

DESCRIPTION

CAPSULE PRODUCTION METHOD, CAPSULE, CONTENT, SOLIDIFIED PRODUCT,
AND COMPOSITION

Technical Field

[0001]

The present invention relates to a capsule production method, a capsule, a content, a solidified product, and a composition.

Background Art

[0002]

In the production of capsules containing contents such as foods, for example, a submerged curing coating method (orifice method) is used. The method is used, for example, to produce artificial salmon roe or the like. In this method, the liquid (core material) to be encapsulated is dispersed in a polymer liquid such as alginic acid and dropped into a curing liquid containing calcium to provide capsules.

Such capsules can enclose ingredients such as pharmaceuticals, health foods, foods, and animal feed in a coating film prepared using a solution of proteins such as gelatin or polysaccharides such as starch. Therefore, wide application includes the food industry, pharmaceutical industry, and the like.

[0003]

While capsules are widely used as so-called health foods such as supplements, general foods using capsules are not well

known. For example, JP 2007-14252 A and the like disclose a sour seasoning containing a capsule formed of a coating film as a base material of agar and gellan gum and/or carrageenan, which encloses a sesame aroma component.

In addition, JP 2018-143101 A and the like disclose a capsule for preventing food texture deterioration, which is used in an edible medium containing edible oil, the capsule containing agar as the main component of the coating film. The capsules disclosed in the above-described Patent Literatures have had a particle size of about 3 mm or less, and the amount of encapsulation was small.

[0004]

Such encapsulation may be performed by the orifice method as described above or by a reverse orifice method (reverse method). The orifice method is a method of mixing a substance to be encapsulated (core material) with a polymer, and dropping the core material mixed with the polymer into a curing liquid to react with the polymer and cause gelation. For example, JP 2022-114451 A discloses that a soy sauce solution containing a calcium salt and a soy sauce solution is dropped into an aqueous sodium alginate solution to form capsules. In addition, for example, WO 2011/138478 A discloses a reverse spheronization process for encapsulating wine such as sparkling wine. The capsules disclosed in the above Patent Literatures have been also small.

Summary of Invention

Technical Problem

[0005]

The capsules containing foods and the like disclosed in the above-described Patent Literatures can add new flavors and textures to foods that are served together with the food capsules. However, depending on the application, a large amount of encapsulation is required.

On the other hand, capsules with a large amount of encapsulation are produced by producing so-called empty capsules and filling them with the content. However, a step of producing empty capsules and a step of filling the content are required, resulting in poor efficiency. In addition, filling the content may require high technical skills and specialized equipment.

Solution to Problem

[0006]

In the orifice method and the reverse orifice method (reverse method), productivity is high because capsules are formed by dropping the content including the core material into the curing liquid. However, these methods utilize a weak force such as surface tension for encapsulation, making it difficult to produce capsules with a large amount of encapsulation.

[0007]

In addition, the dropped content become flattened on the surface of the curing liquid and then enter the curing liquid. Herein, if the content has low wettability with the curing liquid, a gelled polymer coating film is formed while forming a

nearly spherical shape due to surface tension in order to minimize the surface area. Herein, if the surface tension is small compared to the volume of the droplet, it is also difficult for the droplet to become spherical. Therefore, it is not easy to produce capsules with a large amount of encapsulation by using a method of dropping the content into the curing liquid or the like.

In addition, like the reverse orifice method (reverse method), a mixture of a core material and curing liquid is enclosed in a membrane and poured into a polymer liquid, which may cause a capsule coating film to be formed outside the membrane even if the membrane is rough.

[0008]

The present inventor has made an intensive investigation and found that capsules with a large amount of encapsulation can be produced by putting the content containing a core material and curing liquid into a mold and solidifying them, and charging the solidified content (hereinafter referred to as the solidified content) into a contacting solution. The present disclosure has been made based on the above findings.

[0009]

One embodiment of the present disclosure includes the following aspects.

<1>

A method for producing capsules, comprising:

a step of solidifying a content including a core material and a curing agent to provide a solidified content; and

a step of contacting the solidified content with a contacting solution including a coating-film forming agent to provide a capsule including the solidified content and a coating film with the solidified content encapsulated.

[0010]

<2>

The method according to <1>, wherein the solidified content is obtained by freezing the content.

[0011]

<3>

The method according to <1> or <2>, further comprising a step of separating the capsule from the contacting solution.

[0012]

<4>

The method according to <1> or <2>, further comprising a step of submerging the capsule in a solution including the core material at 35% by volume or more.

[0013]

<5>

The method according to <1> or <2>, wherein the content includes ethyl alcohol.

[0014]

<6>

The method according to <1> or <2>, wherein the content includes a thickener.

[0015]

<7>

The method according to <1> or <2>, wherein the content includes at least one of xanthan gum and a water-soluble cellulose derivative.

[0016]

<8>

The method according to <1> or <2>, wherein a temperature of the contacting solution is 40°C or more.

[0017]

<9>

The method according to <1> or <2>, wherein the content includes a solid material.

[0018]

<10>

The method according to <7>, wherein the solid material is a second capsule encapsulating a second content or fruit pulp.

[0019]

<11>

The method according to <1> or <2>, comprising a step of bringing the capsule into contact with a cation-imparting solution to charge a surface of the capsule with cations.

[0020]

<12>

The method according to <1> or <2>, further comprising a step of applying a coating treatment to the surface of the capsule.

[0021]

<13>

The method according to <1> or <2>, wherein an amount of the solidified content encapsulated in the capsule is 1 ml or more.

[0022]

<14>

The method according to <1> or <2>, wherein a breaking load of the capsule is 1 to 10 N.

[0023]

<15>

The method according to <1> or <2>, wherein an average thickness of the coating film is 10 μm to 10 mm.

[0024]

<16>

A capsule comprising:

at least one of a content including a core material and a solidified content including a core material;

a coating film encapsulating the content and the solidified content; and

a coating that coats the coating film and includes at least one of agar and gelatin,

wherein a total amount of the content and the solidified content is 1 ml or more.

[0025]

<17>

The capsule according to <16>, wherein the content includes ethyl alcohol.

[0026]

<18>

The capsule according to <16> or <17>, wherein the content and the solidified content include a thickener.

[0027]

<19>

The capsule according to <16> or <17>, wherein the content and the solidified content include at least one of xanthan gum and a water-soluble cellulose derivative.

[0028]

<20>

The capsule according to <16> or <17>, wherein the coating film seamlessly encapsulates the content and the solidified content.

[0029]

<21>

The capsule according to <16> or <17>, wherein the content includes a solid material.

[0030]

<22>

The capsule according to <21>, wherein the solid material is a second capsule encapsulating a second content, or fruit pulp.

[0031]

<23>

A content comprising a core material and a curing agent and used in the production method according to <1> or <2>.

[0032]

<24>

A solidified content obtained by solidifying the content according to <23>.

[0033]

<25>

A composition comprising the solidified content according to <24> and a contacting solution including a coating-film forming agent.

Advantageous Effects of Invention

[0034]

The production method of the present disclosure can produce capsules with a large amount of encapsulation.

Description of Embodiments

[0035]

The contents of the present disclosure will be described in detail below, but are not limited thereto.

[0036]

In the present description, "to" indicating a numerical range is used to include the numerical values written before and after it as the lower limit and upper limit.

In the numerical ranges described step by step in the present description, the upper limit value or lower limit value described in one numerical range may be replaced with the upper limit value or lower limit value of another numerical range described stepwise. In addition, in the numerical ranges

described in the present description, the upper limit value or lower limit value of the numerical range may be replaced with the values shown in Examples.

A combination of two or more preferred aspects is a more preferred aspect in the present description.

[0037]

In the present description, the term "core material" refers to a material encapsulated in a capsule produced by the production method of the present disclosure.

[0038]

In the present description, "water-soluble" means that the solubility in 100 g of water with a pH of 7.0 and a liquid temperature of 22°C is 0.1 g or more.

[0039]

In the present description, "contact" between a solidified content and a solution containing an agent for forming a coating film includes not only the case where they come into contact with each other, but also the case where the solidified content is submerged in the solution. In addition, the contact also includes a case where they do not come into contact with each other, but a case where the solidified content and the solution containing the agent for forming a coating film are close enough to start a reaction.

