters can be measured through gas chromatography after the sugar fatty acid esters are isolated from the composition and then are derivatized.

[0017]

The range of the number of fatty acid ester groups in the sugar fatty acid esters varies according to the number of ester-bondable hydroxy groups within the molecular structure of sugar which is a hydrophilic group, and the number is, for example, 1 to 8 in the sucrose fatty acid esters, and is 2 to 4 in the sorbitan fatty acid esters.

In the composition (1), from the viewpoint of being able to form a coating by using the water-based solvent, when the total amount of the sugar-based surfactant is 100% by mass, the content of sugar fatty acid esters having three or less fatty acid ester groups (monoester, diester, or triester) is preferably 50% by mass or more, more preferably 60% by mass or more, further preferably 70% by mass or more. The upper limit is not particularly limited, but should be 100% by mass or less.

Further, from the same point of view, when the total amount of the sugar-based surfactant is 100% by mass, the content of sugar fatty acid esters having six or more fatty acid ester groups (hexaester, heptaester, octa- or higher ester) is preferably 30% by mass or less, more preferably 20% by mass or less, more preferably 10% by mass or less. The sugar fatty acid esters having six or more fatty acid ester groups may not be contained, and the content thereof should be 0% by mass or more.

[0018]

For each of the numbers of fatty acid ester groups, the content ratio can be measured according to the METHOD OF ASSAY described in Residue Monograph prepared by the meeting of the Joint FAO/WHO Expert Committee on Food

Additives (JECFA), 84th meeting 2017, and "Sucrose Esters of Fatty Acids" and "Sucrose Oligoesters Type I" and "Sucrose Oligoesters Type II" prepared at the 71st JECFA (2009) and published in FAO JECFA Monographs 7 (2009), after the sugar fatty acid esters are isolated from the composition.

[0019]

<<Measurement of monoester to triester, and tetra- and higher esters>>

A solution, which is obtained by dissolving a sample in a certain amount of tetrahydrofuran (stabilizer-containing GPC or industrial grade) and removing insoluble substances with a membrane filter of 0.5 μm , is used as a measurement sample, and is subjected to high-speed liquid chromatography under the following conditions. For the composition ratios, a peak area of each of monoester to trimester, and an integrated peak area of tetra- and higher esters are individually calculated, and the ratios of all peaks detected up to 43 min, to the total peak area, are calculated.

The peak area corresponds to the area from the starting point (rising position) of each peak to the ending point (falling position).

When the starting point or the ending point is unclear because two or more peaks are adjacent to each other, the area is calculated by using a point at which data between the peaks is minimized, as the starting point and the ending point.

[0020]

<Measurement condition: monoester to triester, and tetra- and higher esters>

Device: HLC-8320GPC detector: differential refractometer (manufactured by Tosoh Corporation)

Column: TSK-gel G1000HXL, G2000HXL, G3000HXL, G4000HXL (manufactured by Tosoh Corporation)

Column temperature: 40°C

Detector temperature: 40°C

Eluent: tetrahydrofuran (stabilizer-containing GPC or industrial grade)

Flow rate: 0.8 ml/min

Injection volume: 80 μl

Measurement time: 50 min (the area ratio is calculated on the basis of all peaks detected up to 43 min)

[0021]

<<Measurement of tetraester to octaester>>

A solution, which is obtained by dissolving a sample in a certain amount of methanol (special grade reagent)/tetrahydrofuran (HPLC grade containing no stabilizer) = 20/80 (vol/vol), and removing insoluble substances with a membrane filter of 0.45 μm , is used as a measurement sample, and is subjected to high-speed liquid chromatography under the following conditions. For the composition ratios of tetraester to octaester, a peak area of each of tetraester to octaester is individually calculated, and the ratios of tetraester to octaester, to the total peak area, are calculated, in which the area ratios of tetraester to octaester are calculated with respect to the area ratio of tetra- and higher esters obtained in the above << Measurement of monoester to triester, and tetra- and higher esters >>, through proportional division.

The peak area corresponds to the area from the starting point (rising position) of each peak to the ending point (falling position).

When the starting point or the ending point is unclear because two or more peaks are adjacent to each other, the area is calculated by using a point at which data between the peaks is minimized, as the starting point and the ending point.

[0022]

<Measurement condition: tetraester to octaester>

Device

Degasser: DGU-20A (manufactured by Shimadzu Corporation)

Pump: LC-20AD (manufactured by Shimadzu Corporation)

Oven: CTO-20A (manufactured by Shimadzu Corporation)

Detector: RID-20A differential refractometer (manufactured by Shimadzu Corporation)

Column: 150 mm $\times$ 4.6 mm i.d.; ODS-2 (manufactured by GL Sciences Inc.)

Column temperature: 40°C

Detector temperature: 40°C

Eluent: methanol (special grade reagent)/tetrahydrofuran (HPLC grade containing no stabilizer) = 70/30 to 50/50 (vol/vol)

Flow rate: 0.8 ml/min

Injection volume: 20 μl

Measurement time: 16 min

[0023]

[Water-based solvent]

Examples of the water-based solvent contained in the composition (1)

include water; and alcohols such as ethanol, isopropanol, ethylene glycol, and glycerin. From the viewpoint of applicability to food products, an aqueous composition using water as a solvent is preferable, but from the viewpoint of stability and coatability, a small amount of organic solvent such as the above described alcohol may be contained as a solvent, in addition to water.

The content of the organic solvent in the composition (1) is preferably 30% by mass or less, more preferably 20% by mass or less, further preferably 10% by mass or less, still further preferably 5% by mass or less.

[0024]

[pH adjuster]

The composition (1) of the present invention may contain a pH adjuster.

As for the pH adjuster, for example, acetic acid, lactic acid, citric acid, ammonia, etc. can be used.

[0025]

[Physical properties of composition (1)]

(Non-volatile component concentration)

The non-volatile component concentration in the composition (1) is not particularly limited, but is preferably 0.1% by mass to 60% by mass, more preferably 0.2% by mass to 50% by mass, further preferably 0.3% by mass to 40% by mass, still further preferably 0.5% by mass to 20% by mass, particularly preferably 1% by mass to 10% by mass. When the non-volatile component concentration is 0.1% by mass to 60% by mass, it becomes easy to form a coating having a suitable film thickness while appropriately dissolving the sugar-based surfactant in the water-based solvent.

The "non-volatile component concentration" in the present invention is the concentration of non-volatile components contained in the composition except for the solvent.

[0026]

(Content of sugar-based surfactant)

Among the non-volatile components in the composition (1), the content of the sugar-based surfactant in the composition (1) is preferably 60% by mass or more when the upper limit is 100% by mass, more preferably 70% by mass or more, further preferably 80% by mass or more, still further preferably 90% by mass or more, from the viewpoint of being able to improve the water vapor barrier property and the oxygen barrier property of the obtained coating film.

Since the coating in the present invention is obtained by volatilizing the solvent from the composition, the appropriate content of the sugar-based surfactant in the coating is also the same as above.

[0027]

(pH of composition (1))

The pH of the composition (1) is preferably 4 to 10, more preferably 4 to 8 from the viewpoint of safe applicability to food products.

[0028]

(HLB of sugar-based surfactant)

The HLB of the sugar-based surfactant in the composition (1) is not particularly limited, but is preferably 5 or more, more preferably 7 or more, further preferably 9 or more from the viewpoint of being able to form a coating by using the water-based solvent. The upper limit of the HLB is usually 20, more preferably 18 or less.

[0029]

<Composition (2)>

A composition according to a second embodiment of the present invention (hereinafter, also simply referred to as "a composition (2)") contains a sugar-based surfactant and a water-based solvent. The main component of the sugar-based surfactant is sugar fatty acid esters, and in 100% by mass of the sugar fatty acid esters, the content of sugar fatty acid esters having three or less fatty acid ester groups (hereinafter, referred to as "low fatty acid esters" in some cases) is 50 to 98% by mass, and the content of sugar fatty acid esters having five or more fatty acid ester groups (hereinafter, referred to as "high fatty acid esters" in some cases) is 2 to 50% by mass.

The composition (2) has a good liquid stability because the sugar-based surfactant has the above features. A film obtained from the composition (2) is excellent in the water vapor barrier property, and thus is suitable for coating a food product. Further, the film also has an oxygen barrier property, and thus is particularly suitable for coating fruits and vegetables. Preferably, from the film obtained from the composition (2), the water-based solvent is removed as described below.

[0030]

In the composition (2), saturated fatty acids may account for 50% by mass or more in fatty acids constituting the sugar fatty acid esters.

In the composition (2), in the fatty acids constituting the sugar fatty acid esters, the mass ratio of saturated fatty acids to unsaturated fatty acids may be 50/50 to 99/1.

The non-volatile component concentration in the composition (2) may be 1% by mass to 20% by mass.

Among the non-volatile components of the composition (2), the content of the sugar-based surfactant may be 60% by mass or more.

In the composition (2), the water-based solvent may be water or a mixture of water and alcohol.

The composition (2) may be used for coating fruits and vegetables.

Hereinafter, the composition (2) will be described in detail.

[0031]

[Sugar-based surfactant]

In the composition (2), the main component of the sugar-based surfactant is sugar fatty acid esters. Here, the main component means that the sugar fatty acid esters are the largest component in the sugar-based surfactant, and the content thereof is, for example, 50% by mass or more, preferably 60% by mass or more, more preferably 70% by mass or more, further preferably 80% by mass or more, still further preferably 90% by mass or more. As for the sugar-based surfactant, the sugar fatty acid esters may be used alone, and thus, may account for 100% by mass or less.

By using the sugar fatty acid esters as the main component of the sugar-based surfactant, it is possible to suppress the stickiness of the obtained coating, and to improve the water vapor barrier property and the oxygen barrier property. Further, for the same reason, as described above, the sugar-based surfactant preferably has crystallinity. Since the sugar fatty acid esters can take a crystal structure, the water vapor barrier property and the oxygen barrier property of the obtained coating can be improved.

[0032]

(Sugar fatty acid esters)

The sugar in the sugar fatty acid esters of the composition (2) may be any of monosaccharides, disaccharides, trisaccharides, tetrasaccharides, polysaccharides, sugar alcohols and other oligosaccharides.

Examples of the monosaccharide include pentoses such as ribulose, xylulose, ribose, arabinose, xylose, lyxose, and deoxyribose; and hexoses such as

psicose, fructose, sorbose, tagatose, allose, altrose, glucose, mannose, gulose, idose, galactose, talose, fucose, fuculose, and rhamnose.

Examples of the disaccharide include sucrose, lactose, maltose, trehalose, turanose, and cellobiose.

Examples of the trisaccharide include raffinose, melezitose, and maltotriose.

Examples of the tetrasaccharide include acarbose, and stachyose.

Examples of the polysaccharide include glycogen, starch, cellulose, dextrin, glucan, fructan, and chitin.

As for the sugar alcohol, sorbitol, erythritol, xylitol, maltitol, lactitol, mannitol, glycerin, etc. may be exemplified, and it may be a condensate of these sugar alcohols.

As for other oligosaccharides, fructo-oligosaccharides, galacto-oligosaccharides, mannan-oligosaccharides, lactosucrose, etc. may be exemplified.

From the viewpoint of availability, sugar fatty acid esters containing disaccharides among the above are preferred, and sugar fatty acid esters containing sucrose, that is, sucrose fatty acid esters, are more preferred.

It is not necessary to use only one type of sugar fatty acid esters, and two or more types may be used in combination. In a case where two or more types are combined, the content of sucrose fatty acid esters is the same as that in the composition (1).

[0033]

In the composition (2), in 100% by mass of the sugar fatty acid esters, the content of low fatty acid esters is 50 to 98% by mass, and the content of high fatty acid esters is 2 to 50% by mass.

In a composition containing only the low fatty acid esters, the low fatty acid esters form a higher-order structure and tend to aggregate during preparation of the composition, and thus sediment or floating matter is likely to be generated. Meanwhile, when the content of the high fatty acid esters is higher than the upper limit value, the storage stability of the composition is likely to deteriorate.

In the composition (2), when the number of fatty acid ester groups falls within the range, since the sugar fatty acid esters are suppressed from forming a higher-order structure and aggregating, the sediment or floating matter is not generated during preparation of the composition, and the liquid stability of the composition is increased. Further, since the sediment or floating matter is not

generated over time, the storage stability of the composition is also increased.

[0034]

From the viewpoint, the content of the low fatty acid esters is preferably 60% by mass or more, more preferably 70% by mass or more. Further, it is preferably 95% by mass or less, more preferably 90% by mass or less, further preferably 85% by mass or less, still further preferably 80% by mass or less.

