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(54) Title: EDIBLE PRODUCT, METHOD OF PREPARING THE PRODUCT AND PROCESS OF PREPARING A READY-TO-EAT FOOD PRODUCT

(57) Abstract: The invention relates to a water-continuous edible product comprising 20-85 wt% water and at least 5 wt%, of dissolved components selected from salts, sugars, sugar alcohols and combinations thereof, and having a water activity in the range of 0.70 to 0.95, said product containing: • at least 50 pmol/kg of allyl isothiocyanate (AITC); and • 480-2,200 pmol/kg of cinnamate; wherein the AITC and cinnamate are present in respective concentrations [AITC] and [cinnamate] that meet the following requirement: [AITC] < 230 - (0.064 x [cinnamate]); and wherein [AITC] is the concentration of AITC in the edible product in pmol/kg and [cinnamate] is the concentration of cinnamate in the edible product in pmol/kg. Despite its relatively high water activity, the water-continuous edible product of the present invention is effectively protected against growth of yeast and mould by the presence of a combination of allyl isothiocyanate and cinnamate in the indicated concentrations. A method of preparing the product and a process of preparing a ready-to-eat food product are also claimed.



EDIBLE PRODUCT, METHOD OF PREPARING THE PRODUCT AND PROCESS OF PREPARING A READY-TO-EAT FOOD PRODUCT

Technical field of the invention

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The present invention relates to an edible product containing a preservative system. More particularly, the invention provides a water-continuous edible product comprising 20-85 wt% water and at least 5 wt%, of dissolved components selected from salts, sugars, sugar alcohols and combinations thereof, and having a water activity in the
10 range of 0.70 to 0.95, said product containing a preservative combination of allyl isothiocyanate (AITC) and cinnamate.

Background of the invention

15 Industrially produced savoury products like bouillons, soups and sauces are well known. Savoury products can be divided in ready-to-eat products and concentrated products. Ready-to-eat savoury products merely require heating by the consumer. Concentrated savoury products need to be diluted with hot water prior to consumption.

20 Dry concentrated savoury products have the advantage of low volume and good shelf stability. Aqueous concentrated savoury products are more voluminous but are often preferred as they appear more fresh and of higher quality. However, these aqueous concentrated savoury products often require the addition of preservatives to render them shelf-stable and/or to achieve an acceptable open shelf-life.

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WO 01/35769 describes products, including food products, comprising:

- (a) a constituent comprising one or more isothiocyanate compounds; and
- (b) a preservative selected from the group consisting of sorbate preservatives, benzoate preservatives, and mixtures thereof.

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US 2007/275140 describes a beverage composition comprising:

a preservative system comprising from about 20 ppm to about 400 ppm of cinnamic acid and from about 100 ppm to about 1000 ppm of at least one weak acid chosen from benzoic acid, sorbic acid, alkali metal salts of benzoic acid and/or sorbic acid, and
35 mixtures thereof;

- at least one beverage component chosen from juices, sweeteners and mixtures thereof; and
- from about 60% to about 99% of water, by weight relative to the total composition; wherein the composition has a pH ranging from about 2.4 to about 4.5

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WO 2012/085881 describes an antimicrobial protectant composition comprising

(a) allyl isothiocyanate; and

(b) an organic acid selected from acetic acid, propionic acid and mixtures thereof and optionally further comprising

10 (c) green tea *Camelia sinensis* extract.

This international patent application also describes food products containing such antimicrobial protectant composition.

WO2008/098804 describes a microbiologically stable low fat or oil consumer food
15 product comprising: an aliphatic isothiocyanate; an aromatic isothiocyanate; and 3-65 % oil, wherein the aliphatic and aromatic isothiocyanates are present at a concentration ratio from about 1:3 to about 1:300, respectively; and wherein the aliphatic and aromatic isothiocyanates make up collectively, more than about 75 ppm of the total concentration of the consumer product.

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Lia et al. (*Antimicrobial and chemopreventive properties of herbs and spices*, Current Medical chemistry 2004 (11), 1451-1460) report on the antimicrobial properties of herbs and spices. Allyl isothiocyanate is listed as the major antimicrobial component of mustard.