[0040]

[Method for producing capsules]

A method for producing capsules of the present disclosure includes:

a step of solidifying a content including a core material and a curing agent to provide a solidified content; and

a step of contacting the solidified content with a contacting solution including a coating-film forming agent to provide a capsule including the solidified content and a coating film with the solidified content encapsulated.

The method for producing capsules of the present disclosure can further include a step of separating the capsule from the contacting solution.

The method for producing capsules of the present disclosure can further include a step of bringing the capsule into contact with a cation-imparting solution.

The method for producing capsules of the present disclosure can further include a step of applying a coating treatment to the surface of the capsule.

Each step will be explained below.

[0041]

The production method of the present disclosure can produce capsules with a large amount of encapsulation.

In addition, the production method of the present disclosure can produce capsules that are seamless and have an excellent appearance.

In addition, capsules produced by the orifice method tend to gel over time, and the entire capsules becomes a gel, but the capsules produced by the production method of the present disclosure tend not to gel over time.

[0042]

(Step of providing solidified content)

A method for producing capsules of the present disclosure includes a step of solidifying a content including a core material and a curing agent to provide a solidified content.

The solidified contents include not only those that have been completely solidified, but also those that are in progress of solidification and those that have not completely solidified.

In one embodiment, the solidification of the content involves causing a phase change of the content, such as freezing the content or gelling the content, and preferably freezing the content.

In one embodiment, solidifying the content is to mix a liquid state material and a solid state material.

In one embodiment, the solidified content is a content that is capable of retaining a shape thereof at 25°C.

The viscosity of the solidified content can be 0.1 Pa·s or more, 1 Pa·s or more, 5 Pa·s or more, or 10 Pa·s or more.

In the present disclosure, the viscosity is measured in accordance with JIS K 7117-2.

[0043]

The solidification of the content can be achieved by freezing the content, and in this case, it is preferable to adjust the freezing temperature appropriately depending on the composition of the content, and for example, the temperature of the content is preferably equal to or less than the freezing point, more preferably from 0 to -120°C, still more preferably from -10 to -70°C, and particularly preferably from -20 to -

50°C. The freezing point of ethyl alcohol is -117°C.

In the present disclosure, the freezing temperature refers to a temperature of the environment in which the content is frozen.

The freezing time is not particularly limited, and is preferably adjusted appropriately depending on the freezing temperature, and can be, for example, 10 minutes to 48 hours.

Freezing of the content can be performed, for example, by storing the content in a freezer.

[0044]

In one embodiment, solidifying the content can be performed after placing the content into a mold having the desired shape.

The shape of the mold is not particularly limited, and the shape of the capsule to be produced can be determined by the shape of the mold, thus allowing to produce the capsule having various shapes and allowing to improve the design of the capsule produced by the production method of the present disclosure.

Examples of the shape of the mold include a sphere, an ellipse, a cube, a heart, a star, a diamond, and a spade.

The method for taking out the solidified content from the mold is not particularly limited, and, for example, the solidified content may be taken out by breaking the mold, or may be taken out without breaking the mold.

Examples of the mold are illustrated in Figs. 1 to 3.

As illustrated in Fig. 1, a hemispherical content 510 frozen in a hemispherical mold 500 may protrude a little from

the hemispherical mold 500 due to expansion of water upon freezing. When preparing a frozen spherical object, re-freezing another hemispherical content 512, which is similarly frozen in a hemispherical shape, is processed and overlapped such that half-cut surfaces 516 thereof are fit each other, and is re-frozen to allow a frozen spherical object 514 to be formed.

Reference numerals 520 and 530 in Figs. 2 and 3 indicate molds.

[0045]

<Content>

The content contains a core material and a curing agent.

The content may or may not contain a special material.

The content may or may not contain an additive.

The amount of the content used in the production method of the present disclosure is not particularly limited, and the production method of the present disclosure is suitable for producing capsules with a large amount of encapsulation, which can be set to 1 ml or more, 3 ml or more, and even 5 ml or more. The upper limit of the amount of encapsulation is not particularly limited, and may be 1000 ml or less, 700 ml or less, or 600 ml or less.

[0046]

The alcohol content ratio relative to the total volume of the content is preferably 30% by volume or less, more preferably 25% by volume or less, and still more preferably 20% by volume or less.

Setting the alcohol content ratio to 30% by volume or less

can favorably promote the freezing of the content when solidifying the content by freezing.

The lower limit of the alcohol content ratio is not particularly limited, and the content may not contain alcohol.

Alcohol content ratio is the content ratio in the content at 25°C.

[0047]

The content can be obtained, for example, by mixing, dissolving, or dispersing each component.

[0048]

<Core material>

In the present disclosure, the type of the core material is not particularly limited, and examples thereof include pharmaceuticals, detergents, fabric softeners, health foods, foods, and animal feed.

In addition, the core material may be any of liquid, powder, and solid.

The core material may be, for example, any of alcohol, water, saccharides such as glucose, sugar, or fructose, salts, or other water-soluble liquids or aqueous solutions.

The core material may be ethyl alcohol or drinks containing ethyl alcohol. Examples of drinks containing ethyl alcohol include Japanese sake, wine, whisky, liqueur, and vodka.

In addition, the core material may be those generally referred to as fermented liquor, distilled liquor, or mixed liquor, which are classified according to the production method.

In addition, the core material may be fats and oils and/or

oil-soluble materials. Examples of the fats and oils include coconut oil, vegetable oil, and animal oil. Examples of the oil-soluble materials include perfumes, aroma oils, and menthol.

In addition, the core material may be an aqueous liquid food such as soy sauce solution, condensed milk, various types of vinegar, white soup stock, carbonated alcoholic drinks, lemon juice, fruit juice, coffee, carbonated fruit drinks, and the like.

The soy sauce solution described above has a high sodium concentration, and fruit juice has a low pH, and thus it has been difficult to encapsulate them with the orifice method or the like. The production method of the present disclosure can easily encapsulate even such a core material.

The content can include one or more core materials.

[0049]

The content ratio of the core material with respect to the total volume of the content is preferably 30 vol% or more, more preferably 45 vol% or more, still more preferably 50 vol% or more, and may be 70% or more or 80 vol% or more. Setting the content ratio of the core material within the above numerical range can maintain, at a high level, core material properties such as taste and aroma. The upper limit of the content ratio is not particularly limited, but can be 99 vol% or less and 95 vol% or less.

[0050]

<Curing agent>

As the curing agent, a polyvalent cation salt can be used,

and examples thereof include a calcium salt, an iron salt, a zinc salt, and an aluminum salt.

When the core material is a food or the like and the capsule produced by the production method of the present disclosure is edible, the calcium salt and the like are preferably those used for food, and examples thereof include calcium lactate, calcium chloride, and calcium gluconate.

When the core material is a food or the like and the capsule produced by the production method of the present disclosure is edible, it is preferable to use calcium lactate as the curing agent.

As the curing agent, calcium chloride can be used, but when the capsule is edible, calcium lactate is preferably used instead of calcium chloride from the viewpoint of maintaining the taste and the like.

The content can include one or more curing agents.

[0051]

The content ratio of the curing agent with respect to the total mass of the content is preferably 1% by mass or more, more preferably 1.5% by mass or more, and still more preferably 2% by mass or more.

Setting the content ratio of the curing agent to 1% by mass or more can improve coating-film forming properties.

The content ratio of the curing agent is not particularly limited, but is, for example, preferably 5% by mass or less, more preferably 4% by mass or less, and still more preferably 3% by mass or less.

[0052]

The content may contain a curing liquid containing a curing agent. For example, the content can contain an aqueous solution (calcium lactate aqueous solution) containing a curing agent.

The content ratio of the curing agent with respect to the total mass of the aqueous solution containing the curing agent is preferably 1 to 7% by mass, and more preferably 2 to 5% by mass.

When the content contains alcohol, it may be difficult for the curing liquid containing the curing agent to form a solution with alcohol. Setting the content ratio of the curing agent within the above numerical range can improve the dispersibility of the curing solution in alcohol, thereby allowing the solution to be easily prepared.

[0053]

<Special material>

The content may contain a special material. Examples of the special materials include thickeners, dyes, and other solid materials. The content may contain one or more special materials.

[0054]

Examples of the thickener include gelatin, xanthan gum, guar gum, carrageenan, gum arabic, starch, and water-soluble cellulose derivatives.

The content contains the thickener, thereby allowing to improve the coating-film forming properties and the yield of

capsule production.