Meanwhile, the content of the high fatty acid esters is preferably 5% by mass or more, more preferably 10% by mass or more. Further, it is preferably 40% by mass or less, more preferably 30% by mass or less, still further preferably 20% by mass or less.

[0035]

Besides the low fatty acid esters and the high fatty acid esters, the composition (2) may contain sugar fatty acid esters (tetraesters) having four fatty acid ester groups.

The content of tetraesters may be 0% by mass or more, and is preferably 5% by mass or more, more preferably 10% by mass or more. Further, it is preferably 48% by mass or less, more preferably 40% by mass or less, further preferably 35% by mass or less.

[0036]

The constituent fatty acids of the sugar fatty acid esters are preferably edible oil. The number of carbon atoms of the constituent fatty acid of the sugar fatty acid esters is the same as that in the composition (1).

[0037]

The constituent fatty acids of the sugar fatty acid esters in the composition (2) may be saturated or unsaturated fatty acids, but from the viewpoint of easily becoming a solid at room temperature (20 to 25°C), and suppressing the stickiness of the obtained coating, the saturated fatty acids are preferred. Sugar fatty acid esters (a) having saturated fatty acids tend to take regular structures in the coating, and thus can improve the water vapor barrier property and the oxygen barrier property of the obtained coating.

In the constituent fatty acids, the content of the saturated fatty acids is preferably 50% by mass or more, more preferably 60% by mass or more, further preferably 70% by mass or more, still further preferably 80% by mass or more, further preferably 90% by mass or more. The upper limit is not particularly limited, but should be 100% by mass or less.

As for the saturated fatty acid, more specifically, lauric acid, myristic acid, pentadecyl acid, palmitic acid, margaric acid, stearic acid, behenic acid, etc. may be exemplified, and among these, lauric acid, myristic acid, palmitic acid, and stearic acid are preferred, and myristic acid, palmitic acid, and stearic acid are more preferred. Among these saturated fatty acids, one type may be used alone, or two or more types may be used in combination.

[0038]

Further, the sugar fatty acid esters (a), and sugar fatty acid esters (b) having unsaturated fatty acids may be used in combination. When the sugar fatty acid esters (a) and the sugar fatty acid esters (b) are used in combination, the liquid stability and the storage stability of the composition are further increased. Further, when the sugar fatty acid esters (a) and the sugar fatty acid esters (b) are used in combination, the appearance in application to a food product becomes good.

When the sugar fatty acid esters (a) and the sugar fatty acid esters (b) are used in combination, it is preferable that the amounts are adjusted such that the mass ratio of saturated fatty acids to unsaturated fatty acids becomes 50/50 to 99/1. The mass ratio is more preferably 50/50 to 90/10, further preferably 50/50 to 80/20, further preferably 55/45 to 70/30.

As for the unsaturated fatty acid, more specifically, palmitoleic acid, oleic acid, erucic acid, etc. may be exemplified, and among these, oleic acid, and erucic acid are preferable. Among these unsaturated fatty acids, one type may be used alone, or two or more types may be used in combination.

[0039]

[Water-based solvent]

The water-based solvent contained in the composition (2) contains at least water.

Further, from the viewpoint of liquid stability and coatability, a mixture of water and an organic solvent having an affinity with water is preferred, and as for the organic solvent, alcohol such as ethanol, isopropanol, ethylene glycol, or glycerin is more preferred.

The content of water in the composition (2) is preferably 70% by mass to 99% by mass, more preferably 80% by mass to 98% by mass, further preferably 90% by mass to 95% by mass.

Meanwhile, the content of the organic solvent in the composition (2) is preferably 1% by mass to 30% by mass, more preferably 2% by mass to 20% by

mass, further preferably 3% by mass to 10% by mass.

[0040]

[Other ingredients]

The composition (2) may contain a surfactant other than the sugar-based surfactant, a pH adjuster, or the like.

As for the surfactant other than the sugar-based surfactant, organic acid monoglyceride, propylene glycol fatty acid ester, polysorbate, lecithin, etc. may be exemplified. Among the non-volatile components of the composition (2), the content of these surfactants is preferably 0% by mass to 40% by mass, more preferably 1% by mass to 30% by mass, further preferably 5% by mass to 20% by mass.

As for the pH adjuster, for example, acetic acid, lactic acid, citric acid, ammonia, etc. can be used. From the viewpoint of safety, it is desirable that the content of the pH adjuster is the content by which the pH of the composition (2) becomes 4 to 10, preferably 4 to 8.

[0041]

[Physical properties of composition (2)]

(Non-volatile component concentration)

The non-volatile component concentration in the composition (2) is preferably 1% by mass to 20% by mass, more preferably 2% by mass to 15% by mass, further preferably 3% by mass to 10% by mass. When the non-volatile component concentration falls within the range, it becomes easy to form a coating having a suitable film thickness, so that transpiration from the food product can be effectively suppressed.

In a case where the content of the low fatty acid esters and the high fatty acid esters is outside the range of the composition (2), when the non-volatile component concentration is low (for example, about 0.5% by mass), a problem hardly occurs in the liquid stability and the storage stability. Whereas when it is 1% by mass or more, the liquid stability and the storage stability tend to deteriorate.

[0042]

In the composition (2), the content of the sugar-based surfactant, the pH of the composition and the HLB of the sugar-based surfactant are the same as those in the composition (1).

[0043]

<Composition (3)>

A composition according to a third embodiment of the present invention (hereinafter, also simply referred to as "a composition (3)") includes a sugar-based surfactant and a water-based solvent, and has a surface tension of 34 mN/m or less at 25°C.

Since the composition (3) has the above features, when a coating liquid is applied to the surface of a food product, the drying speed is fast and the appearance after application is also good. A film obtained from the composition (3) is excellent in the water vapor barrier property, and thus is suitable for coating a food product. Further, the film also has an oxygen barrier property, and thus is particularly suitable for coating fruits and vegetables. Preferably, from the film obtained from the composition (3), the water-based solvent is removed as described below.

[0044]

In the composition (3), the main component of the sugar-based surfactant is preferably sugar fatty acid esters.

In the composition (3), in the fatty acids constituting the sugar fatty acid esters, the mass ratio of saturated fatty acids to unsaturated fatty acids may be 50/50 to 99/1.

In the composition (3), in 100% by mass of the sugar fatty acid esters, the content of sugar fatty acid esters having three or less fatty acid ester groups may be 50 to 98% by mass.

In the composition (3), in 100% by mass of the sugar fatty acid esters, the content of sugar fatty acid esters having five or more fatty acid ester groups may be 2 to 50% by mass.

In the composition (3), the non-volatile component concentration may be 0.1% by mass to 20% by mass.

Among the non-volatile components of the composition (3), the content of the sugar-based surfactant may be 60% by mass or more.

In the composition (3), the water-based solvent may be water or a mixture of water and alcohol.

In the composition (3), the content of the alcohol may be 1% by mass to 40% by mass.

The composition (3) may be used for coating fruits and vegetables.

Hereinafter, the composition (3) will be described in detail.

[0045]

(Surface tension)

Since the composition (3) has a surface tension of 34 mN/m or less at 25 °C, wettability is improved after the composition is applied to a food product, and thus, the drying speed gets faster. Further, since the wettability is improved, the coating liquid is prevented from excessively remaining on food products such as fruits and vegetables. Thus, traces of application or whitening of a coating film hardly occur. From the viewpoint, the surface tension at 25°C is more preferably 32 mN/m or less, further preferably 30 mN/m or less.

The lower limit value is not particularly limited, but is usually 10 mN/m or more, preferably 15 mN/m or more, further preferably 20 mN/m or more.

The surface tension can be measured by the method described in Examples.
[0046]

(Defoaming time)

The defoaming time of the composition (3) at 25°C is preferably 60 min or less, more preferably 40 min or less, further preferably 20 min or less, still further preferably 10 min or less. When the defoaming time falls within the range, in a case where bubbles are generated due to liquid transfer, etc. during the coating step, it is possible to prevent traces of bubbles from remaining after drying. The defoaming time is preferably as short as possible, and thus should be 0 min or more.

The defoaming time can be measured by the method described in Examples.

[0047]

[Sugar-based surfactant]

From the same viewpoint as in the composition (2), in the sugar-based surfactant of the composition (3), the main component is preferably sugar fatty acid esters.

Structures of sugar and fatty acids in the sugar fatty acid esters are the same as in the composition (2).

[0048]

In the composition (3), in 100% by mass of the sugar fatty acid esters, the content of sugar fatty acid esters having three or less fatty acid ester groups (low fatty acid esters) is preferably 50 to 98% by mass. From the viewpoint of being able to improve the solubility in the water-based solvent, this ratio is more preferably 60% by mass or more, further preferably 70% by mass or more.

Further, it is more preferably 95% by mass or less, further preferably 90% by mass or less, still further preferably 85% by mass or less, even more preferably 80% by mass or less.

[0049]

Further, in the composition (3), in 100% by mass of the sugar fatty acid esters, the content of sugar fatty acid esters having five or more fatty acid ester groups (high fatty acid esters) is preferably 2 to 50% by mass. From the viewpoint of increasing the stability of the composition, this ratio is preferably 5% by mass or more, more preferably 10% by mass or more. Further, it is preferably 40% by mass or less, more preferably 30% by mass or less, still further preferably 20% by mass or less.

[0050]

Besides the low fatty acid esters and the high fatty acid esters, the composition (3) may contain sugar fatty acid esters (tetraesters) having four fatty acid ester groups.

In 100% by mass of the sugar fatty acid esters, the content of tetraesters may be 0% by mass or more, preferably 5% by mass or more, more preferably 10% by mass or more. Also, it is preferably 48% by mass or less, more preferably 40% by mass or less, further preferably 35% by mass or less.

[0051]

The constituent fatty acids of the sugar fatty acid esters in the composition (3) may be saturated or unsaturated fatty acids, but from the viewpoint of improving the wettability of the composition, and improving the drying speed and the appearance of the coating film, it is more preferable that both saturated fatty acids and unsaturated fatty acids are contained.

Sugar fatty acid esters (a) having saturated fatty acids tend to become a solid at room temperature (20 to 25°C), and thus can suppress the stickiness of the obtained coating. Further, the sugar fatty acid esters (a) tend to take regular structures in the coating, and thus can improve the water vapor barrier property and the oxygen barrier property of the obtained coating.

Meanwhile, sugar fatty acid esters (b) having unsaturated fatty acids tend to easily become a liquid at room temperature (20 to 25°C). As the sugar fatty acid esters (b) are contained, the surface tension of the composition is reduced, so that the drying speed after application gets faster, and traces of the coating liquid hardly remain on the food product.

[0052]

The blending ratio of the sugar fatty acid esters (a) and the sugar fatty acid esters (b) is preferably adjusted according to amounts by which the mass ratio of saturated fatty acids to unsaturated fatty acids is 50/50 to 99/1. The mass ratio is more preferably 50/50 to 90/10, further preferably 50/50 to 80/20, further preferably 55/45 to 70/30.

[0053]

[Water-based solvent and other ingredients]

The water-based solvent and other ingredients in the composition (3) are the same as in the composition (2).

[0054]

[Physical properties of composition (3)]

(Non-volatile component concentration)

The non-volatile component concentration in the composition (3) is not particularly limited, but is preferably 0.1% by mass to 20% by mass, more preferably 0.5% by mass to 15% by mass, further preferably 1% by mass to 10% by mass. When the non-volatile component concentration falls within the range, it becomes easy to form a coating having a suitable film thickness, so that transpiration from the food product can be effectively suppressed. Further, since excessive application of the coating liquid can be prevented, traces of the coating liquid also hardly remain.

[0055]

In the composition (3), the content of the sugar-based surfactant, the pH of the composition, and the HLB of the sugar-based surfactant are the same as those in the compositions (1) and (2).

[0056]

<Coated food product>

A coated food product of the present invention contains a sugar-based surfactant in the coating. The coating is excellent in the water vapor barrier property, and thus can suppress transpiration from the food product, and can maintain the freshness. Further, the coating also has an oxygen barrier property, and thus can also suppress aging caused by respiration especially in fruits and vegetables.

[0057]

The coating does not necessarily need to cover the entire food product, and

may cover only a portion of the food product as long as it can suppress transpiration from the food product and respiration.

For example, when the food product is a fruit or vegetable, the coating may cover only a portion of the fruit or vegetable. The area of the coating is preferably 10% or more of the total surface area of the fruit or vegetable, more preferably 25% or more, further preferably 40% or more, still further preferably 50% or more.