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Patel (*Plant essential oils and allied volatile fractions as multifunctional additives in meat and fish-based food products: a review*, Food Additives & Contaminants: 2015 (32), no. 7, 1049-1064) discusses plant essential oils and their application as food preservatives. Reference is made to a study by Kamii et al. (2001) in which the
30 antibacterial activity of essential oil vapours against histamine-producing bacteria in tuna and mackerel flesh was evaluated. Allyl isothiocyanate and salicylaldehyde in the oils were found to quell aerobic bacteria and histamine-producing bacteria.

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Summary of the invention

The inventors have developed a preservative system that is particularly effective in preventing growth of yeast and mould in edible products with high water activity (0.70 to 0.95). More particularly the inventors have discovered that yeast and mould growth in water-continuous edible products can be prevented very effectively by incorporating a combination of at least 50 $\mu\text{mol/kg}$ of allyl isothiocyanate (AITC) and 480-2,200 $\mu\text{mol/kg}$ of cinnamate, wherein the AITC and cinnamate are present in respective concentrations [AITC] and [cinnamate] that meet the following requirement: [AITC] $\leq$ 230 – (0.064 x [cinnamate]); and wherein [AITC] is the concentration of AITC in the edible product in $\mu\text{mol/kg}$ and [cinnamate] is the concentration of cinnamate in the edible product in $\mu\text{mol/kg}$.

This preservative combination can be used instead of other preservatives like benzoate or sorbate. Thus, the present invention allows the food developer more freedom to formulate shelf-stable edible products.

These and other aspects, features and advantages will become apparent to those of ordinary skill in the art from a reading of the following detailed description and the appended claims. For the avoidance of doubt, any feature of one aspect of the present invention may be utilised in any other aspect of the invention.

Detailed description of the invention

A first aspect of the invention relates to a water-continuous edible product comprising 20-85 wt% water and at least 5 wt%, of dissolved components selected from salts, sugars, sugar alcohols and combinations thereof, and having a water activity in the range of 0.70 to 0.95, said product containing:

- at least 50 $\mu\text{mol/kg}$ of allyl isothiocyanate (AITC); and
 - 480-2,200 $\mu\text{mol/kg}$ of cinnamate;
- wherein the AITC and cinnamate are present in respective concentrations [AITC] and [cinnamate] that meet the following requirement: [AITC] $\leq$ 230 – (0.064 x [cinnamate]); and wherein [AITC] is the concentration of AITC in the edible product in $\mu\text{mol/kg}$ and [cinnamate] is the concentration of cinnamate in the edible product in $\mu\text{mol/kg}$.

The term "cinnamate" as used herein refers to cinnamic acid ((E)-3-phenylprop-2-enoic acid), salts of cinnamic acid, dissociated forms of the acid and these salts, and combinations thereof.

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Whenever reference is made to the water content of the edible product this includes the water that is contained in ingredients, such as vegetables, unless otherwise indicated. The water content in the edible product can be measured by completely drying the edible product and comparing the weight before and after drying.

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When the concentration of components of the edible product is expressed by weight of the water, this refers to the total amount of water present in the edible product.

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The word "comprising" is intended to mean "including" but not necessarily "consisting of" or "composed of." In other words, the listed steps or options need not be exhaustive. It is noted that the examples given in the description below are intended to clarify the invention and are not intended to limit the invention to those examples per se. Ratio's are weight/weight, unless indicated otherwise. Similarly, all percentages are weight/weight percentages unless otherwise indicated. Except in the operating and comparative examples, or where otherwise explicitly indicated, all numbers in this description indicating amounts of material or conditions of reaction, physical properties of materials and/or use are to be understood as modified by the word "about".

20

Numerical ranges expressed in the format "from x to y" are understood to include x and y. When for a specific feature multiple preferred ranges are described in the format "from x to y", it is understood that all ranges combining the different endpoints are also contemplated.

25

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps.

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Water-continuous edible product

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The water-continuous edible product according to the present invention includes, for example, oil-in-water emulsions, bi-continuous emulsions and suspensions. The water-

continuous edible product of the present invention can be provided in different forms, e.g., a liquid, a paste or a gel. Preferably, the water-continuous edible product is a paste or a gel. Most preferably, the water-continuous edible product is a gel.

- 5 The water-continuous edible product preferably has a pH of at least 3.5, more preferably of 4 to 9, most preferably of 4.5 to 8.

Typically, the water-continuous edible product contains 30-70 wt%, more preferably 35-60 wt% and most preferably 40-50 wt% of dry matter.

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The water-continuous edible product preferably contains at least 10 wt% and more preferably at least 12 wt% of dissolved components selected from salts, sugars, sugar alcohols and combinations thereof.