From the viewpoint of improving the coating-film forming properties, the yield of capsule production, and the strength of the capsule, the thickener is preferably at least one of xanthan gum and water-soluble cellulose.

When the capsule produced by the production method of the present disclosure is edible, the strength of the capsule is improved, thereby allowing an elastic texture to be imparted.

From the viewpoint of suppressing the occurrence of wrinkles in the coating film, the thickener is preferably water-soluble cellulose.

In the present disclosure, the cellulose derivative means a compound in which a substituent such as a methyl group is introduced into a hydroxy group in a cellulose molecule by an ether bond or an ester bond.

Examples of the water-soluble cellulose derivative include methyl cellulose, hydroxypropyl cellulose, carboxymethyl cellulose, and hydroxyethyl cellulose.

The content may contain one or more thickeners.

[0055]

The content ratio of the thickener with respect to the total mass of the content is preferably 0.01 to 2% by mass, more preferably 0.02 to 1% by mass, still more preferably 0.03 to 0.7% by mass, particularly preferably 0.05 to 0.5% by mass, and most preferably 0.07 to 0.4% by mass.

Setting the content ratio of the thickener within the above numerical range can further improve the coating-film

forming properties, the yield of capsule production, and the strength of the capsule.

In addition, when a water-soluble cellulose derivative is used as the thickener, setting the content ratio of the thickener within the above numerical range can further improve the coating-film forming properties and the yield of capsule production, and can effectively suppress the occurrence of wrinkles in the coating film.

[0056]

As the pigment, a conventionally known pigment can be appropriately selected and used. Examples of the pigment include purple sweet potato pigment, gardenia red pigment, capsicum pigment, rack pigment, spirulina pigment, onion pigment, tamarind pigment, caramel pigment, turmeric pigment, citan pigment (sandalwood red), krill pigment, orange pigment, carotene, blue No. 1, yellow No. 4, and green No. 3, but are not limited thereto.

The content contains a pigment, thereby allowing the solidified content contained in the coating film to be colored, and the designability of the capsule produced by the production method of the present disclosure to be improved.

The content can contain one or more pigments.

[0057]

The content ratio of the pigment with respect to the total mass of the content is preferably 0.01 to 0.1% by mass, and more preferably 0.02 to 0.5% by mass.

Setting the content ratio of the pigment within the above

numerical range can not only further improve the designability of the capsule, but also maintain the core material properties (for example, when the core material is food, taste, aroma, and the like).

[0058]

In the present disclosure, the solid material is a component other than the core material, the curing agent, the thickener, and the dye, and means a component that is solid at 25°C.

The content can contain one or more solid materials.

In one embodiment, the solid materials are flesh of fruits, vegetables, and the like.

In one embodiment, the solid material is a second capsule encapsulating a second content. The second capsule may be a capsule produced by the production method of the present disclosure, may be a capsule produced by the production method disclosed in JP 2022-114451 A, may be a capsule produced by the orifice method, or may be a capsule produced by the reverse method.

The second content may be the same as or different from the content or the solidified content.

In one embodiment, the content contains alcohol as the core material, and the second content contains lemon juice, fruit juice, and the like as the core material.

In one embodiment, the content contains a detergent as the core material and the second content contains a softener as the core material.

In one embodiment, the solid material is a fiber component. Examples of the fiber component include a water-insoluble cellulose derivative (crystalline cellulose).

[0059]

The content ratio of the solid material with respect to the total mass of the content is not particularly limited, and is preferably appropriately adjusted according to the purpose.

When the pulp is used as the solid material, the content ratio of the solid material with respect to the total mass of the content is preferably 3 to 50% by mass, and more preferably 10 to 40% by mass.

When the second capsule is used as the solid material, the content ratio of the solid material with respect to the total mass of the content is preferably 3 to 50% by mass, and more preferably 10 to 40% by mass.

[0060]

<Additive>

The content may contain an additive. Examples of the additive include a preservative, an antioxidant, a stabilizer, a preservative, and an emulsifier.

The content ratio of the additive with respect to the total mass of the content is not particularly limited, and is preferably appropriately adjusted according to the purpose.

[0061]

(Step of providing capsule)

The method for producing capsules of the present disclosure includes a step of contacting the solidified content

with a contacting solution containing a coating-film forming agent to provide a capsule including the solidified content and a coating film encapsulating the solidified content.

"The solidified content is contained in the coating film" means that the solidified content may be present inside the coating film, and means an encapsulation state as long as at least a part of the solidified content is present inside the capsule, even if the melted content oozes out from the capsule.

In one embodiment, the solidified content and the contacting solution come into contact with each other, thereby causing the curing agent and the coating-film forming agent to undergo a gelation reaction, and forming a coating film on the surface of the solidified content.

The coating film contained in the capsule may encapsulate a content obtained by melting the solidified content.

In one embodiment, two or more solidified contents may be encapsulated within the coating film. For example, a capsule can be produced by bonding two solidified contents and contacting them with a contacting solution.

The amount of the solidified content encapsulated in the coating film is not particularly limited, and the production method of the present disclosure is suitable for producing capsules with a large amount of encapsulation, which can be set to 1 ml or more, 3 ml or more, and even 5 ml or more. The upper limit of the amount of the solidified content encapsulated is not particularly limited, and may be, for example, 1000 ml or less, 700 ml or less, or 600 ml or less.

[0062]

From the viewpoint of improving the strength of the capsule, the average thickness of the coating film is preferably 10 μm to 10 mm, more preferably 20 μm to 5 mm, still more preferably 30 μm to 3 mm, particularly preferably 50 μm to 2 mm, and may be 100 μm to 1 mm.

The average thickness of the coating film is an average thickness of any five points.

[0063]

In one embodiment, the contact with the solidified content and the contacting solution each other is performed by submerging the solidified content in the contacting solution. The solidified content may be entirely or partially submerged in the contacting solution.

In one embodiment, the contact with the solidified content and the contacting solution each other is performed by pouring the contacting solution onto the solidified content from above or the like.

In one embodiment, the contact with the solidified content and the contacting solution each other is performed by spraying the contacting solution to the solidified content.

In one embodiment, the contact with the solidified content and the contacting solution each other is performed by leaving the solidified content in an environment in which the contacting solution is, for example, sprayed.

When the solidified content is a frozen content, it is considered that at least a part of the frozen content is thawed

by contact with the frozen content and the contacting solution each other, and the contained curing agent and coating-film forming agent react with each other to form a coating film on the surface thereof.

[0064]

The time of the contact with the solidified content and the contacting solution each other is preferably appropriately adjusted according to, for example, various components contained in the solidified content and the content ratio thereof, the type of the coating-film forming agent contained in the contacting solution and the content ratio thereof, and can be, for example, 10 minutes to 48 hours.

[0065]

<Contacting solution>

The contacting solution contains a coating-film forming agent.

The contacting solution contains a solvent to dissolve or disperse the coating-film forming agent. Examples of the solvent include water and a conventionally known organic solvent. Examples of the water include distilled water, purified water, and deionized water.

[0066]

The content ratio of the coating-film forming agent with respect to the total mass of the contacting solution is preferably 0.1 to 3% by mass, more preferably 0.3 to 2% by mass, and particularly preferably 0.4 to 1% by mass.

Setting the content ratio of the coating-film forming

agent within the above numerical range can improve the coating-film forming properties and the yield of capsule production.

[0067]

The type of the coating-film forming agent is not particularly limited as long as it can form a coating film around the solidified content when the contacting solution and the solidified content come into contact with each other.

In one embodiment, the coating-film forming agent is a gelling agent. As the gelling agent, alginate is preferable, and alginate acid metal salt is more preferable.

Examples of the alginate acid metal salt include alkali metal salts such as sodium salts and potassium salts, alkaline earth metal salts such as calcium and magnesium salts, and metal salts such as iron and tin.

When the core material is a food product or the like and the capsule produced by the production method of the present disclosure is edible, sodium alginate is preferable as the alginate acid metal salt. Using sodium alginate can cause the capsule produced by the production method of the present disclosure to be transparent or translucent, and thus the encapsulated solidified content can be visually observed, and thus the designability of the capsule can be improved.

The coating-film forming agent may be used singly or in combination of two or more.

[0068]

The temperature of the contacting solution is preferably 25 to 100°C, more preferably 30 to 80°C, and still more

preferably 40 to 75°C.

Setting the temperature of the contacting solution within the above numerical range can improve the coating-film forming properties and the yield of capsule production.