Further, from the viewpoint of maintaining the freshness of fruits and vegetables, it is desirable that the coating covers at least a portion where a large amount of water transpires. As for the portion where a large amount of water transpires, for example, sites such as stomata on the underside of leaves, stems, peduncles, rachises, calyces or roots, or cut surfaces at the time of harvesting may be exemplified.

Furthermore, from the viewpoint of maintaining the freshness without significantly changing the appearance of fruits and vegetables, it is preferable to cover only the portion where a large amount of water transpires.

[0058]

Further, as described above, from the viewpoint of suppressing the stickiness of the obtained coating, and being able to improve the water vapor barrier property and the oxygen barrier property, the sugar-based surfactant preferably has crystallinity.

The presence or absence of crystallinity of the sugar-based surfactant in the coating can be confirmed by the presence or absence of the crystal melting peak temperature measured for the coating. Therefore, in the DSC to be described below, it is desirable that a crystal melting peak derived from the sugar-based surfactant is detected.

The crystal melting peak temperature of the coating is preferably 40°C to 80°C, more preferably 45°C to 70°C. When the crystal melting peak temperature is 40°C or more, the stickiness of the obtained coating can be suppressed. Meanwhile, when the crystal melting peak temperature is 80°C or less, heating can be reduced in the case of dissolution in the water-based solvent, resulting in good productivity.

The crystal melting peak temperature is a temperature at which the crystal melting peak is detected in differential scanning calorimetry (DSC) measurement, in which the measurement is performed at a heating rate of 10°C/min.

[0059]

[Food product]

As for the food product in the present invention, fresh foods such as fruits and vegetables, meat, and fish, and processed foods such as dairy products, and bakery products may be exemplified.

Above all, the coating of the present invention is preferably applied to fruits and vegetables or dairy products whose quality is likely to deteriorate due to transpiration, because it has an excellent water vapor barrier property. Further, it is more preferable that the coating is applied to fruits and vegetables which are subject to aging due to respiration because it also has an oxygen barrier property.

Examples of the fruits and vegetables include: fruits such as apples, cherries, peaches, green plums, citrus fruits (such as oranges, grapefruits, tangerines, and sudachi), persimmons, figs, strawberries, kiwifruit, grapes, blueberries, bananas, mangoes, melons, papayas, lychees, apricots, avocados, cantaloupes, guavas, heavenly peaches, pears (Japanese pears, western pears, etc.), and plums; root vegetables such as radishes, carrots, burdocks, bamboo shoots, sweet potatoes, onions, gingers, taros, and Chinese yams; leaf and stem vegetables such as asparaguses, cabbages, lettuce, spinach, Chinese cabbages, cauliflowers, and broccoli; fruit vegetables such as tomatoes, eggplants, pumpkins, green peppers, and cucumbers; wild vegetables such as brackens, and osmund; fungi such as shiitake mushrooms, king trumpet mushrooms, white beech mushrooms, hon-shimeji mushrooms, enoki mushrooms, and hen of the woods; and cut flowers such as chrysanthemums, roses, and lilies.

Examples of the dairy products include cheese, and butter.

[0060]

[Physical properties of coating]

(Average film thickness)

The average film thickness of the coating of the present invention is preferably 0.1 μm to 10 μm , more preferably 0.5 μm to 5 μm . When the average film thickness is 0.1 μm or more, the water vapor barrier property and the oxygen barrier property are improved. Meanwhile, when the average film thickness is 10 μm or less, the coating can be formed in a state where the texture of the food product is maintained.

In the present invention, the thickness of the coating does not need to be uniform in the entire food product.

The average film thickness of the coating can be obtained from an average value of thicknesses measured for 10 or more randomly selected points after the coated food product is freeze-dried in advance, and then the coating is peeled off and its cross-section is observed with an electron microscope or a metallurgical microscope, etc.

[0061]

(Water vapor barrier property)

In the coating of the present invention, the water vapor transmission rate is preferably 0.1 to 20 g/(m²·day) per 1 μm at 30°C and 50% RH, more preferably 0.5 to 10 g/(m²·day), further preferably 1 to 5 g/(m²·day).

In the case of the coating made of the compositions (2) and (3), the water vapor transmission rate is preferably 0.1 to 30 g/(m²·day) per 1 μm at 30°C and 50% RH, more preferably 0.5 to 20 g/(m²·day), further preferably 1 to 10 g/(m²·day).

When the water vapor transmission rate falls within the range, transpiration from the food product can be suppressed, and freshness can be maintained.

The water vapor transmission rate (WVTR) can be measured by a differential pressure method using a water vapor transmission rate measurement device DELTAPERM on the basis of JIS K7129-5. More specifically, it is a value obtained by converting the value of the water vapor transmission rate measured when the coating is formed on a polyethylene terephthalate film with a thickness of 50 μm, under the conditions of 30°C and 50% RH, into a transmission rate per 1 μm by the following equation.

[0062]

[Formula 1]

$$\text{WVTR per 1 } \mu\text{m of coating film} = \frac{\text{thickness of coating film (}\mu\text{m)}}{\frac{1}{\text{WVTR of PET film having coating film}} - \frac{1}{\text{WVTR of PET film}}}$$

[0063]

(Oxygen barrier property)

In the coating of the present invention, the oxygen transmission rate is preferably 0.1 to 100 cc/(m²·day·atm) per 1 μm at 25°C and 50% RH, more preferably 0.5 to 90 cc/(m²·day·atm), further preferably 1 to 50 cc/(m²·day·atm).

In the case of the coating made of the compositions (2) and (3), the oxygen transmission rate is preferably 0.1 to 1000 cc/(m²·day·atm) per 1 μm at 25 °C and 50% RH, more preferably 0.5 to 700 cc/(m²·day·atm), further preferably 1 to 500 cc/(m²·day·atm).

When the oxygen transmission rate falls within the range, aging caused by respiration of fruits and vegetables can be suppressed, and the freshness can be further maintained.

The oxygen transmission rate (OTR) can be measured by an equal pressure method using an oxygen transmission rate measurement device OX-TRAN2/21 (manufactured by MOCON) on the basis of JIS K7126-2. More specifically, it is a value obtained by converting the value of the oxygen transmission rate measured when the coating is formed on a polyethylene terephthalate film with a thickness of 50 μm under the conditions of 25°C and 50% RH, into a transmission rate per 1 μm by the following equation.

[0064]

[Formula 2]

$$\text{OTR per 1 } \mu\text{m of coating film} = \frac{\text{thickness of coating film } (\mu\text{m})}{\frac{1}{\text{OTR of PET film having coating film}} - \frac{1}{\text{OTR of PET film}}}$$

[0065]

<Manufacturing method of coated food product>

The coated food product of the present invention is produced by a method of applying the composition to a food product, or a method of applying the sugar-based surfactant to a food product with no solvent. After the composition is applied to the food product, drying may be performed.

For the application and drying of the composition, and the solvent-free application of the sugar-based surfactant, the methods described in the "coating formation method" to be described below can be appropriately used.

[0066]

<Coating formation method>

As for the coating formation method of the present invention (hereinafter, also referred to as "the present method"), a method of applying the composition to a food product, or a method of applying the sugar-based surfactant to a food product

with no solvent may be exemplified.

[0067]

[Application of composition]

When the composition is applied to the food product, the application method is not particularly limited, and examples thereof include a method of directly applying a coating liquid to the food product, such as brush coating and curtain coating; an immersion method such as impregnation coating; and a jetting method such as spray coating.

Among these, the immersion method or the jetting method are preferred from the viewpoint of being able to relatively uniformly cover the food surface having a three-dimensional shape.

When the food product is a fruit or vegetable, depending on the type of the fruit or vegetable and the easiness of a coating work, a coating may be formed on the surface of the fruit or vegetable after harvesting, or harvesting may be carried out after a coating is formed on the surface of the fruit or vegetable. In a case where the coating is formed before harvesting, it is desirable that the coating is formed in a stage where the fruit or vegetable has reached a desired degree of maturity.

[0068]

In the present method, it is preferable to apply the composition to a portion of the food product from the viewpoint of shortening the drying time of the composition, and increasing the efficiency of the coating formation treatment.

For example, when the food product is a fruit or vegetable, the composition may be applied to only a portion of the fruit or vegetable. In this case, the application area is preferably 10% or more with respect to the total surface area of the fruit or vegetable, is more preferably 25% or more, further preferably 40% or more, still further preferably 50% or more.

Further, from the viewpoint of maintaining the freshness of the fruits and vegetables, it is desirable to apply the composition to at least a portion where a large amount of water transpires.

From the viewpoint of minimizing the necessary usage amount of the sugar-based surfactant, the composition may be applied to only a portion where a large amount of water transpires.

[0069]

In the present method, after the composition is applied to the food product,

a part of the applied composition may be removed. The removal method is not particularly limited, but examples thereof include removal by wind pressure, which uses an air dryer.

For example, by removing the excess composition on the food surface, it is possible to prevent poor drying in a portion where an excessive amount is applied.

Further, by removing the composition in a part of the food product, it is possible to minimize the necessary usage amount of the sugar-based surfactant.

In a case where the food product is a fruit or vegetable, by covering at least a portion where a large amount of water transpires, it is possible to maintain the freshness. Thus, the composition in other portions may be removed.

Regarding the application method, there is an example described in "Coating Method" published in 1979 (written by Yuji Harasaki, Maki books).

[0070]

[Drying]

After the composition is applied to the food product, the coating may be dried for the purpose of removing the water-based solvent, for example. As for the drying method, for example, static drying, air drying or heat drying may be exemplified, but from the viewpoint of maintaining the freshness of food products, a method of static drying at room temperature (20 to 25°C), or a method of air drying at room temperature is preferable.

[0071]

[Solvent-free application of sugar-based surfactant]

When the sugar-based surfactant is applied to the food product with no solvent, preferred is a method of heating the sugar-based surfactant to a temperature at which liquidity is exhibited (e.g., the melting point of the sugar-based surfactant to the melting point + 30°C), and carrying out application to the food product through curtain coating, spray coating, or the like. In the case of solvent-free application, those made of only the sugar-based surfactant may be applied to the food product, but the sugar-based surfactant mixed with other components (non-volatile components, etc.) than the solvent may be appropriately applied.

[0072]

As in [application of composition], from the viewpoint of increasing the efficiency of the coating formation treatment, it is preferable to apply the sugar-based surfactant to a portion of the food product. Further, after the sugar-based

surfactant is applied to the food product, a part of the applied sugar-based surfactant may be removed.

[0073]

<Food product shipping method>

A food product shipping method of the present invention includes (A) a step of conveying a food product, (B) a step of forming a coating on the food product, and (C) a step of inspecting the coated food product by using an evaluation device, and is characterized in that in the step (B), the coating is formed on the food product by the coating formation method of the present invention. The food product on which the coating has been formed and the inspection has been carried out in this way is shipped to a consumption destination by transportation or the like.

The order of the step (B) and the step (C) in the shipping method may be reversed. That is, there may be an order of the step (A), the step (B), and the step (C), or an order of the step (A), the step (C), and the step (B).

Hereinafter, the order of the step (A), the step (B), and the step (C) will be described in detail as an example on the basis of the image diagram illustrated in Fig. 1.

[0074]

Fig. 1 is an image diagram of the food product shipping method of the present invention. The step (A) of conveying a food product is a step of providing a food product to the step (B). Such a method is not particularly limited, and examples thereof include continuous conveyance using a belt conveyor or the like, and collective conveyance of many food products through a truck or the like.

Fig. 1 illustrates a mode in which a food product 10 is conveyed by using a belt conveyor 11. The food product 10 is placed on the belt conveyor, and then is provided to the step (B) as rotating rolls 12 are rotated.

[0075]

The following step (B) is a step of forming a coating on the food product 10 conveyed in the step (A). In the formation of the coating, the method described in the "coating formation method" can be suitably used.

Fig. 1 illustrates an immersion method which is one of preferable modes. The food product 10 is immersed in an immersion bath 13 filled with the composition of the present invention, and the composition is applied to the surface of the food product. The belt conveyor is provided with food fixing units such as claws, and thus the food product 10 is carried into and out of the immersion bath

in a state where it is fixed. Next, a solvent is removed in a drying furnace 14, and a coating is formed on the food product 10. Meanwhile, the drying furnace 14 may be omitted, and then the food product 10 may be allowed to stand still at room temperature and dried, or in the solvent-free application, drying may be omitted.
[0076]

When the coating is formed only on a portion of the food product in the step (B), it is preferable that the composition is applied or sprayed from above the food product 10 placed on the belt conveyor, prior to the conveying to the drying furnace 14.