- 15 According to a particularly preferred embodiment, the water-continuous edible product is a savoury product, more preferably a savoury food concentrate. For the purpose of the present invention a savoury food concentrate is intended to mean a food product that is designed to be consumed only after appropriate dilution with a hot aqueous phase. After the dilution the food concentrate results in a ready-to-eat product like a
- 20 bouillon, a soup, a sauce, a gravy or a dish. In the present context, the term dilution is intended to encompass dilution, dissolving and dispersing as some ingredients in the concentrate may be said to be diluted while others could be said to rather dissolve/disperse. The aqueous phase may be water or part of a dish. For example when the concentrate is mixed with hot water it may result in a soup or gravy. On the
- 25 other hand the concentrate can also be designed to prepare a dish like a stew whereby the concentrate is diluted into the dish during the preparation thereof. The formulation of the savoury food concentrate is adjusted to the desired dilution factor. For example, if the dilution is 10 fold, the ingredients in the concentrate will be 10 times higher than in the prepared ready-to-eat product. The dilution rate is preferably at least 5 times, at
- 30 least 10 times and at most 30 times. Diluting 20g of concentrate in 180g of aqueous phase would correspond to a dilution of 10 times. Thus, the present invention includes a process to prepare a ready-to-eat food product said process comprising the steps of a) providing a food concentrate according to the invention

b) diluting said food concentrate with a hot aqueous phase with a dilution ratio of at least 5 times to form a ready-to-eat food product like a bouillon, a soup, a sauce, a gravy or a dish.

5 Allyl isothiocyanate (AITC)

Allyl isothiocyanate ($\text{CH}_2\text{CHCH}_2\text{NCS}$) can be added as an essentially pure substance or it may be added in the form of a plant material or an isolate of a plant material.

Examples of plant materials that can be used as a source of AITC include horseradish, mustard (particularly black mustard), turnip, cabbage, brussels sprout, kale, collards
10 and cauliflower.

The water-continuous edible product preferably comprises at least 60 $\mu\text{mol/kg}$, more preferably at least 70 $\mu\text{mol/kg}$, even more preferably at least 80 $\mu\text{mol/kg}$ and most preferably at least 90 $\mu\text{mol/kg}$ of AITC.

15

Calculated by weight of water, the product preferably comprises 70-600 $\mu\text{mol/kg}$, more preferably 90-520 $\mu\text{mol/kg}$, even more preferably 110-450 $\mu\text{mol/kg}$, yet more preferably 125-370 $\mu\text{mol/kg}$ and most preferably 135-300 $\mu\text{mol/kg}$ of AITC.

20 Allyl isothiocyanate is typically poorly water-soluble. Nonetheless at the concentration in which AITC is employed in the water-continuous edible product of the present invention the bulk of the AITC is typically dissolved in the water. Naturally, if lipid components are present in the edible product, a substantial fraction of the AITC may be dissolved in these lipid components. Preferably, at least 90 wt.% of the AITC, more
25 preferably at least 95 wt.% of the AITC in the water-continuous edible product is present in dissolved form. Most preferably, all of the AITC present in the product is dissolved.

Cinnamate

30 Cinnamate can be added as an essentially pure substance or it may be added in the form of a plant material or an isolate of a plant material. Examples of plant materials that can be used as a source of cinnamate include cinnamon, coffee beans, tea, Yerba mate, cocoa, apples and pears, berries, citrus, grape, *Brassica* vegetables, spinach, beetroot, artichoke, potato, tomato, celery, faba beans, and cereals.

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The water-continuous edible product of the present invention preferably comprises 530-1,600 $\mu\text{mol/kg}$, more preferably 600-1,500 $\mu\text{mol/kg}$ and most preferably 800-1,200 $\mu\text{mol/kg}$ of cinnamate.

- 5 Calculated by weight of water, the water-continuous edible product preferably comprises not more than 6,500 $\mu\text{mol/kg}$, more preferably 750-3,000 $\mu\text{mol/kg}$ and most preferably 1,000-2,400 $\mu\text{mol/kg}$ of cinnamate.

- 10 Preferably, at least 90 wt.% of the cinnamate, more preferably at least 95 wt.% of the cinnamate in the edible product is present in dissolved form. Most preferably, all of the cinnamate present in the product is dissolved.