The temperature of the contacting solution means the temperature of the contacting solution before contact with the solidified content, preferably the temperature of the contacting solution within 5 minutes before contact with the solidified content, more preferably the temperature of the contacting solution within 1 minute before contact with the solidified content, and still more preferably the temperature of the contacting solution immediately before contact with the solidified content (within 30 seconds).

The difference between the temperature of the contacting solution and the surface temperature of the solidified content is preferably 30°C to 100°C, more preferably 40°C to 95°C, and still more preferably 45°C to 90°C.

Setting the temperature difference within the above numerical range can improve the coating-film forming properties and the yield of capsule production.

[0069]

(Step of separation)

The method for producing capsules of the present disclosure can further include a step of separating the capsule from the contacting solution.

The separation method is not particularly limited, and for example, can be performed by taking out the capsule from the

contacting solution with a wire mesh or the like.

The capsule taken out may or may not be washed with water such as distilled water as desired.

From the viewpoint of suppressing bonding between capsules, it is preferable to wash the capsules taken out, it is more preferable to wash the capsules within 5 minutes after taking out, it is still more preferable to wash the capsules within 3 minutes, and it is particularly preferable to wash the capsules within 1 minute.

[0070]

(Step of contacting with cation-imparting solution)

The method for producing capsules of the present disclosure can further include a step of bringing the capsule into contact with a cation-imparting solution. For example, the method can be performed by submerging the capsule in a cation-imparting solution.

Including the step in the production method of the present disclosure can improve the strength of the capsule to be produced.

The surfaces of the capsules separated by the separation step tend to be anionically charged. Bringing the capsule into contact with the cation-imparting solution can cause the surface of the capsule to be charged with cations, and the strength thereof can be improved.

[0071]

<Cation-imparting solution>

The cation-imparting solution contains a cation-imparting

agent.

The cation-imparting solution contains a solvent to dissolve or disperse the cation-imparting agent. The solvent is as described above, and the description thereof is omitted herein.

[0072]

The cation-imparting agent is not particularly limited as long as it can charge the surface of the coating film with cations, and examples thereof include chitosan, protamine, and poly-L-lysine.

The cation-imparting agent may be used singly, or may be used in combination of two or more.

[0073]

The content ratio of the cation-imparting agent with respect to the total mass of the cation-imparting solution is preferably 0.1 to 5% by mass, more preferably 0.3 to 3% by mass, and particularly preferably 0.4 to 2% by mass.

Setting the content ratio of the cation-imparting agent within the above numerical range can cause the charge of the cations on the surface of the coating film to proceed well, and the strength of the capsule can be improved.

[0074]

(Step of performing coating treatment)

The method for producing capsules of the present disclosure can further include a step of applying a coating treatment to the surface of the capsule. The step may be performed before or after the step of contacting with the

cation-imparting solution, but is preferably performed after from the viewpoint of the strength of the capsule.

Performing the coating treatment can form a coating on the surface of the capsule, and the strength thereof can be improved.

In one embodiment, the coating treatment can be performed by bringing the capsule into contact with the coating treatment solution. For example, the coating treatment can be performed by submerging the capsule in a coating treatment solution.

[0075]

The coating film and the coating are partially or entirely mixed, and thus it is difficult to measure each average thickness, but from the viewpoint of improving the strength of the capsule, the sum of the average thicknesses of the coating film and the coating is preferably 10 μm to 10 mm, more preferably 20 μm to 5 mm, still more preferably 30 μm to 3 mm, particularly preferably 50 μm to 2 mm, and may be 100 μm to 1 mm.

The sum of the average thicknesses of the coating film and the coating is measured at any five points.

[0076]

<Coating treatment solution>

The coating treatment solution contains a coating agent.

The coating treatment solution contains a solvent to dissolve or disperse the coating agent. The solvent is as described above, and the description thereof is omitted herein.

[0077]

The coating agent is not particularly limited, and examples thereof include agar (agarose) and gelatin (collagen).

The coating agent may be used singly, or may be used in combination of two or more.

[0078]

The content ratio of the coating agent with respect to the total mass of the coating solution is preferably 0.1 to 5% by mass, more preferably 0.3 to 3% by mass, and particularly preferably 0.4 to 2% by mass.

Setting the content ratio of the coating agent within the above numerical range can form the coating well, and the strength of the capsule can be improved.

[0079]

The type of the coating agent is not particularly limited as long as it can form a coating film around the solidified content when the contacting solution and the solidified content come into contact with each other.

In one embodiment, the coating agent is a gelling agent. As the gelling agent, alginate is preferable, and alginate acid metal salt is more preferable.

Examples of the alginate acid metal salt include alkali metal salts such as sodium salts and potassium salts, alkaline earth metal salts such as calcium and magnesium salts, and metal salts such as iron and tin.

When the core material is a food product or the like and the capsule produced by the production method of the present disclosure is edible, metal sodium alginate is preferable as the

alginate acid metal salt. Using metal sodium alginate can cause the capsule produced by the production method of the present disclosure to be transparent or translucent, and thus the encapsulated solidified content can be visually observed, and thus the designability of the capsule can be improved.

[0080]

The temperature of the contacting solution is preferably 25 to 100°C, more preferably 30 to 80°C, and still more preferably 40 to 75°C.

Setting the temperature of the contacting solution within the above numerical range can improve the coating-film forming properties and the yield of capsule production.

The temperature of the contacting solution means the temperature of the contacting solution before contact with the solidified content, preferably the temperature of the contacting solution within 5 minutes before contact with the solidified content, more preferably the temperature of the contacting solution within 1 minute before contact with the solidified content, and still more preferably the temperature of the contacting solution immediately before contact with the solidified content (within 30 seconds).

[0081]

The contact time between the capsule and the coating treatment solution is not particularly limited, and is preferably appropriately adjusted according to the type of the coating agent, the content ratio thereof, and the like, but can be set to, for example, 5 minutes to 2 hours.

[0082]

(Contact with core material solution)

The method for producing a capsule of the present disclosure can further include a step of bringing the capsule into contact with a solution (core material solution) containing 35% by volume or more of the core material. For example, the contact can be performed by submerging the capsule in a core material solution. The core material contained in the core material solution may or may not migrate into the coating film by the contact.

When the capsule produced by the production method of the present disclosure is edible, it is possible to impart the taste and aroma of the core material to the produced capsule by including the production method of the present disclosure and the contact step.

The core material has been described above, and thus the description thereof is omitted. The core material contained in the coating film and the core material contained in the core material solution may be the same or different.

The core material solution contains a solvent to dissolve or disperse the core material. The solvent is as described above, and the description thereof is omitted herein.

[0083]

From the viewpoint of well imparting the taste and aroma of the core material to the capsule, the content ratio of the core material contained in the core material solution is preferably 40 to 99% by volume, and more preferably 50 to 99% by

volume.

[0084]

The contact time between the capsule and the core material solution is not particularly limited, and is preferably appropriately adjusted according to the type of the core material, the content ratio thereof, and the like, but can be, for example, 2 to 36 hours, 6 to 24 hours, or 10 to 20 hours.

[0085]

The breaking load of the capsule produced by the production method of the present disclosure described above is preferably 1 to 10 N, and more preferably 2 to 8 N.

The breaking strength of the capsule is measured by using a creep meter.

Specifically, the capsule is placed on a sample stage of a creep meter, and the capsule is compressed from above by a plunger until the height of the capsule reaches a height of 0.8 H (20% reduction) from the height H before compression, thereby measuring the breaking strength of the capsule.

The height before compression is a height at which the plunger comes into contact with the capsule and starts to sense pressure.

·Creep meter: RE2-33005 C manufactured by Yamaden Co., Ltd.

·Plunger: Disc shape (4cmφ)

·Load cell: 20 N

·Speed: speed 10 mm/sec

[0086]

(Other steps)

The production method of the present disclosure may include steps other than the above steps.

For example, a step of applying sugar, dry fruit powder, chocolate powder, or the like to the surface of a coating film or a coating may be included.

In addition, the solidified content in the coating film may be melted by performing a treatment such as storing the capsule at room temperature or heating.

[0087]

[Capsule]

The capsule of the present disclosure includes at least one of a content containing a core material and a solidified content containing the core material, a coating film containing the content and the solidified content, and a coating covering the coating film and containing at least one of agar and gelatin, and

the total amount of the content and the solidified content is 1 ml or more.