Further, the food product 10 may be placed on the belt conveyor and conveyed into the drying furnace 14 while an immersion surface faces upwards, by food gripping units, such as robot hands, after only a portion thereof is immersed in the immersion bath 13.

[0077]

After the food product 10 is immersed in the immersion bath 13, a part of the applied composition may be removed by an air dryer (not illustrated) or the like.

[0078]

Next, the step (C) is a step of inspecting the food product 10 on which the coating is formed in the step (B), by using an evaluation device 15. As the evaluation device, an optical sensor, a weight scale, a camera, etc. can be used.

The inspection in the inspection step (C) include various inspection items, but preferably includes at least one inspection selected from the group consisting of appearance inspection, sugar content inspection, and size inspection.

In the present invention, since the coating has high transparency, no interference is caused in the non-destructive inspection using light, such as sugar content inspection. Thus, it is possible to use conventional inspection methods (e.g., JP 2012-78206A) which have been used for food products, as they are.

[0079]

As described above, coated food products that have been subjected to the conveyance step (A), the coating forming step (B), and the inspection step (C) are shipped by normal means. Fig. 1 illustrates an example of shipping by a shipping vehicle 16.

[Example]

[0080]

Next, the present invention will be described in more detail by Examples. Meanwhile, the present invention is not limited to Examples described below.

[0081]

<Test Examples 1 to 5: Japanese pear (kosui)>

In Test Examples 1 to 5, a coating was formed on the surface of a Japanese pear (kosui) and the freshness retention evaluation was performed.

[0082]

The following materials were dissolved in water in amounts described in Table 1 to prepare compositions of Test Examples 1 to 4.

The compositions of Test Examples 1 to 4 were applied to the surfaces of Japanese pears through an immersion method, and were dried at room temperature (20 to 25°C) for 30 min to form coatings. Further, a Japanese pear on which no coating was formed was used for Test Example 5.

L-1695: sucrose laurate, manufactured by Mitsubishi Chemical Corporation "Ryoto (registered trademark) Sugar Ester L-1695", HLB: about 16, content of mono- to triesters: 96% by mass or more

P-1570: sucrose palmitate, manufactured by Mitsubishi Chemical Corporation "Ryoto (registered trademark) Sugar Ester P-1570", HLB: about 15, content of mono- to triesters: 96% by mass or more

S-570: sucrose stearate, manufactured by Mitsubishi Chemical Corporation "Ryoto (registered trademark) Sugar Ester S-570", HLB: about 5, content of mono- to triesters: 86% by mass or more

S-1670: sucrose stearate, manufactured by Mitsubishi Chemical Corporation "Ryoto (registered trademark) Sugar Ester S-1670", HLB: about 16, content of mono- to triesters: 97% by mass or more

[0083]

[Freshness retention evaluation]

The freshness retention evaluation was performed on the coated Japanese pears of Test Examples 1 to 4, and the Japanese pear of Test Example 5, by the weight retention rate, the hardness retention rate, and the color and taste.

Japanese pears are already sufficiently sweet in their immature state, and are suitable for eating in that state. As Japanese pears ripen, their color changes from green to brown. Furthermore, if the ripening excessively progresses, the original crunchy texture of the Japanese pears is lost, and the commercial value is reduced.

For the reasons, in relation to the Japanese pears, the freshness retention effect was confirmed by the hardness retention rate, the color and the taste in addition to the weight retention rate for confirming transpiration suppression.

[0084]

(Weight retention rate)

For the coated Japanese pears of Test Examples 1 to 4, and the Japanese pear of Test Example 5, the weight retention rates ((weight after storage/weight on day 0) $\times$ 100(%)) after storage at 20°C and 90% RH for 10 days and 14 days were obtained on the basis of the weight of the Japanese pear before storage (day 0).

[0085]

(Hardness retention rate)

For the coated Japanese pears of Test Examples 1 to 4, and the Japanese pear of Test Example 5, the hardness was measured at the time of breakage in the cross-section of the Japanese pear by using a fruit hardness tester KM-5 (manufactured by Fujiwara Seisakusho Co., Ltd.). A fruit hardness tester having a cylindrical tip was used. The hardness retention rate ((hardness after storage for 14 days/hardness on day 0) $\times$ 100(%)) after storage at 20°C and 90% RH for 14 days was obtained on the basis of the hardness of the Japanese pear before storage (day 0).

[0086]

(Color)

For the coated Japanese pears of Test Examples 1 to 4, and the Japanese pear of Test Example 5, the ground color evaluation was performed by using a fruit color chart supervised by the Fruit Tree Experiment Station of the Ministry of Agriculture, Forestry and Fisheries. The evaluation was performed twice before storage (day 0), and after storage at 20°C and 90% RH for 10 days. The evaluation based on this fruit color chart indicates that the larger the numerical value, the more advanced the ripening.

[0087]

(Taste)

For the coated Japanese pears of Test Examples 1 to 4, and the Japanese pear of Test Example 5, a taste test was conducted by four subjects, and the evaluation was performed according to the following criteria. The evaluation was performed twice before storage (day 0) and after storage at 20°C and 90% RH for 14 days. As described above, since the texture of the Japanese pear also affects

the commercial value, the evaluation of B or more was regarded as PASS, and C was regarded as FAILURE. Among evaluations of the four subjects, an evaluation of the largest number of people was filled in Table 1. When there were divided evaluations each of which was made by two people, the poorer evaluation was filled in Table.

A: The texture is the same as that of the Japanese pear as the blank (the state of Test Example 5 on day 0).

B: Japanese pear's original crunchy texture is reduced as compared to that of the blank.

C: There is no crunchy texture at all.

[0088]

Table 1 illustrates the configurations and evaluation results of Test Examples 1 to 5.

[0089]

[Table 1]

		Test Example 1	Test Example 2	Test Example 3	Test Example 4	Test Example 5
Sugar-based surfactant						
L-1695	[wt%]	5	-	-	-	-
P-1570	[wt%]	-	5	-	-	-
S-570	[wt%]	-	-	5	-	-
S-1670	[wt%]	-	-	-	5	-
Thickness of coating	[μm]	1.5	1.5	1.5	1.5	-
Weight retention rate						
0 days	[%]	100	100	100	100	100
10 days	[%]	97.6	97.2	98.0	97.8	97.0
14 days	[%]	96.7	96.2	97.2	96.9	95.7
Hardness retention rate						
0 days	[%]	100	100	100	100	100
14 days	[%]	100	95	75	92	59
Color						
0 days	-	3.0	3.0	3.0	3.0	3.0
10 days	-	4.0	4.0	4.0	4.0	5.0
Taste						
0 days	-	A	A	A	A	A
14 days	-	A	A	B	A	C

[0090]

From Table 1, it was confirmed that the freshness retention effect was obtained by providing a sugar-based surfactant-containing coating to the surface of the Japanese pear, because the coated Japanese pears in Test Examples 1 to 4

were superior to the Japanese pear in Test Example 5 in terms of all of the weight retention rate, the hardness retention rate, the color and the taste.

[0091]

<Test Examples 6 to 10: avocado>

In Test Examples 6 to 10, a coating was formed on the surface of an avocado and the freshness retention evaluation was performed.

[0092]

The following materials were dissolved in water in amounts described in Table 2 to prepare compositions of Test Examples 6 to 9.

The compositions of Test Examples 6 to 9 were applied to the surfaces of avocados through an immersion method, and were dried at room temperature (20 to 25°C) for 30 min to form coatings. Further, an avocado on which no coating was formed was used for Test Example 10.

S-570: The product name and composition are the same as described above.

S-970: sucrose stearate, manufactured by Mitsubishi Chemical Corporation "Ryoto (registered trademark) Sugar Ester S-970", HLB: about 9, content of mono- to triesters: 92% by mass or more

S-1170: sucrose stearate, manufactured by Mitsubishi Chemical Corporation "Ryoto (registered trademark) Sugar Ester S-1170", HLB: about 11, content of mono- to triesters: 94% by mass or more

S-1670: The product name and composition are the same as described above.

[0093]

[Freshness retention evaluation]

The freshness retention evaluation was performed on the coated avocados of Test Examples 6 to 9, and the avocado of Test Example 10, by the weight retention rate, the hardness and the color.

As avocados ripen, they are softened, and their color changes from green to dark purple. These changes of the avocados are easy to notice, and consumers also generally evaluate the freshness of the avocados by the hardness and the color. Thus, in relation to the avocados, the freshness retention effect was confirmed by the hardness and the color in addition to the weight retention rate for confirming the transpiration suppression.

[0094]

(Weight retention rate)

For the coated avocados of Test Examples 6 to 9, and the avocado of Test Example 10, the weight retention rates ((weight after storage/weight on day 0) × 100(%)) after storage at 25°C and 50% RH for 3 days, 8 days, 11 days, and 16 days were obtained on the basis of the weight of the avocado before storage (day 0).

[0095]

(Hardness)

Four coated avocados of each of Test Examples 6 to 9, and four avocados of Test Example 10 were prepared, and the hardness was evaluated when the surface was lightly pressed with a finger.

○ (good): The hardness is the same as or is slightly softer than that of the blank (the state of Test Example 10 on day 0), and thus the deformation is small even when the surface is pressed.

× (bad): It is considerably softer than the blank, and large deformation occurs when the surface is pressed.

The evaluation was performed six times before storage (day 0), and after storage at 25°C and 50% RH for 3 days, 8 days, 11 days, 16 days, and 21 days, and the change of the hardness was evaluated by the following criteria.

A: Samples that can be evaluated as ○ (good) account for more than 75%.

B: Samples that can be evaluated as ○ (good) account for more than 50%, and 75% or less.

C: Samples that can be evaluated as ○ (good) account for more than 25%, and 50% or less.

D: Samples that can be evaluated as ○ (good) account for more than 0%, and 25% or less.

E: There is no sample that can be evaluated as ○ (good) (0%).

[0096]

(Color)

Four coated avocados of each of Test Examples 6 to 9, and four avocados of Test Example 10 were prepared, and the color change was evaluated by the following criteria. The evaluation was performed five times before storage (day 0), and after storage at 25°C and 50% RH for 3 days, 8 days, 11 days, and 16 days, and the color change was evaluated by the following criteria.

A: Samples whose surfaces have completely turned dark purple are not present (0%) or account for less than 25%.

B: Samples whose surfaces have completely turned dark purple account for

25% or more and less than 50%.

C: Samples whose surfaces have completely turned dark purple account for 50% or more and less than 75%.

D: Samples whose surfaces have completely turned dark purple account for 75% or more and less than 100%.

E: Surfaces of all samples are completely dark purple (100%).

[0097]

Table 2 illustrates the configurations and evaluation results of Test Examples 6 to 10.

[0098]

[Table 2]

		Test Example 6	Test Example 7	Test Example 8	Test Example 9	Test Example 10
Sugar-based surfactant						
S-570	[wt%]	5	-	-	-	-
S-970	[wt%]	-	5	-	-	-
S-1170	[wt%]	-	-	5	-	-
S-1670	[wt%]	-	-	-	5	-
Thickness of coating	[μ m]	1.5	1.5	1.5	1.5	-
Weight retention rate						
0 days	[%]	100	100	100	100	100
3 days	[%]	98.7	98.5	99.0	98.3	97.0
8 days	[%]	95.8	95.1	96.9	95.5	91.4
11 days	[%]	94.0	92.9	95.0	93.7	88.1
16 days	[%]	91.0	89.3	93.4	90.4	83.2
Hardness						
0 days	-	A	A	A	A	A
3 days	-	A	A	A	A	A
8 days	-	A	A	A	A	A
11 days	-	A	A	A	A	B
16 days	-	B	B	A	A	C
21 days	-	C	B	A	A	E
Color						
0 days	-	A	A	A	A	A
3 days	-	A	A	A	A	B
8 days	-	C	B	C	A	C
11 days	-	C	B	C	D	C
16 days	-	C	C	D	D	E

[0099]

From Table 2, it was confirmed that the freshness retention effect was obtained by providing a sugar-based surfactant-containing coating to the surface of the avocado because the coated avocados in Test Examples 6 to 9 were superior to the avocado in Test Example 10 in terms of all of the weight retention rate, the hardness and the color change.

[0100]

<Test Examples 11 to 16: persimmon>

In Test Examples 11 to 16, a coating was formed on the surface of a persimmon and the freshness retention evaluation was performed.

[0101]

The following materials were dissolved in water in amounts described in Table 3 to prepare compositions of Test Examples 11 to 15.