Gel

- 15 As explained herein before, according to a particularly preferred embodiment, the present water-continuous edible product is a gelled product.

- As known in the art, at 20°C a gel is normally solid, i.e. not a pourable liquid. In normal use, a consumer cannot pour a gelled product from its packaging, but it can be removed from the packaging as one piece, which maintains its shape (shape stable).
- 20 Indeed, a solid gel is not considered to have a viscosity, which can be measured with for example a Brookfield viscometer, as the texture of the solid gel will break during measurement. An edible product in the form of a gel can deform under pressure or gravity to some extent, depending on how strong the gel is, but the elasticity of the gel allows the product to revert its original shape after removal of the pressure. The water-
- 25 continuous edible product of the present invention preferably is an elastic gel. The gel may be a brittle gel, for example when agar-agar is used as a gelling agent. In case of a brittle gel, the gel has a breaking point. A breaking point can be analysed by a person skilled in the art.

- 30 The edible products of the present invention can be characterised by measuring the elastic modulus G' and the viscous modulus G'' thereof. Elastic and viscous moduli are terms known in the art of rheology. They have been described for example in "Das Rheologie Handbuch, Thomas Mezger, Curt R. Vincentz-Verlag, Hannover, 2000". The elastic modulus G' of the edible product is preferably higher than 30 Pa, more
- 35 preferably higher than 50 Pa, more preferably higher than 80 Pa. It is preferably lower

than 50000 Pa, more preferably lower than 10000 Pa, even more preferably lower than 5000 Pa, more preferably lower than 1000 Pa, more preferably lower than 500 Pa, more preferably lower than 350 Pa.

- 5 The viscous modulus G'' is preferably higher than 1 Pa, more preferably higher than 5 Pa, more preferably higher than 10 Pa.

The ratio of the elastic modulus to the viscous modulus G'/G'' of the edible product is preferably higher than 1, more preferably higher than 2, even more preferably higher
10 than 5. It is preferably lower than 1000, preferably lower than 200, even more preferably lower than 100, most preferably lower than 50.

Said values for the elastic modulus (G') and viscous modulus (G'') can be obtained by performing a measurement in a standard rheometer, such as an Anton Paar Physica
15 rheometer or a TA Instruments rheometer, mounted with a parallel plate geometry and applying the following experimental protocol:

- Pre-heat the plate to 75°C
- Melt the sample and load the liquid sample onto the plate,
- Cool the sample to 5 °C, at a rate of 5 °C/min
- 20 • Hold the sample at 5 °C for 15 minutes
- Heat the sample to 20 °C and keep the sample at this temperature for 10 minutes
- Record the values for the elastic modulus (G') and viscous modulus (G'') 10
minutes after the sample has reached 20 °C, by oscillating the plate at a strain of
1% and a frequency of 1 Hz

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A gel shows elastic deformation. This type of deformation is to a large extent reversible. For example, after reducing deforming pressure, e.g. from gravity or gentle pressure by a finger, the shape will reform to a large extent to its original form. In addition, at 20°C, a gel in the context of the present invention does not flow, like a
30 liquid. Further, at 20°C, after cutting of the gel in some pieces, the pieces of gel cannot be substantially adhered and united by simple re-assembling of the gel pieces, to form the original volume of the gel.

In contrast to a gel, a paste does not show elastic deformation but shows a plastic
35 deformation behavior, at least, the plastic deformation is (much) higher than the

elastic deformation. Thus, after deformation by pressure, a paste will hardly return towards its original shape, if at all. Also liquid products neither show elastic deformation, nor are they shape stable after removal from the package. It is therefore in the normal skill of the artisan, to assess whether a product is a gel or not.

5

A gel can be distinguished from a paste in the following manner using a texture analysis machine (TAX-T2) of Stable Micro Systems as known in the art. (e.g. WO 2012/097930). That method is based on a standard measurement called TPA (Texture Profile Analysis), as known for a skilled person and as described for example
10 in "Gums and Stabilisers for the Food Industry 6", edited by G.O. Phillips, P.A. Williams and D.J. Wedlock (published by Oxford University Press, 1992). The product with minimum dimensions of 45 mm length / 30 mm width / 10 mm height, in the packaging (e.g. a plastic tub), is punched twice with a 5 mm diameter spherical (ball) probe (P/5S, stainless steel), to create a small deformation of the surface of the product by 2,5 mm.
15 The TA-parameters are: Prespeed 1 mm/s, Test speed 0.5 mm/s, Post-Test speed 1 mm/s, Distance 2.5 mm, Second Distance 2.5 mm, Trigger Auto, Trigger Force 0.0 g, Trigger Distance 0.1mm.