In a second embodiment, the capsule of the present disclosure includes a solidified content containing a core material, and a coating film containing the content and the solidified content, and the solidified content is a frozen content. In the second embodiment, the coating film may encapsulate a content containing a core material. In addition, the coating covering a coating film and containing at least one of agar and gelatin may be contained.

The content and the solidified content may contain a curing agent, a special material, an additive, and the like.

The coating film may encapsulate two or more solidified contents, or may encapsulate two or more contents.

The type and content ratio of the content, the solidified content, the curing agent, the special material, the additive, and the like are the same as those described in the production method of the present disclosure, and thus the description thereof is omitted herein.

The coating film and the coating are also similar to the matters described in the production method of the present disclosure, and thus the description thereof is omitted herein.

The total amount of the content and the solidified content contained in the coating film can be 1 ml or more, 3 ml or more, or 5 ml or more. The upper limit of the total amount is not particularly limited, and may be, for example, 1000 ml or less, 700 ml or less, or 600 ml or less.

[0088]

From the viewpoint of improving the designability of the capsule, the coating film preferably seamlessly encapsulates the content and the solidified content.

[0089]

The breaking load of the capsule of the present disclosure is preferably 1 to 10 N, and more preferably 2 to 8 N.

[0090]

The capsule of the present disclosure may be produced by the above described production method of the present disclosure,

or may be produced by a different method.

[0091]

One embodiment of the capsule of the present disclosure is illustrated in, but not limited to, Figs. 23 to 25.

A capsule 100 illustrated in Fig. 23 contains a coating film 101 and a content containing a core material encapsulated in the coating film 101 and/or a solidified content 102 containing a core material.

A capsule 200 illustrated in Fig. 24 contains a coating film 201 and a content containing a core material encapsulated in the coating film 201 and/or a solidified content 202 containing a core material, and

the content containing the core material and/or the solidified content 202 containing the core material contains a second capsule 200 as a solid material.

A capsule 400 illustrated in Fig. 25 contains a coating film 401 and a content containing a core material encapsulated in the coating film 401 and/or solidified contents 402 and 403 containing a core material. The capsule illustrated in Fig. 25 encapsulates a solidified content containing two contents and/or a core material in a coating film.

[0092]

[Content]

The content of the present disclosure contains a core material and a curing agent, and is used in the production method of the present disclosure described above.

The content of the present disclosure may contain a

special material, an additive, and the like.

The type, content ratio, and the like of the core material, the curing agent, the special material, and the additive have been described above, and thus the description thereof is omitted herein.

[0093]

[Solidified content]

The solidified content of the present disclosure is obtained by solidifying the above described content of the present disclosure.

The solidified content has been described in the production method of the present disclosure described above, and thus the description thereof is omitted herein.

[0094]

[Composition]

The composition of the present disclosure contains a solidified content of the present disclosure described above and a contacting solution containing a coating-film forming agent.

The composition of the present disclosure can contain a coating film encapsulating the solidified content and a capsule containing a solidified content.

The contacting solution and the capsule have been described above, and thus description thereof is omitted herein.

Brief Description of Drawings

[0095]

Fig. 1 is a schematic diagram illustrating an embodiment

of a mold.

Fig. 2 is a schematic diagram illustrating an embodiment of a mold.

Fig. 3 is a schematic diagram illustrating an embodiment of a mold.

Fig. 4 illustrates a photograph of a capsule (Example 1).

Fig. 5 illustrates a photograph of a capsule (Example 2).

Fig. 6 is a photograph illustrating the influence of the temperature of a contacting solution on the appearance of a capsule.

Fig. 7 is a photograph illustrating the influence of the temperature of a contacting solution on the appearance of a capsule.

Fig. 8 is a photograph illustrating the influence of the temperature of a contacting solution on the appearance of a capsule.

Fig. 9 is a graph illustrating the influence of the temperature of a contacting solution on the formation rate of capsules.

Fig. 10 is a graph illustrating the influence of the temperature of a contacting solution on the formation rate of a capsule.

Fig. 11 is a graph illustrating the influence of the temperature of a contacting solution on the formation rate of a capsule.

Fig. 12 is a diagram illustrating breaking loads of capsules produced in Examples 5a and 6a.

Fig. 13 illustrates initial capsule heights of capsules produced in Examples 5a and 6a.

Fig. 14 is a diagram illustrating an analysis example of capsule strength.

Fig. 15 illustrates initial capsule heights of capsules produced in Examples 6b and 9b.

Fig. 16 is a diagram illustrating a photograph of a capsule of Example 10.

Fig. 17 is a diagram illustrating a breaking load and a sample height in Example 14.

Fig. 18 is a diagram illustrating an influence on a breaking load in Example 15.

Fig. 19 is a diagram illustrating the influence on the sample height in Example 15.

Fig. 20 is a diagram illustrating an influence on a breaking load in Example 15.

Fig. 21 is a diagram illustrating the influence on the sample height in Example 15.

Fig. 22 is a diagram illustrating the concentration of a core material solution in a liquid encapsulated in a capsule.

Fig. 23 is a schematic cross-sectional diagram illustrating an embodiment of a capsule of the present disclosure.

Fig. 24 is a schematic cross-sectional diagram illustrating an embodiment of a capsule of the present disclosure.

Fig. 25 is a schematic cross-sectional diagram

illustrating an embodiment of a capsule of the present disclosure.

[0096]

Hereinafter, embodiments of the present disclosure will be described with reference to the drawings. However, the present disclosure is not limited to these.

Examples

[0097]

[Preparation of content]

As a core material, commercially available tequila (ethyl alcohol 40% (volume basis), product name: Tequila silver, production: Souza Tequila Import Company (Mexico), import: Suntory Holdings Limited) and commercially available orange juice (product name: POM Pon Juice, name: Fruit Mix Juice (concentrated reduction), raw material name: fruit (orange (Brazil), unshu mikan (made in Japan))/fragrance) were prepared.

4% calcium lactate aqueous solution (reagent name: calcium lactate (powder), mass basis, produced by Junsei Chemical Co., Ltd.) was prepared as a curing agent.

Further, commercially available xanthan gum (product name: Xanthan gum standard (powder), produced by Unitec Foods Co., Ltd.) was prepared as a thickener, and 0.2 and 0.5% (mass basis) xanthan gum aqueous solutions were prepared by using deionized water, respectively.

In addition, commercially available methyl cellulose

(product name: methyl cellulose H (powder), produced by Unitec Foods Co., Ltd.) was prepared, and a 0.2% (mass basis) methyl cellulose aqueous solution was prepared by using deionized water. In addition, commercially available crystalline cellulose (product name: domestic fine powder crystalline cellulose, produced by Nippon Garlic Corporation) was prepared, and a 0.2% (mass basis) crystalline cellulose aqueous solution was prepared.

In addition, a purple sweet potato dye (product name: KC Red SL-9 (aqueous liquid), produced by Kobe Chemical Co., Ltd.), a gardenia red dye (product name: KC Red KL-7 (aqueous liquid), produced by Kobe Chemical Co., Ltd.), and a capsicum dye (product name: KC Orange PE-EN (capsicum dye emulsion formulation), produced by Kobe Chemical Co., Ltd.) were prepared.

In addition, commercially available lemon fruit (purchased at a supermarket) was prepared.

[0098]

(Example 1)

Equal amounts (on a volume basis) of tequila and a 4% calcium lactate aqueous solution were mixed to provide a content.

The content ratio of calcium lactate with respect to the total mass of the content at 25°C was 2% by mass.

The content ratio of ethyl alcohol (containing a tequila) in the content at 25°C was 20% by volume (the content of the tequila was 50% by volume).

[0099]

(Example 2)

Equal amounts (on a volume basis) of orange juice and a 4% calcium lactate aqueous solution were mixed to provide a content. The content ratio of calcium lactate with respect to the total mass of the content at 25°C was 2% by mass.

[0100]

(Example 3)

Equal amounts (on a volume basis) of distilled water and a 4% calcium lactate aqueous solution were mixed to provide a content. The content ratio of calcium lactate with respect to the total mass of the content at 25°C was 2% by mass.

[0101]

(Example 4)

Equal amounts (on a volume basis) of tequila, a 4% calcium lactate aqueous solution, and a 0.5% xanthan gum aqueous solution were mixed to provide a content. The content ratio of calcium lactate with respect to the total mass of the content at 25°C was 2% by mass. The content ratio of ethyl alcohol (containing a tequila) in the content at 25°C was 20% by volume (the content of the tequila was 50% by volume). The content ratio of xanthan gum with respect to the total mass of the content at 25°C was 0.25% by mass.