The compositions of Test Examples 11 to 15 were applied to the surfaces of persimmons through an immersion method, and were dried at room temperature (20 to 25°C) for 30 min to form coatings. Further, a persimmon on which no coating was formed was used for Test Example 16.

S-570: The product name and composition are the same as described above.

S-1170: The product name and composition are the same as described above.

S-1670: The product name and composition are the same as described above.

[0102]

[Freshness retention evaluation]

The freshness retention evaluation was performed on the coated persimmons of Test Examples 11 to 15, and the persimmon of Test Example 16, by the weight retention rate and the hardness retention rate.

As persimmons ripen, they are softened. Such a change is easy to notice, and consumers also generally evaluate the freshness of the persimmons by the hardness. Thus, in relation to the persimmons, the freshness retention effect was confirmed by the hardness retention rate in addition to the weight retention rate for confirming the transpiration suppression.

[0103]

(Weight retention rate)

For the coated persimmons of Test Examples 11 to 15, and the persimmon of Test Example 16, the weight retention rates ((weight after storage/weight on day 0) × 100(%)) after storage at 25°C and 50% RH for 7 days, 9 days, and 12 days were obtained on the basis of the weight of the persimmon before storage (day 0).

[0104]

(Hardness retention rate)

Six coated persimmons of each of Test Examples 11 to 15, and six persimmons of Test Example 16 were prepared, and the percentage of samples that

passed the following criteria was regarded as the hardness retention rate (reference; journal of horticultural society / vol. 38 (1969) No. 2, relationship between maturation phenomenon and respiration type after fruit harvest (1st report), presence or absence of respiratory climacteric in persimmon fruit, Takashi Iwata, Katsuya Nakagawa, Kuniyasu Ogata).

A: Sufficiently hard.

B: It is very soft as a whole, but is firm.

C: It seems to be ruptured when pressed with a finger, or a part of the pulp becomes water-soaked.

D: It becomes very soft, or a part of the pericarp is ruptured.

Measurement was performed according to this index, and fruits ranked C and D were evaluated as being softened (failed).

[0105]

Table 3 illustrates the configurations and evaluation results of Test Examples 11 to 16.

[0106]

[Table 3]

		Test Example 11	Test Example 12	Test Example 13	Test Example 14	Test Example 15	Test Example 16
Sugar-based surfactant							
S-570	[wt%]	5	-	-	-	-	-
S-1170	[wt%]	-	0.5	2	5	-	-
S-1670	[wt%]	-	-	-	-	5	-
Thickness of coating	[μm]	1.5	0.15	0.6	1.5	1.5	-
Weight retention rate							
0 days	[%]	100	100	100	100	100	100
7 days	[%]	97.1	95.9	96.1	97.3	97.3	94.6
9 days	[%]	96.6	95.0	95.1	96.7	96.6	93.3
12 days	[%]	95.7	93.7	93.9	95.8	95.6	91.6
Hardness retention rate							
0 days	[%]	100	100	100	100	100	100
7 days	[%]	100	83.3	66.7	100	100	66.7
9 days	[%]	83.3	50.0	50.0	100	33.3	33.3
12 days	[%]	50.0	33.3	50.0	100	33.3	16.7

[0107]

From Table 3, it was confirmed that the freshness retention effect was obtained by providing a sugar-based surfactant-containing coating to the surface of the persimmon because the coated persimmons in Test Examples 11 to 15 were superior to the persimmon in Test Example 16 in terms of both the weight retention rate and the hardness retention rate.

[0108]

<Test Examples 17 to 18: sudachi>

In Test Examples 17 to 18, a coating was formed on the surface of a sudachi and the freshness retention evaluation was performed.

[0109]

“Ryoto (registered trademark) Sugar Ester S-1670” manufactured by Mitsubishi Chemical Corporation was dissolved in water in the amount described in Table 4 to prepare a composition of Test Example 17.

The composition of Test Example 17 was applied to the surface of a sudachi through an immersion method, and was dried at room temperature (20 to 25°C) for 30 min to form a coating. Further, a sudachi on which no coating was formed was used for Test Example 18.

[0110]

[Freshness retention evaluation]

The freshness retention evaluation was performed on the coated sudachi of Test Example 17 and the sudachi of Test Example 18, by the weight retention rate and the color.

As sudachi ripen, their color changes from green to yellow. Such a change is easy to notice, and consumers also generally evaluate the freshness of the sudachi by the color. Thus, in relation to the sudachi, the freshness retention effect was confirmed by the color in addition to the weight retention rate for confirming the transpiration suppression.

[0111]

(Weight retention rate)

For the coated sudachi of Test Example 17, and the sudachi of Test Example 18, the weight retention rates ((weight after storage/weight on day 0) × 100(%)) after storage at 15°C and 90% RH for 6 days, 8 days, and 11 days were obtained on the basis of the weight of the sudachi before storage (day 0).

[0112]

(Color)

Five coated sudachi of Test Example 17, and five sudachi of Test Example 18 were prepared, and the color change was evaluated.

○ (good): A green portion equivalent to the blank (the state of Test Example 18 on day 0) accounts for 80% or more in the entire surface.

× (not good): A green portion equivalent to the blank (the state of Test Example 18 on day 0) accounts for less than 80% in the entire surface.

The evaluation was performed four times before storage (day 0), and after storage at 15°C and 90% RH for 6 days, 8 days, and 11 days, and the color change was evaluated by the following criteria.

A: Samples that can be evaluated as ○ (good) account for more than 80%.

B: Samples that can be evaluated as ○ (good) account for more than 60% and 80% or less.

C: Samples that can be evaluated as ○ (good) account for more than 40% and 60% or less.

D: Samples that can be evaluated as ○ (good) account for more than 20% and 40% or less.

E: Samples that can be evaluated as ○ (good) account for 20% or less.

[0113]

Table 4 illustrates the configurations and evaluation results of Test Examples 17 to 18.

[0114]

[Table 4]

		Test Example 17	Test Example 18
Sugar-based surfactant			
S-1670	[wt%]	5	-
Thickness of coating	[μm]	1.5	-
Weight retention rate			
0 days	[%]	100	100
6 days	[%]	98.9	96.2
8 days	[%]	98.4	95.2
11 days	[%]	97.9	93.9
Color			
0 days	-	A	A
6 days	-	A	A
8 days	-	A	C
11 days	-	A	E

[0115]

From Table 4, it was confirmed that the freshness retention effect was obtained by providing a sugar-based surfactant-containing coating to the surface of the sudachi, because the coated sudachi in Test Example 17 was superior to the sudachi in Test Example 18 in terms of both of the weight retention rate and the color change.

[0116]

<Test Examples 19 to 22: water vapor barrier property>

In Test Examples 19 to 22, a coating film was formed on a polyethylene terephthalate film, and the water vapor barrier property was evaluated.

[0117]

[Test Example 19]

"Ryoto (registered trademark) Sugar Ester S-570" manufactured by Mitsubishi Chemical Corporation was dissolved in water such that the content of the sugar-based surfactant became 2% by mass, and then an aqueous composition 5-1 was prepared.

The aqueous composition 5-1 was applied with a #20 bar coater to a PET film (with a thickness of 50 μm , manufactured by TOYOBO CO., LTD.: A4160 type) whose high-smooth surface side had been subjected to corona treatment in advance, and was dried at room temperature (20 to 25°C) for 24 h. Then, a coating film with a thickness (after drying) of 0.74 μm was formed on the PET film.

[0118]

[Test Example 20]

"Ryoto (registered trademark) Sugar Ester S-1670" manufactured by Mitsubishi Chemical Corporation was dissolved in water such that the content of the sugar-based surfactant became 2% by mass, and then an aqueous composition 5-2 was prepared.

A coating film with a thickness of 0.58 μm was formed by using the aqueous composition 5-2 in the same manner as in Test Example 19.

[0119]

[Test Example 21]

The PET film having the coating film obtained in Test Example 20 was heated at 70°C for 15 min, and then was cooled.

[0120]

[Test Example 22]

A PET film on which no coating film was formed was used for Test Example 22.

[0121]

[Water vapor barrier property evaluation]

For the PET films having coating films in Test Examples 19 to 21, and the PET film of Test Example 22, the water vapor transmission rate was measured under conditions of 30°C and 50% RH by using a water vapor transmission rate measurement device DELTAPERM manufactured by Technolox Ltd. on the basis

of the method of JIS K7129-5.

Further, for the PET films having coating films in Test Examples 19 to 21, the water vapor transmission rate per 1 μm of the coating film was obtained by the following equation.

[0122]

[Formula 3]

$$\text{WVTR per 1 } \mu\text{m of coating film} = \frac{\text{thickness of coating film } (\mu\text{m})}{\frac{1}{\text{WVTR of PET film having coating film}} - \frac{1}{\text{WVTR of PET film}}}$$

[0123]

Table 5 illustrates the configurations and evaluation results of Test Examples 19 to 22.

[0124]

[Table 5]

		Test Example 19	Test Example 20	Test Example 21	Test Example 22
Substrate					
Type	-	PET	PET	PET	PET
Thickness	[μm]	50	50	50	50
Coating film					
Sugar-based surfactant	-	S-570	S-1670	S-1670	-
Presence or absence of heating treatment	-	Absence	Absence	Presence	-
Thickness	[μm]	0.74	0.58	0.58	-
Water vapor transmission rate (actual value)	[$\text{g}/\text{m}^2/\text{day}$]	0.87	0.78	0.89	1.19
Water vapor transmission rate per 1 μm of Coating film	[$\text{g}/\text{m}^2/\text{day}$]	2.39	1.31	2.05	-

[0125]

From Table 5, it was confirmed that a sugar-based surfactant-containing coating had a water vapor barrier property, because the PET films having coating films in Test Examples 19 to 21 were superior to the PET film of Test Example 22 in terms of the water vapor barrier property.

Further, in Test Examples 20 and 21, the water vapor barrier property was changed before and after the heating treatment. Since the crystal growth is slow in the sugar-based surfactant (S-1670) used in Test Examples 20 and 21, before the heating treatment, the coating film has a crystal structure of the sugar-based

surfactant in the coating film, whereas after the heating treatment, the coating film does not have a crystal structure of the sugar-based surfactant. Therefore, from the results of Test Examples 20 and 21, it was confirmed that the water vapor barrier property was further improved when the coating film had a crystal structure.

[0126]

<Test Examples 23 to 26: oxygen barrier property>

In Test Examples 23 to 26, a coating film was formed on a polyethylene terephthalate film, and the oxygen barrier property was evaluated.

[0127]

[Test Example 23]

"Ryoto (registered trademark) Sugar Ester S-1170" manufactured by Mitsubishi Chemical Corporation was dissolved in water such that the content of the sugar-based surfactant became 2% by mass, and then an aqueous composition 6-1 was prepared.

The aqueous composition 6-1 was applied with a #20 bar coater to a PET film (with a thickness of 50 μm , manufactured by TOYOBOKO CO., LTD.: A4160 type) whose high-smooth surface side had been subjected to corona treatment in advance, and was dried at room temperature (20 to 25°C) for 24 h. Then, a coating film with a thickness (after drying) of 0.42 μm was formed on the PET film.

[0128]

[Test Example 24]

"Ryoto (registered trademark) Sugar Ester S-1170" manufactured by Mitsubishi Chemical Corporation was dissolved in water such that the content of the sugar-based surfactant became 5% by mass, and then an aqueous composition 6-2 was prepared.

A coating film with a thickness of 0.56 μm was formed by using the aqueous composition 6-2 in the same manner as in Test Example 23.

[0129]

[Test Example 25]

The PET film having the coating film obtained in Test Example 24 was heated at 70°C for 15 min, and then was cooled.

[0130]

[Test Example 26]

A PET film on which no coating film was formed was used for Test Example

26.

[0131]

[Oxygen barrier property evaluation]

For the PET films having coating films in Test Examples 23 to 25, and the PET film of Test Example 26, the oxygen transmission rate was measured under conditions of 25°C and 50% RH by using an oxygen transmission rate measurement device "OX-TRAN2/21" manufactured by MOCON on the basis of JIS K7126-2.

Further, for the PET films having coating films in Test Examples 23 to 25, the oxygen transmission rate per 1 μm of the coating film was obtained by the following equation.

[0132]

[Formula 4]

$$\text{OTR per 1 } \mu\text{m of coating film} = \frac{\text{thickness of coating film } (\mu\text{m})}{\frac{1}{\text{OTR of PET film having coating film}} - \frac{1}{\text{OTR of PET film}}}$$

[0133]

Table 6 illustrates the configurations and evaluation results of Test Examples 23 to 26.

[0134]

[Table 6]

		Test Example 23	Test Example 24	Test Example 25	Test Example 26
Substrate					
Type	-	PET	PET	PET	PET
Thickness	[μm]	50	50	50	50
Coating film					
Sugar-based surfactant	-	S-1170	S-1170	S-1170	-
Presence or absence of heating treatment	-	Absence	Absence	Presence	-
Thickness	[μm]	0.42	0.56	0.56	-
Oxygen transmission rate (actual value)	[cc/m ² /day/atm]	24	20	24	27
Oxygen transmission rate per 1 μm of Coating film	[cc/m ² /day/atm]	91	43	91	-

[0135]

From Table 6, it was confirmed that a sugar-based surfactant-containing coating had an oxygen barrier property, because the PET films having coating films in Test Examples 23 to 25 were superior to the PET film of Test Example 26 in terms of the oxygen barrier property.

Further, in Test Examples 24 and 25, the oxygen barrier property was

changed before and after the heating treatment. Since the crystal growth is slow in the sugar-based surfactant (S-1170) used in Test Examples 24 and 25, before the heating treatment, the coating film has a crystal structure of the sugar-based surfactant in the coating film, whereas after the heating treatment, the coating film does not have a crystal structure of the sugar-based surfactant. Therefore, from the results of Test Examples 24 and 25, it was confirmed that the oxygen barrier property was further improved when the coating film had a crystal structure.

[0136]

<Test Examples 27 to 28: shine muscat>

In Test Examples 27 to 28, a coating was formed on the surface of a shine muscat cluster and the freshness retention evaluation was performed.

[0137]

"Ryoto (registered trademark) Sugar Ester S-1170" manufactured by Mitsubishi Chemical Corporation was dissolved in water in the amount described in Table 7 to prepare a composition of Test Example 27.

The composition of Test Example 27 was applied to the surface of a shine muscat cluster through an immersion method, and was dried at room temperature (20 to 25°C) for 30 min to form a coating. Further, a shine muscat cluster on which no coating was formed was used for Test Example 28.

[0138]

[Freshness retention evaluation]

It is known that the rachis of the shine muscat turns brown as the freshness is reduced. Therefore, for the coated shine muscat of Test Example 27, and the shine muscat of Test Example 28, the freshness retention evaluation was performed by the color of the rachis.

[0139]

(Color)

Eight coated clusters of shine muscats of Test Example 27, and eight clusters of shine muscats of Test Example 28 were prepared, and the color change of the rachis was evaluated.

○ (good): a green portion equivalent to the blank (the state of Test Example 28 on day 0) accounts for 80% or more in the entire surface of the rachis.

× (not good): a green portion equivalent to the blank (the state of Test Example 28 on day 0) accounts for less than 80% in the entire surface of the rachis.

The evaluation was performed five times before storage (day 0), and after storage at 5°C and 50% RH for 13 days, 15 days, 18 days, and 21 days, and the color change was evaluated by the following criteria.

A: samples that can be evaluated as ○ (good) account for more than 75%.

B: samples that can be evaluated as ○ (good) account for more than 50%, and 75% or less.

C: samples that can be evaluated as ○ (good) account for more than 25%, and 50% or less.

D: samples that can be evaluated as ○ (good) account for more than 0%, and 25% or less.

E: there is no sample that can be evaluated as ○ (good) (0%).

[0140]

Table 7 illustrates the configurations and evaluation results of Test Example 27 to 28.

[0141]

[Table 7]

		Test Example 27	Test Example 28
Sugar-based surfactant			
S-1170	[wt%]	5	-
Thickness of coating	[μm]	1.5	-
Color			
0 days	-	A	A
13 days	-	A	B
15 days	-	B	C
18 days	-	C	D
21 days	-	C	D

[0142]

From Table 7, it was confirmed that the freshness retention effect was obtained by providing a sugar-based surfactant-containing coating to the surface of the shine muscat, because the color change of the rachis in the coated shine muscat of Test Example 27 was less than that in the shine muscat of Test Example 28.

[0143]

<Test Examples 29 to 30: Kyoho grape>

In Test Examples 29 to 30, a coating was formed on the surface of a kyoho grape cluster, and the freshness retention evaluation was performed.

[0144]

"Ryoto (registered trademark) Sugar Ester S-1170" manufactured by Mitsubishi Chemical Corporation was dissolved in water in the amount described in Table 8 to prepare a composition of Test Example 29.

The composition of Test Example 29 was applied to the surface of a kyoho grape cluster through an immersion method, and was dried at room temperature (20 to 25°C) for 30 min to form a coating. Further, a kyoho grape cluster on which no coating was formed was used for Test Example 30.

[0145]

[Freshness retention evaluation]

It is known that the rachis of the kyoho grape turns brown as the freshness is reduced. Therefore, for the coated kyoho grape of Test Example 29, and the kyoho grape of Test Example 30, the freshness retention evaluation was performed by the color of the rachis.

[0146]

(Color)

Six coated clusters of kyoho grapes of Test Example 29, and six clusters of kyoho grapes of Test Example 30 were prepared, and the color change of the rachis was evaluated.

○ (good): A green portion equivalent to the blank (the state of Test Example 30 on day 0) accounts for 80% or more in the entire surface of the rachis.

× (not good): A green portion equivalent to the blank (the state of Test Example 30 on day 0) accounts for less than 80% in the entire surface of the rachis.

The evaluation was performed four times before storage (day 0), and after storage at 5°C and 50% RH for 10 days, 13 days, and 16 days, and the color change was evaluated by the following criteria.

A: Samples that can be evaluated as ○ (good) account for more than 80%.

B: Samples that can be evaluated as ○ (good) account for more than 60% and 80% or less.

C: Samples that can be evaluated as ○ (good) account for more than 40% and 60% or less.

D: Samples that can be evaluated as ○ (good) account for more than 20% and 40% or less.

E: Samples that can be evaluated as ○ (good) account for 20% or less.

[0147]

Table 8 illustrates the configurations and evaluation results of Test Examples 29 to 30.

[0148]

[Table 8]

		Test Example 29	Test Example 30
Sugar-based surfactant			
S-1170	[wt%]	5	-
Thickness of coating	[μm]	1.5	-
Color			
0 days	-	A	A
10 days	-	A	A
13 days	-	A	D
16 days	-	C	E

[0149]

From Table 8, it was confirmed that the freshness retention effect was obtained by providing a sugar-based surfactant-containing coating to the surface of the kyoho grape, because the color change of the rachis in the coated kyoho grape of Test Example 29 was less than that in the kyoho grape of Test Example 30.

[0150]

<Test Examples 31 to 33: strawberry>

In Test Examples 31 to 33, a coating was formed on the surface of a strawberry (Kaorino) and the freshness retention evaluation was performed.

[0151]

The following materials were dissolved in water in amounts described in Table 9 to prepare compositions of Test Examples 31 to 32.

The compositions of Test Examples 31 to 32 were applied to the surfaces of strawberries through an immersion method, and were dried at room temperature (20 to 25°C) for 30 min to form coatings. Further, a strawberry on which no coating was formed was used for Test Example 33.

P-1570: the product name and composition are the same as described above.

S-1670: the product name and composition are the same as described above.

[0152]

[Freshness retention evaluation]

The freshness retention evaluation was performed on the coated

strawberries of Test Examples 31 and 32, and the strawberry of Test Example 33, by the gloss retention rate, the calyx freshness and the weight retention rate.

It is known that the surface gloss of the strawberry is lost and the calyx withers as the freshness is reduced. Therefore, the freshness retention effect was confirmed by the gloss retention rate and the calyx freshness in addition to the weight retention rate for confirming transpiration suppression.

[0153]

(Gloss retention rate)

16 coated strawberries of each of Test Examples 31 and 32, and 16 strawberries of Test Example 33 were prepared, and the change of the surface gloss was evaluated.

○ (good): A glossy portion equivalent to the blank (the state of Test Example 33 on day 0) accounts for 80% or more in the entire surface of the strawberry.

× (not good): A glossy portion equivalent to the blank (the state of Test Example 33 on day 0) accounts for less than 80% in the entire surface of the strawberry.

The evaluation was performed four times before storage (day 0) and after storage at 5°C and 50% RH for 3 days, 7 days, and 9 days, and the change of surface gloss was evaluated by the following criteria.

A: Samples that can be evaluated as ○ (good) account for more than 80%.

B: Samples that can be evaluated as ○ (good) account for more than 60% and 80% or less.

C: Samples that can be evaluated as ○ (good) account for more than 40% and 60% or less.

D: Samples that can be evaluated as ○ (good) account for more than 20% and 40% or less.

E: Samples that can be evaluated as ○ (good) account for 20% or less.

[0154]

(Calyx freshness)

16 coated strawberries of each of Test Examples 31 and 32, and 16 strawberries of Test Example 33 were prepared, and the change of the calyx freshness was evaluated.

○ (good): in one strawberry, the number of twisted sepals of the calyx is one or less.

× (not good): in one strawberry, the number of twisted sepals of the calyx is

more than one.

The evaluation was performed four times before storage (day 0), and after storage at 5°C and 50% RH for 3 days, 7 days, and 9 days, and the change of the calyx freshness was evaluated by the following criteria.

A: Samples that can be evaluated as ○ (good) account for more than 80%.

B: Samples that can be evaluated as ○ (good) account for more than 60% and 80% or less.

C: Samples that can be evaluated as ○ (good) account for more than 40% and 60% or less.

D: Samples that can be evaluated as ○ (good) account for more than 20% and 40% or less.

E: Samples that can be evaluated as ○ (good) account for 20% or less.

[0155]

(Weight retention rate)

For the coated strawberries of Test Examples 31 and 32, and the strawberry of Test Example 33, the weight retention rates ((weight after storage/weight on day 0) × 100(%)) after storage at 5°C and 50% RH for 3 days, 7 days, and 9 days were obtained on the basis of the weight of the strawberry before storage (day 0).

[0156]

Table 9 illustrates the configurations and evaluation results of Test Examples 31 to 33.

[0157]

[Table 9]

		Test Example 31	Test Example 32	Test Example 33
Sugar-based surfactant				
P-1570	[wt%]	5	-	-
S-1670	[wt%]	-	5	-
Thickness of coating	[μm]	1.5	1.5	-
Gloss retention rate				
0 days	-	A	A	A
3 days	-	A	A	A
7 days	-	A	A	D
9 days	-	A	A	E
Calyx freshness				
0 days	-	A	A	A
3 days	-	A	A	B
7 days	-	C	C	D
9 days	-	D	E	E
Weight retention rate				

0 days	[%]	100	100	100
3 days	[%]	96.0	96.0	89.8
7 days	[%]	91.4	91.4	78.4
9 days	[%]	88.9	88.9	72.3

[0158]

From Table 9, it was confirmed that the freshness retention effect was obtained by providing a sugar-based surfactant-containing coating to the surface of the strawberry, because in the coated strawberries in Test Examples 31 and 32, the gloss and the calyx freshness were maintained, and the weight retention rate was also excellent, as compared to in the strawberry of Test Example 33.

[0159]

<Test Examples 34 to 42: partial coating>

In Test Examples 34 to 42, in a case where coatings were partially formed on avocados, persimmons, and strawberries (beni hoppe), the influence on the efficiency of a coating formation treatment, and the freshness retention effect was evaluated.

[0160]

[Test Example 34]

"Ryoto (registered trademark) Sugar Ester S-1670" manufactured by Mitsubishi Chemical Corporation was dissolved in water such that the content of the sugar-based surfactant became 3% by mass, and then an aqueous composition 10-1 was prepared.

The aqueous composition 10-1 was applied to the entire surface of an avocado through an immersion method, and was allowed to stand still at room temperature (20 to 25°C). Then, the time (drying time) required for the coating film to become non-sticky on the entire surface was determined.

[0161]

[Test Example 35]

An avocado was allowed to stand still, and the aqueous composition 10-1 was sprayed from above to such an extent that the surface got wet. Then, a coating film was formed only on the half of the avocado surface (50% or more of the total surface area). It was allowed to stand still at room temperature (20 to 25°C), and the time (drying time) required for the coating film to become non-sticky on the entire surface was determined.

[0162]

[Test Example 36]

An avocado on which no coating was formed was used for Test Example 36.

[0163]

[Freshness retention evaluation (avocado)]

For the coated avocados of Test Examples 34 to 35, and the avocado of Test Example 36, the freshness retention evaluation was performed by the weight retention rate, the hardness, and the color, in accordance with the same criteria as in Test Examples 6 to 10.