[0102]

(Example 5)

Equal amounts (on a volume basis) of tequila, a 4% calcium lactate aqueous solution, and a 0.2% xanthan gum aqueous

solution were mixed to provide a content. The content ratio of calcium lactate with respect to the total mass of the content at 25°C was 2% by mass. The content ratio of ethyl alcohol (containing a tequila) in the content at 25°C was 20% by volume (the content of the tequila was 50% by volume). The content ratio of xanthan gum with respect to the total mass of the content at 25°C was 0.1% by mass.

[0103]

(Example 6)

Equal amounts (on a volume basis) of tequila, a 4% calcium lactate aqueous solution, and a 0.2% methyl cellulose were mixed to provide a content. The content ratio of calcium lactate with respect to the total mass of the content at 25°C was 2% by mass. The content ratio of ethyl alcohol (containing a tequila) in the content at 25°C was 20% by volume (the content of the tequila was 50% by volume). The content ratio of methyl cellulose with respect to the total mass of the content at 25°C was 0.1% by mass.

[0104]

(Example 7)

Equal amounts (on a volume basis) of orange juice, a 4% calcium lactate aqueous solution, and a 0.5% xanthan gum aqueous solution were mixed to provide a content. The content ratio of calcium lactate with respect to the total mass of the content at 25°C was 2% by mass. The content ratio of xanthan gum with respect to the total mass of the content at 25°C was 0.25% by mass.

[0105]

(Example 8)

Equal amounts (on a volume basis) of distilled water, a 4% calcium lactate aqueous solution, and a 0.5% xanthan gum aqueous solution were mixed to provide a content. The content ratio of calcium lactate with respect to the total mass of the content at 25°C was 2% by mass. The content ratio of xanthan gum with respect to the total mass of the content at 25°C was 0.25% by mass.

[0106]

(Example 9)

Equal amounts (on a volume basis) of tequila, a 4% calcium lactate aqueous solution, and a 0.2% crystalline cellulose were mixed to provide a content. The content ratio of calcium lactate with respect to the total mass of the content at 25°C was 2% by mass. The content ratio of ethyl alcohol (containing a tequila) in the content at 25°C was 20% by volume (the content of the tequila was 50% by volume). The content ratio of crystalline cellulose with respect to the total mass of the content at 25°C was 0.1% by mass.

[0107]

(Example 10)

Equal amounts (on a volume basis) of orange juice, a 4% calcium lactate aqueous solution, and a 0.2% methyl cellulose were mixed to provide a content. The content ratio of calcium lactate with respect to the total mass of the content at 25°C was 2% by mass. The content ratio of methyl cellulose with

respect to the total mass of the content at 25°C was 0.1% by mass.

[0108]

[Freezing of content]

In each of the above described Examples, each of the contents (mixed solution) was placed in a hemispherical mold by 7 ml, and frozen to provide a frozen content. The freezing temperature was -40°C, and the freezing time was 1 hour.

The surface temperature of the frozen content was -5°C.

[0109]

[Preparation of contacting solution]

Commercially available sodium alginate (product name: sodium alginate (powder), manufactured by Marugo Corporation) was prepared, and a 0.5% (mass basis) sodium alginate aqueous solution was prepared by using deionized water.

[0110]

[Contact with contacting solution]

50 ml of a 0.5% sodium alginate aqueous solution was placed in a beaker and heated with a heater to provide a contacting solution made of a 0.5% sodium alginate aqueous solution at about 70°C. Coating film formation was performed by adding the frozen contents obtained by freezing the contents of Examples 1 to 10 to the contacting solution one by one to provide about 3cm ϕ hemispherical capsules.

At this time, the temperature of the contacting solution decreased by about 10°C.

[0111]

[Separation from contacting solution]

The formed approximately 3 cm Φ hemispherical capsules were scooped with wire mesh and separated from the contacting solution. Thereafter, the wire mesh was washed with running water made of distilled water.

A frozen content and a content obtained by melting the frozen content were encapsulated in the coating film of the obtained capsule, and liquid leakage was not confirmed.

In addition, the obtained capsules were all seamless and had an excellent appearance.

In addition, the obtained capsules were placed in a container with a screw cap and stored at 4°C for 1 month. After storage, the capsule was cut, and the content was confirmed, and as a result, gelation was not observed.

Figs. 4 and 5 illustrate photographs of capsules of Example 1 and Example 2 obtained at this time.

[0112]

(Examples 1a to 4a, Examples 7a and 8a: change in temperature of contacting solution)

In addition, capsules were produced in the same manner as in the production of the capsules with the frozen contents of Examples 1 to 4, 7, and 8, except that the temperature of the contacting solution was changed to 4°C, 25°C, 40°C, 60°C, or 80°C.

A frozen content and a content obtained by melting the frozen content were encapsulated in the coating film of the obtained capsule, and liquid leakage was not confirmed.

In addition, the obtained capsules were all seamless and had an excellent appearance.

In addition, the obtained capsules were placed in a container with a screw cap and stored at 4°C for 1 month. After storage, the capsule was cut, and the content was confirmed, and as a result, gelation was not observed.

The photographs of the obtained capsules are illustrated in Figs. 6 to 8.

The upper part of Fig. 6 illustrates a modification of Example 1.

The lower part of Fig. 6 illustrates a modification of Example 4.

The upper part of Fig. 7 illustrates a modification of Example 2.

The lower part of Fig. 7 illustrates a modification of Example 7.

The upper part of Fig. 8 illustrates a modification of Example 3.

The lower part of Fig. 8 illustrates a modification of Example 8.

These figures show that when the temperature of the contacting solution is 40°C or more, the surface of the capsule becomes smooth, whereby the appearance of the capsule is excellent, and the designability is further improved.

[0113]

In addition, Figs. 9 to 11 illustrate the yield of capsules.

The horizontal axis represents the temperature of the contacting solution (in the figure, described as capsule dissolution temperature), and the vertical axis represents the capsule formation rate.

The capsule formation rate means the number of capsules with the coating film undamaged when 10 pieces of capsules are produced by the above described method.

Xanthan gum (-) in Fig. 9 illustrates a modification of Example 1.

Xanthan gum (+) in Fig. 9 illustrates a modification of Example 4.

Xanthan gum (-) in Fig. 10 illustrates a modification of Example 2.

Xanthan gum (+) in Fig. 10 illustrates a modification of Example 7.

Xanthan gum (-) in Fig. 11 illustrates a modification of Example 3.

Xanthan gum (+) in Fig. 11 illustrates a modification of Example 8.

In Fig. 11, the solid line and the dotted line overlap each other.

[0114]

(Examples 5a and 6a: use of methyl cellulose)

(Example 5a) Capsules were produced in the same manner as described above, except that xanthan gum was changed to methyl cellulose in Example 5.

(Example 6a) Capsules were produced in the same manner as

described above, except that methyl cellulose was changed to xanthan gum in Example 6.

A frozen content and a content obtained by melting the frozen content were encapsulated in the coating film of the obtained capsule, and liquid leakage was not confirmed.

In addition, the obtained capsules were all seamless and had an excellent appearance.

In addition, the obtained capsules were placed in a container with a screw cap and stored at 4°C for 1 month. After storage, the capsule was cut, and the content was confirmed, and as a result, gelation was not observed.

The breaking load of the capsules produced in Examples 5a and 6a and the height of the capsules before compression (hereinafter, also referred to as an initial capsule height, and is described as a sample height in the drawing) are illustrated in Figs. 12 and 13.

In Figs. 12 and 13, the bar graph described as containing 0.1% xanthan gum shows the result of Example 6a, and the bar graph described as containing 0.1% methylcellulose shows the result of Example 5a.

The breaking load was measured under the following conditions with a creep meter. Specifically, the capsule was disposed such that the circular bottom surface of the hemispherical capsule was in contact with the sample stage of the creep meter, and the capsule was compressed from above by a plunger until the height of the capsule reached a height of 0.8 H (20% reduction) from the height H before compression. Before

reaching the compression ratio, the capsule was broken. The load at the time of breaking was taken as the breaking load.

The height before compression was set to a height at which the plunger came into contact with the capsule and started to sense pressure.