[0164]

[Test Example 37]

"Ryoto (registered trademark) Sugar Ester S-1170" manufactured by Mitsubishi Chemical Corporation was dissolved in water such that the content of the sugar-based surfactant became 5% by mass, and then, an aqueous composition 10-2 was prepared.

The aqueous composition 10-2 was applied to the entire surface of an persimmon through an immersion method, and was allowed to stand still at room temperature (20 to 25°C). Then, the time (drying time) required for the coating film to become non-sticky on the entire surface was determined.

[0165]

[Test Example 38]

A persimmon was immersed in the aqueous composition 10-2 with a calyx portion facing downwards, so that a coating film was formed only around the calyx. It was allowed to stand still at room temperature (20 to 25°C), and the time (drying time) required for the coating film to become non-sticky on the entire surface was determined.

[0166]

[Test Example 39]

A persimmon on which no coating was formed was used for Test Example 39.

[0167]

[Freshness retention evaluation (persimmon)]

For the coated persimmons of Test Examples 37 to 38, and the persimmon of Test Example 39, the freshness retention evaluation was performed by the weight retention rate and the hardness retention rate in accordance with the same criteria as in Test Examples 11 to 16.

[0168]

[Test Example 40]

The aqueous composition 10-1 was applied to the entire surface of a strawberry through an immersion method, and was allowed to stand still at room temperature (20 to 25°C). Then, the time (drying time) required for the coating film to become non-sticky on the entire surface was determined.

[0169]

[Test Example 41]

A strawberry was allowed to stand still, and the aqueous composition 10-1 was sprayed from above to such an extent that the surface got wet. Then, a coating film was formed only on the half of the strawberry surface (50% or more of the total surface area). It was allowed to stand still at room temperature (20 to 25°C), and the time (drying time) required for the coating film to become non-sticky on the entire surface was determined.

[0170]

[Test Example 42]

A strawberry on which no coating was formed was used for Test Example 42.

[0171]

[Freshness retention evaluation (strawberry)]

For the coated strawberries of Test Examples 40 and 41, and the strawberry of Test Example 42, the freshness retention evaluation was performed by the weight retention rate.

[0172]

(Weight retention rate)

For the coated strawberries of Test Examples 40 and 41, and the strawberry of Test Example 42, the weight retention rates ((weight after storage/weight on day 0) × 100(%)) after storage at 5°C and 80% RH for 4 days, 7 days, and 10 days were obtained on the basis of the weight of the strawberry before storage (day 0).

[0173]

Table 10 illustrates the configurations and evaluation results of Test Examples 34 to 42.

[0174]

[Table 10]

	Test Example 34	Test Example 35	Test Example 36	Test Example 37	Test Example 38	Test Example 39	Test Example 40	Test Example 41	Test Example 42
Sugar-based surfactant									
S-1670	3	3	-	-	-	-	3	3	-
S-1170	-	-	-	5	5	-	-	-	-
coated portion	Entire surface	Half surface	-	Entire surface	Around calyx	-	Entire surface	Half surface	-
Drying time	90	10	-	90	60	-	90	10	-
Weight retention rate (avocado)									
0 days	100	100	100	-	-	-	-	-	-
3 days	98.3	98.0	97.6	-	-	-	-	-	-
6 days	96.4	95.8	94.8	-	-	-	-	-	-
8 days	94.5	93.6	92.5	-	-	-	-	-	-
Hardness (avocado)									
0 days	A	A	A	-	-	-	-	-	-
3 days	A	A	A	-	-	-	-	-	-
6 days	A	B	D	-	-	-	-	-	-
8 days	D	C	E	-	-	-	-	-	-
Color (avocado)									
0 days	A	A	A	-	-	-	-	-	-
1 day	B	B	C	-	-	-	-	-	-
3 days	C	C	D	-	-	-	-	-	-
6 days	D	D	E	-	-	-	-	-	-
Weight retention rate (persimmon)									
0 days	-	-	-	100	100	100	-	-	-
7 days	-	-	-	97.6	96.2	95.6	-	-	-
10 days	-	-	-	96.9	95.2	94.5	-	-	-
14 days	-	-	-	95.6	93.2	92.4	-	-	-
Hardness retention rate (persimmon)									
0 days	-	-	-	100	100	100	-	-	-
7 days	-	-	-	100	100	100	-	-	-
10 days	-	-	-	100	100	83.3	-	-	-
14 days	-	-	-	100	83.3	50.0	-	-	-
Weight retention rate (strawberry)									
0 days	-	-	-	-	-	-	100	100	100
4 days	-	-	-	-	-	-	97.7	97.0	96.1
7 days	-	-	-	-	-	-	95.3	94.8	92.6
10 days	-	-	-	-	-	-	93.7	93.0	89.6

[0175]

From Table 10, it was confirmed that as compared to in Test Examples 34, 37 and 40 in which coatings were entirely formed on the avocado, the persimmon and the strawberry, in Test Examples 35, 38 and 41 in which coatings were partially formed, the drying time can be shortened, and the efficiency of the coating formation treatment was high. It is thought that this is because if a coating is entirely formed, a liquid puddle is formed on the bottom surface during standing still, and it takes time for the coating film to dry.

Further, it was confirmed that the freshness retention effect was obtained even if the coating is present only on a part of the avocado, the persimmon and the strawberry, because even Test Examples 35, 38 and 41 in which coatings were partially formed were more excellent than Test Examples 36, 39 and 42 from the viewpoint of the weight retention rate, the hardness and the color.

[0176]

<Test Examples 43 to 52: liquid stability>

In Test Examples 43 to 52, the liquid stability of a composition was evaluated.

[0177]

The following materials were blended in amounts described in Table 11 to prepare compositions of Test Examples 43 to 47 and Test Examples 49 to 52. Specifically, corresponding sugar-based surfactants (non-volatile components) were dissolved in a water-based solvent containing ethanol and water at 73°C so as to have contents noted in Table 11, and then were allowed to stand still at room temperature (25°C) for 2 h to prepare coating liquids (compositions). The used materials are as follows.

S-1670; sucrose stearate, manufactured by Mitsubishi Chemical Corporation "Ryoto (registered trademark) Sugar Ester", HLB of about 16

P-1670; sucrose palmitate, manufactured by Mitsubishi Chemical Corporation "Ryoto (registered trademark) Sugar Ester", HLB of about 16

S-170; sucrose stearate, manufactured by Mitsubishi Chemical Corporation "Ryoto (registered trademark) Sugar Ester", HLB of about 1

O-170; sucrose oleate, manufactured by Mitsubishi Chemical Corporation "Ryoto (registered trademark) Sugar Ester", HLB of about 1

ER-290; sucrose erucate, manufactured by Mitsubishi Chemical Corporation "Ryoto (registered trademark) Sugar Ester", HLB of about 2

In Table 11, the content of sugar fatty acid esters having three or less fatty acid ester groups is described in the "low fatty acid ester" column, and the content of sugar fatty acid esters having five or more fatty acid ester groups is described in the "high fatty acid ester" column. This content is a value that is obtained through calculation from the value of the number of fatty acid ester groups measured according to the METHOD OF ASSAY from each of the products, and the blending ratio of each product.

[0178]

[Evaluation]

(Sediment or floating matter)

For the coating liquids (compositions) of Test Examples 43 to 47 and Test Examples 49 to 52 immediately after preparation and after standing still for 4 days, the presence or absence of the sediment or floating matter was visually evaluated. The evaluation criteria are as follows.

A (very good): there is no sediment or floating matter at all, and the transparency of the liquid is uniform.

B (good): the sediment or floating matter is slightly observed, but the transparency of the liquid is uniform (80% or more).

C (poor): the sediment or floating matter is slightly observed, but the boundary between the liquid phase and the sediment or floating matter is ambiguous.

D (very poor): clear sediment or floating matter is observed, and the liquid phase and the sediment or floating matter are clearly separated.

[0179]

(Appearance of coating film)

The coating liquids (compositions) of Test Examples 43 to 47 and Test Examples 49 to 52 were applied to strawberries through an immersion method, and after standing still and drying at room temperature (20 to 25°C), the appearance was visually evaluated. The evaluation criteria are as follows.

A (very good): the number of fruits on which traces of application remain or whose surfaces are whitened accounts for less than 5%.

B (good): the number of fruits on which traces of application remain or whose surfaces are whitened accounts for 5% or more and less than 50%.

C (poor): the number of fruits on which traces of application remain or whose surfaces are whitened accounts for 50% or more.

[0180]

Regarding the oxygen barrier property and the water vapor barrier property, the evaluation was performed in the same manner as in Test Examples 19 to 22 and Test Examples 23 to 26.

[0181]

(Weight retention rate)

For grapes coated with the coating liquids (compositions) of Test Examples 43 to 47 and Test Example 49 through an immersion method, and a grape of Test Example 48 (no coating), the weight retention rates ((weight after storage/weight on day 0) $\times$ 100(%)) after storage at 12°C and 80% RH for 5 days, 12 days, and 24 days were obtained on the basis of the weight of the grape before storage (day 0).

[0182]

[Table 11]

		Test Example 43	Test Example 44	Test Example 45	Test Example 46	Test Example 47	Test Example 48	Test Example 49	Test Example 50	Test Example 51	Test Example 52
Sugar-based surfactant											
S-1670	[part by mass]	80	70	70	80	70	-	-	30	30	100
P-1670	[part by mass]	-	-	-	-	-	-	10	-	-	-
S-170	[part by mass]	20	-	-	20	-	-	90	-	-	-
O-170	[part by mass]	-	30	-	-	-	-	-	70	-	-
ER-290	[part by mass]	-	-	30	-	30	-	-	-	70	-
Low fatty acid ester	[wt%]	80.9	72.0	76.6	80.9	76.6	-	20.2	37.0	47.6	98.3
High fatty acid ester	[wt%]	13.3	19.9	13.1	13.3	13.1	-	59.8	46.2	30.5	-
Non-volatile component concentration	[wt%]	3	3	3	5	5	-	3	3	3	3
Ethanol	[wt%]	5	5	5	5	5	-	5	5	5	5
Water	[wt%]	92	92	92	90	90	-	92	92	92	92
Sedimentation											
Immediately after preparation		A	A	A	B	A	-	D	D	D	A
After 4 days		B	A	A	B	A	-	D	D	D	C
Appearance of coating film		B	A	A	B	A	-	C	C	B	B
Oxygen transmission rate per 1 μm of coating film	[cc/m ² /day/atm]	134.9	472.5	683.9	102.0	373.6	-	772.7	543.1	1809	32.6
Water vapor transmission rate per 1 μm of coating film	[g/m ² /day]	9.1	4.9	27.1	5.5	5.8	-	4.5	5.6	4.2	5.7
Weight retention rate											
0 days	-	100.0	100.0	100.0	100.0	100.0	100.0	100.0	-	-	-
5 days	-	99.2	99.1	99.0	99.0	99.2	98.9	99.1	-	-	-
12 days	-	98.4	97.9	98.0	97.9	98.3	97.3	97.6	-	-	-
24 days	-	97.5	96.4	96.6	96.9	96.9	95.5	95.8	-	-	-

[0183]

From the results of Table 11, it was proved that both immediately after preparation and after standing still for 4 days, in the compositions of Test Examples 43 to 47, there was little sediment or floating matter, the transparency of the liquid was almost uniform, and the stability of the liquid was high. Further, it was suggested that the coatings made of the compositions of Test Examples 43 to 47 have sufficient freshness retention performance, because they had oxygen barrier properties and water vapor barrier properties, and thus it was possible to suppress transpiration from grapes as compared to in Test Example 48.

Meanwhile, in Test Examples 49 to 51 in which the content of sugar fatty acid esters having three or less fatty acid ester groups was less than 50% by mass, in any case immediately after preparation, or after standing still for 4 days, clear sediment or floating matter was observed, and the liquid phase and the sediment or floating matter were clearly separated. That is, it can be seen that the liquid stability is poor. Further, in Test Example 52 in which the content of sugar fatty acid esters having three or less fatty acid ester groups was more than 98% by mass, immediately after preparation, the liquid stability was high, but after standing still for 4 days, sediment or floating matter was slightly observed.

[0184]

<Test Examples 53 to 62: drying speed>

In Test Examples 53 to 62, the drying speed of a coating liquid was evaluated.

[0185]

The following materials were blended in amounts described in Table 12 to prepare compositions of Test Examples 53 to 56 and Test Examples 58 to 62. Specifically, corresponding sugar-based surfactants (non-volatile components) were dissolved in a water-based solvent containing ethanol and water at 73°C so as to have contents described in Table 12, and then were allowed to stand still at room temperature (25°C) for 2 h to prepare coating liquids (compositions). The used materials are the same as in Test Examples 43 to 52.