·Creep meter: RE2-33005 C manufactured by Yamaden Co., Ltd.

·Plunger: Disc shape (4cmφ)

·Load cell: 20 N

·Speed: speed 10 mm/sec

[0115]

Fig. 14 illustrates an analysis example of the capsule strength. The vertical axis represents the load (N), and the horizontal axis represents the distortion ratio (%) based on the height. In this figure, the load increases almost linearly until the distortion ratio approaches 40%, reaches a maximum value at about 40%, and then rapidly decreases. This point was taken as the breaking point, and the load was taken as the breaking load, and interpreted as the hardness of the capsule. The breaking measurement corresponds to the mastication operation, and thus the setting of the compression speed was determined by performing a preliminary experiment. Herein, the distortion ratio is considered to be a property as felt as elasticity of the capsule, and the breaking load is considered to be a property as felt as ease of breaking (chewy). As a preliminary test, a sensitive test was performed to investigate the relevance of these properties from five subjects. A plurality of

samples were prepared such that the distortion ratio up to breakage was about 30% to about 60%, and the elasticity was evaluated by the subjects. At this time, preparing sample was performed under basically the same conditions as in Example 1, and the concentration, temperature, and submerging time of the sodium alginate aqueous solution were adjusted to adjust the film thickness such that the distortion ratio was different. More than about 50 pieces of samples were ultimately damaged, but a majority reported the feeling of being soft. On the other hand, in the samples of 43% to 45%, the majority reported moderate elasticity and comfortable burst. On the other hand, the coating film being extremely thin was ruptured only by pinching. Further, those subjected to coating treatment were subjected to sensory evaluation. For the coated samples with almost the same distortion ratio (43% to 48%) as those without coating treatment, the majority reported the sensation of more elasticity. From these, it is considered that a distortion ratio of about 30% or more, about 35% or more, or about 40 is excellent in texture. In addition, a distortion ratio of about 80% or less, about 70% or less, or about 60% or less is considered to be excellent in texture. Even in the same distortion ratio, those with coating treatment was seem to be more excellent in texture.

From the experiment, those corresponding to a distortion ratio of about 30% was about 4.5 mm to about 5.7 mm, those corresponding to a distortion ratio of about 40% was about 6.0 mm to about 7.6 mm, and those corresponding to a distortion

ratio of about 50% was about 7.5 mm to about 9.0 mm.

[0116]

[Occurrence of wrinkles on capsule surface]

(Examples 6b and 9a)

Capsules were produced in the same manner, except that the cellulose used in Examples 6 and 9 was changed to that illustrated in Fig. 15.

A frozen content and a content obtained by melting the frozen content were encapsulated in the coating film of the obtained capsule, and liquid leakage was not confirmed.

In addition, the obtained capsules were all seamless and had an excellent appearance.

In addition, the obtained capsules were placed in a container with a screw cap and stored at 4°C for 1 month. After storage, the capsule was cut, and the content was confirmed, and as a result, gelation was not observed.

The initial capsule height (in the figure, described as a sample height) of each produced capsule is illustrated in Fig. 15. The initial capsule height is measured by the method described above. In addition, the left part of Fig. 15 illustrates a modification of Example 6, and the right part of Fig. 15 illustrates a modification of Example 9.

From the results illustrated in Fig. 15, it is found that the capsule produced by using the water-soluble cellulose derivative has a larger initial capsule height than the capsule produced without use, and no wrinkle occurs on the coating film surface.

[0117]

A photograph of a capsule produced with the frozen content of Example 10 is illustrated in Fig. 16. Herein, water-soluble cellulose is used, and thus no wrinkle occurs on the capsule surface.

[0118]

(Example 11)

Equal amounts of a tequila to which 0.5% (on a volume basis) of the gardenia red dye was added and a 4% calcium lactate aqueous solution were mixed to provide a content. The content ratio of the gardenia red dye with respect to the total mass of the content at 25°C was 0.25% by mass. The content ratio of calcium lactate with respect to the total mass of the content at 25°C was 2% by mass. The content ratio of ethyl alcohol (containing a tequila) in the content at 25°C was 20% by volume (the content ratio of the tequila was 50% by volume).

[0119]

(Example 12)

Equal amounts of a tequila to which 0.5% (on a volume basis) of the above described capsicum dye was added and a 4% calcium lactate aqueous solution were mixed to provide a content. The content ratio of the capsicum dye with respect to the total mass of the content at 25°C was 0.25% by mass. The content ratio of calcium lactate with respect to the total mass of the content at 25°C was 2% by mass. The content ratio of ethyl alcohol (containing a tequila) in the content at 25°C was 20% by volume (the content ratio of the tequila was 50% by

volume).

Capsules were produced by the method described above for the contents of Examples 11 and 12.

A frozen content and a content obtained by melting the frozen content were encapsulated in the coating film of the obtained capsule, and liquid leakage was not confirmed.

In addition, the obtained capsules were all seamless and had an excellent appearance.

In addition, the obtained capsules were placed in a container with a screw cap and stored at 4°C for 1 month. After storage, the capsule was cut, and the content was confirmed, and as a result, gelation was not observed.

It has been found that the designability of the resulting capsule can be improved by containing the dye in the content.

[0120]

(Example 13)

Equal amounts (on a volume basis) of a tequila and a 4% calcium lactate aqueous solution were mixed, and about 15% by mass of a solid material of a lemon fruit (pulp or the like) was added to provide a content. The content ratio of calcium lactate with respect to the total mass of the content at 25°C was 2% by mass. The content ratio of ethyl alcohol (containing a tequila) in the content at 25°C was 20% by volume (the content of the tequila was 50% by volume). The content ratio of calcium lactate with respect to the total mass of the content at 25°C was 2% by mass.

Capsules were produced in the same manner as described

above except that the above content was used.

A frozen content and a content obtained by melting the frozen content were encapsulated in the coating film of the obtained capsule, and liquid leakage was not confirmed.

In addition, the obtained capsules were all seamless and had an excellent appearance.

In addition, the obtained capsules were placed in a container with a screw cap and stored at 4°C for 1 month. After storage, the capsule was cut, and the content was confirmed, and as a result, gelation was not observed.

The above Example can encapsulate a solid material.

[0121]

[Reinforcement of capsule coating film (coating treatment)]

(Example 14)

Except that xanthan gum was not used, or the content ratio of xanthan gum with respect to the total mass of the content was changed to 0.1% or 0.25%, capsules were produced in the same manner as in Example 4, and the capsules were submerged in a cation-imparting solution liquid and allowed to stand at room temperature (25°C) for about 10 minutes.

The cation-imparting solution at this time contained 0.1% (each on a mass basis) of poly-L-lysine (product name: SALAD KEEP, manufactured by Okuno Chemical Industries Co., Ltd.).

Thereafter, the capsules charged for submergence were scooped with wire mesh and separated from the cation-imparting solution.

Then, the capsules were charged into a coating treatment solution containing a coating agent for submergence, and was allowed to stand at room temperature (25°C) for about 30 minutes to form a coating on the coating film surface. The coating treatment solution contained 0.5% (on a mass basis) of agar (agarose) (product name: powder agar to dissolve in hot water, manufactured by Ina Food Industry Co., Ltd.).

Thereafter, the capsules were scooped with wire mesh, separated, and washed with distilled water.

A frozen content and a content obtained by melting the frozen content were encapsulated in the coating film of the obtained capsule, and liquid leakage was not confirmed.

In addition, the obtained capsules were all seamless and had an excellent appearance.

In addition, the obtained capsules were placed in a container with a screw cap and stored at 4°C for 1 month. After storage, the capsule was cut, and the content was confirmed, and as a result, gelation was not observed.

As a comparison target, capsules (untreated capsules) not treated with the cation-imparting solution and the coating treatment solution were separately prepared.

[0122]

[Measurement of capsule strength]

The breaking loads and capsule heights of the capsule treated with the cation-imparting solution and the coating treatment solution and the untreated capsule were measured 1 day and 4 days after capsule production, respectively, and are

illustrated in Fig. 17.

[0123]

(Example 15)

Except that xanthan gum was not used, or the content ratio of xanthan gum with respect to the total mass of the content was changed to 0.1% or 0.25%, capsules were produced in the same manner as in Example 7.

The capsules were treated with a cation-imparting solution and a coating treatment solution in the same manner as in Example 14.

Thereafter, the capsules were scooped with wire mesh, separated, and washed with distilled water.