The contents of "saturated fatty acid" and "unsaturated fatty acid" in Table 12 are values obtained through calculation from the type of the constituent fatty acid of each product, the value of the number of fatty acid ester groups in each product, and the blending ratio of each product.

[0186]

[Evaluation]

(Surface tension)

The surface tension of the composition was measured by using a surface tension meter (manufactured by Kyowa Interface Science Co., Ltd.: high-performance surface tension meter DyneMaster "DY-500"), under the condition of 25°C, through a Wilhelmy method using a platinum plate. The measurement was performed three times, and the average value was obtained.

[0187]

(Defoaming time)

15 mL of the composition was placed in a 50 mL glass bottle, and the glass bottle was strongly shaken up and down ten times under the condition of 25°C to generate bubbles on the surface of the composition. The time until bubbles disappeared and the liquid level was confirmed when the glass bottle was seen from above was measured. A shorter defoaming time indicates that traces of bubbles hardly remain even after drying when bubbles are generated due to liquid transfer, etc. in the coating step. In Test Examples 55 and 56, since bubbles disappeared immediately after the glass bottle was shaken, "<1" is written.

[0188]

(Drying speed)

The coating liquids (compositions) of Test Examples 53 to 56 and Test Examples 58 to 62 were applied to strawberries through an immersion method, and the time required for drying under conditions of a temperature of 25°C and a humidity of 25% RH was determined. Whether the drying was completed was judged by the presence or absence of the stickiness when the surface was touched with a finger. That is, it was assumed that the drying was completed when there was no stickiness.

[0189]

(Appearance of coating film)

The appearance of the strawberries subjected to the drying speed test was visually evaluated. The evaluation criteria are as follows.

A (very good): the number of fruits on which traces of application remain or whose surfaces are whitened accounts for less than 5%.

B (good): the number of fruits on which traces of application remain or whose surfaces are whitened accounts for 5% or more and less than 50%.

C (poor): the number of fruits on which traces of application remain or

whose surfaces are whitened accounts for 50% or more.

[0190]

Regarding the oxygen barrier property and the water vapor barrier property, the evaluation was performed in the same manner as in Test Examples 19 to 22 and Test Examples 23 to 26.

[0191]

(Weight retention rate)

For grapes coated with the coating liquids (compositions) of Test Examples 53 to 56, Test Examples 58 to 59 and Test Example 61 through an immersion method, and a grape of Test Example 57 (no coating), the weight retention rates ((weight after storage/weight on day 0) $\times$ 100(%)) after storage at 12 °C, and 80% RH for 5 days, 12 days, and 24 days were obtained on the basis of the weight of the grape before storage (day 0).

[0192]

[Table 12]

	Test Example 53	Test Example 54	Test Example 55	Test Example 56	Test Example 57	Test Example 58	Test Example 59	Test Example 60	Test Example 61	Test Example 62
Sugar-based surfactant										
S-1670	70	70	70	70	-	-	80	100	100	100
P-1670	-	-	-	-	-	10	-	-	-	-
S-170	-	-	-	-	-	90	20	-	-	-
O-170	-	30	-	-	-	-	-	-	-	-
ER-290	30	-	30	30	-	-	-	-	-	-
Low fatty acid ester	76.6	72.0	76.6	76.6	-	20.2	80.9	98.3	98.3	98.3
High fatty acid ester	13.1	19.9	13.1	13.1	-	59.8	13.3	-	-	-
Saturated fatty acid	59.7	59.8	59.7	59.7	-	100	100	100	100	100
Unsaturated fatty acid	40.3	40.2	40.3	40.3	-	0	0	0	0	0
Non-volatile component concentration	1	3	3	5	-	3	3	1	3	5
Ethanol	5	5	5	5	-	5	5	5	5	5
Water	94	92	92	90	-	92	92	94	92	90
Surface tension	27	28.6	31.4	28.4	-	34.4	35.1	34.7	35	34.9
Defoaming time	5	5	<1	<1	-	75	1260	1260	>1440	>1440
Drying speed	30	40	40	45	-	60	70	60	60	90
Appearance of coating film	A	A	A	A	-	C	B	B	B	C
Oxygen transmission rate per 1 μm of coating film	735.6	472.5	683.9	373.6	-	772.2	134.9	108.7	32.6	47.1
Water vapor transmission rate per 1 μm of coating film	7.6	4.9	27.1	5.8	-	4.5	9.1	5.8	5.7	5.4
Weight retention rate										
0 days	100	100.0	100.0	100.0	100.0	100.0	100.0	-	100	-
5 days	98.9	99.1	99.0	99.2	98.9	99.1	99.2	-	98.9	-
12 days	98.0	97.9	98.0	98.3	97.3	97.6	98.4	-	98.0	-
24 days	96.8	96.4	96.6	96.9	95.5	95.8	97.5	-	96.1	-

[0193]

In the results of Table 12, the coating liquids (compositions) with a surface tension of 34 mN/m or less in Test Examples 53 to 56 had a short defoaming time, and a fast drying speed, and thus the number of fruits on which traces of application remain or whose surfaces are whitened was very small (less than 5%), so that a very good application appearance was seen. Further, it was suggested that the coatings made of the compositions of Test Examples 53 to 56 have sufficient freshness retention performance, because they had oxygen barrier properties and water vapor barrier properties, and thus it was possible to suppress transpiration from grapes as compared to in Test Example 57.

Meanwhile, the coating liquids (compositions) in Test Examples 58 to 62 had a long defoaming time, and a slow drying speed, and thus the number of fruits on which traces of application remain or whose surfaces are whitened was 5% or more and less than 50% or was 50% or more, so that the application appearance was greatly inferior to that in Examples.

[0194]

From Test Examples 1 to 18 and Test Examples 27 to 62 above, it was confirmed that the freshness of a food product could be maintained by providing a sugar-based surfactant-containing coating to the surface of the food product.

From Test Examples 19 to 22, it was confirmed that the sugar-based surfactant-containing coating had a high water vapor barrier property, and it was presumed that the freshness of the food product was maintained due to the high water vapor barrier property of this coating. Further, from Test Examples 23 to 26, it was confirmed that the sugar-based surfactant-containing coating also had a good oxygen barrier property, and it was presumed that the respiration of fruits and vegetables was suppressed due to the oxygen barrier property of this coating, and the freshness of the food product was further maintained.

From Test Examples 34 to 42, it was confirmed that by forming a coating only on a portion of the food product, it was possible to maintain the freshness of the food product while increasing the efficiency of the coating formation treatment.

From Test Examples 43 to 52, it was confirmed that the liquid stability was improved by a composition in which the content of low fatty acid esters was 50 to 98% by mass in 100% by mass of sugar fatty acid esters, and the content of high fatty acid esters was 2 to 50% by mass.

From Test Examples 53 to 62, it was confirmed that since the composition

with a surface tension of 34 mN/m or less had a fast drying speed, the appearance after application was also improved.

[0195]

In the present invention, the composition for forming a coating has a simple configuration, and contains a sugar-based surfactant usable as a food product, and thus has an advantage of safety in terms of food hygiene.

Further, in the present invention, since a gas barrier property is given by directly providing a coating to a food product, there is no need to use a packaging film made of resin unlike in the past. Thus, there is an advantage in that a filmless state may be achieved, resulting in reduction of the environmental load.

Industrial Applicability

[0196]

The coated food product of the present invention can keep the freshness for a long period of time because it has a coating with a high water vapor barrier property, and thus the transpiration from the food product can be suppressed. The coating also has an oxygen barrier property, and thus, can also suppress aging caused by respiration especially in fruits and vegetables.

Further, in the present invention, since a coating having a freshness retention performance is directly provided to the food product, plastic packaging materials are not required unlike in the past. Then, a filmless state may be achieved, which greatly contributes to the reduction of the environmental load.

Further, as described above, the composition of the present invention, which is for forming a coating film with a high freshness retention, has a good liquid stability, and is excellent in handleability, and furthermore, can make it difficult for traces of application to occur on the food product. Thus, it is possible to maintain the appearance of the food product.

Reference Signs List

[0197]

1: Food Product Shipping System, 10: Food Product, 11: Belt Conveyor, 12: Rotating Roll, 13: Immersion Bath, 14: Drying Furnace, 15: Evaluation Device, 16: Shipping Vehicle

CLAIMS

[Claim 1]

A composition comprising a sugar-based surfactant and a water-based solvent,

wherein a main component of the sugar-based surfactant is a sugar fatty acid ester, and in 100% by mass of the sugar fatty acid ester, a content of a sugar fatty acid ester having three or less fatty acid ester groups is 50 to 98% by mass, and a content of a sugar fatty acid ester having five or more fatty acid ester groups is 2 to 50% by mass.

[Claim 2]

A composition comprising a sugar-based surfactant and a water-based solvent, wherein a surface tension at 25°C is 34 mN/m or less.

[Claim 3]

A coated food product having a coating containing a sugar-based surfactant, wherein the coating covers only a portion of the food product.

[Claim 4]

A method of manufacturing a coated food product, the method comprising:
applying a composition containing a sugar-based surfactant and a water-based solvent to a portion of the food product, or

applying a sugar-based surfactant with no solvent to a portion of the food product.

[Claim 5]

A method of manufacturing a coated food product, the method comprising:
applying a composition containing a sugar-based surfactant and a water-based solvent to the food product, or applying a sugar-based surfactant with no solvent to the food product; and

removing a part of the applied composition or sugar-based surfactant.

[Claim 6]

The composition according to claim 2, wherein a main component of the sugar-based surfactant is a sugar fatty acid ester.

[Claim 7]

The composition according to claim 1, wherein saturated fatty acids account for 50% by mass or more in fatty acids constituting the sugar fatty acid ester.

[Claim 8]

The composition according to claim 1 or 6, wherein in fatty acids constituting the sugar fatty acid esters, a mass ratio of saturated fatty acids to unsaturated fatty acids is 50/50 to 99/1.

[Claim 9]

The composition according to any one of claims 1, 2, and 6 to 8, wherein among non-volatile components of the composition, a content of the sugar-based surfactant is 60% by mass or more.

[Claim 10]

The composition according to any one of claims 1, 2, and 6 to 9, wherein the water-based solvent is water or a mixture of water and alcohol.

[Claim 11]

The composition according to any one of claims 1, 2, and 6 to 10, which is used for coating fruits and vegetables.

[Claim 12]

The coated food product according to claim 3, wherein the sugar-based surfactant is a sucrose fatty acid ester.

[Claim 13]

The coated food product according to claim 12, wherein a lipophilic group of the sugar-based surfactant is a saturated fatty acid.

[Claim 14]

The coated food product according to claim 12 or 13, wherein when a total amount of the sugar-based surfactant is 100% by mass, a content of a sugar fatty acid ester having three or less fatty acid ester groups is 50% by mass or more.

[Claim 15]

The coated food product according to any one of claims 12 to 14, wherein an HLB of the sugar-based surfactant is 5 or more.

[Claim 16]

The coated food product according to any one of claims 12 to 15, wherein an average film thickness of the coating is 0.1 μm to 10 μm .

[Claim 17]

The coated food product according to any one of claims 12 to 16, wherein a crystal melting peak temperature of the coating is 40°C to 80 °C.

[Claim 18]

The coated food product according to any one of claims 12 to 17, wherein

the food product is a fruit or vegetable.

[Claim 19]

The coated food product manufacturing method according to claim 4 or 5, wherein a method of the application is an immersion method or a jetting method.

[Claim 20]

A method of forming a coating, the method comprising:

applying a composition containing a sugar-based surfactant and a water-based solvent to a portion of a food product, or

applying a sugar-based surfactant with no solvent to a portion of a food product.

[Claim 21]

The coating formation method according to claim 20, wherein a method of the application is an immersion method or a jetting method.

[Claim 22]

A method of forming a coating, the method comprising:

applying a composition containing a sugar-based surfactant and a water-based solvent to a food product, or applying a sugar-based surfactant with no solvent to a food product,

wherein after the composition or the sugar-based surfactant is applied to the food product, a part of the applied composition or sugar-based surfactant is removed.

[Claim 23]

A method of shipping a food product, the method comprising:

(A) conveying the food product;

(B) forming a coating on the food product; and

(C) inspecting the coated food product by using an evaluation device,

wherein in the (B) forming of the coating, the coating is formed by the method according to any one of claims 20 to 22.

[Claim 24]

The food product shipping method according to claim 23, wherein the (C) inspecting of the coated food product includes at least one inspection selected from the group consisting of appearance inspection, sugar content inspection, and size inspection.