A frozen content and a content obtained by melting the frozen content were encapsulated in the coating film of the obtained capsule, and liquid leakage was not confirmed.

In addition, the obtained capsules were all seamless and had an excellent appearance.

In addition, the obtained capsules were placed in a container with a screw cap and stored at 4°C for 1 month. After storage, the capsule was cut, and the content was confirmed, and as a result, gelation was not observed.

As a comparison target, capsules (untreated capsules) not treated with the cation-imparting solution and the coating treatment solution were separately prepared.

[0124]

The breaking loads and capsule heights (in the figure, described as a capsule height) of the capsule treated with the

cation-imparting solution and the coating treatment solution and the untreated capsule were measured 1 day and 4 days after capsule production, respectively, and are illustrated in Figs. 18 to 21.

[0125]

(Example 16)

The capsules produced with the content of Example 1 were submerged in a tequila stock solution, a tequila solution containing calcium chloride, or a tequila solution containing calcium lactate for 42 hours, and the content ratio of ethyl alcohol with respect to the total mass of the solidified content and the content encapsulated in the capsule coating film was measured after 2 hours, 6 hours, 12 hours, 18 hours, 30 hours, and 42 hours, respectively.

Both the content ratio of calcium chloride with respect to the total mass of the tequila solution containing calcium chloride and the content ratio of calcium lactate with respect to the total mass of the tequila solution containing calcium lactate were 2% by mass.

The content ratio of tequila with respect to the total mass of the tequila solution containing calcium chloride was 98% by volume, and the content ratio of tequila with respect to the tequila solution containing calcium lactate was 50% by volume.

The results are illustrated in Fig. 22.

In Fig. 22, a line graph connecting black dots indicates a change with time in the ethyl alcohol content ratio of the capsule left standing in the air, the line graph connecting the

black square points indicates the change with time in the ethyl alcohol content ratio of the capsule left standing in the tequila stock solution, and the line graph connecting the white triangle points indicates the change with time in the ethyl alcohol content ratio of the capsule left standing in the tequila solution containing calcium chloride, and the line graph connecting the white rhombus points indicates the change with time in the ethyl alcohol content ratio of the capsule left standing in the tequila solution containing calcium lactate.

From the above results, it has been found that the transfer of tequila into the solidified content in the coating film proceeded by submergence in the tequila stock solution or the like, and the taste and aroma when the capsule was eaten were enhanced.

[0126]

(Example 17)

The capsules produced with the content obtained in Example 3 was treated with a cation-imparting solution and a coating treatment solution in the same manner as described above to form a coating on the surface.

A frozen content and a content obtained by melting the frozen content were encapsulated in the coating film of the obtained capsule, and liquid leakage was not confirmed.

In addition, the obtained capsules were all seamless and had an excellent appearance.

In addition, the obtained capsules were placed in a container with a screw cap and stored at 4°C for 1 month. After

storage, the capsule was cut, and the content was confirmed, and as a result, gelation was not observed.

[0127]

(Example 18)

0.5% sodium alginate aqueous solution in a contacting solution was changed to a 1.0% sodium alginate aqueous solution and the content obtained in Example 3 was used to produce capsules in the same manner as described above.

A frozen content and a content obtained by melting the frozen content were encapsulated in the coating film of the obtained capsule, and liquid leakage was not confirmed.

In addition, the obtained capsules were all seamless and had an excellent appearance.

In addition, the obtained capsules were placed in a container with a screw cap and stored at 4°C for 1 month. After storage, the capsule was cut, and the content was confirmed, and as a result, gelation was not observed.

[0128]

(Example 19)

The capsules obtained in Example 18 was treated with a cation-imparting solution and a coating treatment solution in the same manner as described above to form a coating on the surface.

A frozen content and a content obtained by melting the frozen content were encapsulated in the coating film of the obtained capsule, and liquid leakage was not confirmed.

In addition, the obtained capsules were all seamless and

had an excellent appearance.

In addition, the obtained capsules were placed in a container with a screw cap and stored at 4°C for 1 month. After storage, the capsule was cut, and the content was confirmed, and as a result, gelation was not observed.

[0129]

(Example 20)

The hemispherical mold containing the content was changed to a spherical mold, and the content obtained in Example 3 was used to produce capsules in the same manner as described above.

The volume of the content was 100 ml.

A frozen content and a content obtained by melting the frozen content were encapsulated in the coating film of the obtained capsule, and liquid leakage was not confirmed.

In addition, the obtained capsules were all seamless and had an excellent appearance.

In addition, the obtained capsules were placed in a container with a screw cap and stored at 4°C for 1 month. After storage, the capsule was cut, and the content was confirmed, and as a result, gelation was not observed.

[0130]

(Example 21)

The hemispherical mold containing the content was changed to a spherical mold, and the content obtained in Example 3 was used to produce capsules in the same manner as described above.

The volume of the content was 600 ml.

A frozen content and a content obtained by melting the

frozen content were encapsulated in the coating film of the obtained capsule, and liquid leakage was not confirmed.

In addition, the obtained capsules were all seamless and had an excellent appearance.

In addition, the obtained capsules were placed in a container with a screw cap and stored at 4°C for 1 month. After storage, the capsule was cut, and the content was confirmed, and as a result, gelation was not observed.

[0131]

<Measurement of average thickness>

The average thickness of the capsule coating film obtained in Examples 3 and 17 to 21 (case of having a coating, the sum of the average thicknesses of the coating film and the coating) was measured and summarized in Table 1.

[0132]

[Table 1]

	Average thickness (mm)
Example 3	0.36
Example 17	0.34
Example 18	0.65
Example 19	0.62
Example 20	0.52
Example 21	1.16

CLAIMS

1. A method for producing capsules, comprising:
a step of solidifying a content including a core material and a curing agent to provide a solidified content; and
a step of contacting the solidified content with a contacting solution including a coating-film forming agent to provide a capsule including the solidified content and a coating film with the solidified content encapsulated.
2. The method according to claim 1, wherein the solidified content is obtained by freezing the content.
3. The method according to claim 1 or 2, further comprising a step of separating the capsule from the contacting solution.
4. The method according to claim 1 or 2, further comprising a step of submerging the capsule in a solution including the core material at 35% by volume or more.
5. The method according to claim 1 or 2, wherein the content includes ethyl alcohol.
6. The production method according to claim 1 or 2, wherein the content includes a thickener.
7. The method according to claim 1 or 2, wherein the content includes at least one of xanthan gum and a water-soluble cellulose derivative.
8. The method according to claim 1 or 2, wherein a temperature of the contacting solution is 40°C or more.
9. The method according to claim 1 or 2, wherein the content includes a solid material.
10. The method according to claim 7, wherein the solid

material is a second capsule encapsulating a second content, or fruit pulp.

11. The method according to claim 1 or 2, comprising a step of bringing the capsule into contact with a cation-imparting solution to charge a surface of the capsule with cations.

12. The method according to claim 1 or 2, further comprising a step of applying a coating treatment to the surface of the capsule.

13. The method according to claim 1 or 2, wherein an amount of the solidified content encapsulated in the capsule is 1 ml or more.

14. The method according to claim 1 or 2, wherein a breaking load of the capsule is 1 to 10 N.

15. The method according to claim 1 or 2, wherein an average thickness of the coating film is 10 μm to 10 mm.

16. A capsule comprising:

at least one of a content including a core material and a solidified content including a core material;

a coating film encapsulating the content and the solidified content; and

a coating that coats the coating film and includes at least one of agar and gelatin,

wherein a total amount of the content and the solidified content is 1 ml or more.

17. The capsule according to claim 16, wherein the content includes ethyl alcohol.

18. The capsule according to claim 16 or 17, wherein the

content and the solidified content include a thickener.

19. The capsule according to claim 16 or 17, wherein the content and the solidified content include at least one of xanthan gum and a water-soluble cellulose derivative.

20. The capsule according to claim 16 or 17, wherein the coating film seamlessly encapsulates the content and the solidified content.

21. The capsule according to claim 16 or 17, wherein the content includes a solid material.

22. The capsule according to claim 21, wherein the solid material is a second capsule encapsulating a second content, or fruit pulp.

23. A content comprising a core material and a curing agent and used in the production method according to claim 1 or 2.

24. A solidified content obtained by solidifying the content according to claim 23.

25. A composition comprising the solidified content according to claim 24 and a contacting solution including a coating-film forming agent.