For a gel, the force required for the second deformation step is close to the force
20 required for the first deformation step. This is because of the elastic character of a gel. For a paste (which is not liquid), the force required for the second deformation step will be significantly lower, as in a paste the elasticity is low, if not absent. The time between the two measurements points is sufficient to allow a possible reformation of the gel structure after the first deformation. Typically, the time between
25 the measurements is 10 seconds. For a gel, typically the force required for the second deformation is higher than 85%, preferably higher than 87%, most preferably higher than 90% of the force required for the first deformation.

Preferably, the edible product should also have a certain strength: preferably the
30 strength should be such that the force (in gram) necessary for a plunger to penetrate 10 mm into the edible product exceeds 15g, more preferably exceeds 30g, most preferably exceeds 50g. Moreover, preferably no phase separation occurs during this measurement.

Preferably, the strength measurement is carried out after 1 week storage at ambient temperature (20°C) using a Texture Analyser TA – XT2 plus (Stable Micro Systems Ltd) with a finger probe of 12.7mm diameter and a penetration speed of 0.5 mm/s. The sample is filled in a polypropylene container with the following dimensions:

- 5 • bottom diameter: 5 cm
- top diameter: 6.3 cm
- height of the container: 7.3 cm.

The applied filling height is 5 cm. The finger probe penetrates the sample 15 mm in depth. The strength of the structured edible product corresponds to the force needed at
10 10mm depth.

Water

The water-continuous edible product typically comprises at most 80 wt%, more preferably at most 70 wt%, even more preferably at most 65 wt% water.

15 The water content of the product preferably is at least 30 wt%, more preferably at least 40 wt% and most preferably at least 50 wt%.

The edible product typically has a water activity of at least 0.72, more preferably of at
20 least 0.74 and most preferably of at least 0.75.

The water activity of the edible product is preferably at most 0.93, more preferably at most 0.92, even more preferably at most 0.91 and most preferably at most 0.90.

25 The present invention allows formulation of food products without the need to use relatively low pH. The edible product may have any pH, preferably the pH is at least 3.5, preferably at least 4, preferably at least 4.5, preferably at most 9, more preferably at most 8.

30 Salt

Preferably, the water-continuous edible product (e.g. concentrate) contains at least 5 wt%, preferably at least 8 wt%, more preferably at least 10 wt% salt selected from NaCl, KCl and combinations thereof. Typically, the concentration of this salt in the edible product does not exceed 20 wt.%. Most preferably, the salt content of the edible
35 product does not exceed 18 wt.%.

Calculated by weight of water, the edible product preferably comprises at least 7 wt%, more preferably at least 10 wt% and most preferably at least 14 wt% salt selected from NaCl, KCl and combinations thereof.

5

Preferably, the amount of salt (NaCl and/or KCl) in the edible product does not exceed 30 wt%, even more preferably does not exceed 27 wt%, most preferably does not exceed 25 wt%, calculated by weight of the water that is contained in the water-continuous edible product.

10

The salt (NaCl and/or KCl) in the edible product is preferably fully dissolved.

Gelling system

As explained above, the water-continuous edible product of the present invention preferably is a gelled product. Accordingly, the product preferably contains a gelling system in an amount effective to form a gel. The effective amount may depend on the type of gelling system which is chosen and is known to the skilled person or can be easily determined.

20 Preferably, the gelling system comprises - more preferably is - a gelling system selected from the group consisting of gelatinised modified starch, gelatine combined with gelatinised starch, xanthan gum combined with a glucomannan, xanthan gum combined with a galactomannan, xanthan gum combined with carrageenan, carrageenan, agar-agar, and mixtures thereof. These gelling systems proved
25 advantageous in the context of the present invention, for example as these gelling systems can provide a shape stable gel in the context of this invention.

Gelling systems may comprise one or more polysaccharide gums. The total amount of polysaccharide gums taken together is preferably between 0.1 wt% and 10 wt%, based
30 on the water content of the edible product, more preferably, the amount is from 0.2 to 6 wt%, even more preferably of from 0.3 to 3 wt%, as based on the water content of edible product.

Preferably, the gelling system comprises more than 50 wt%, preferably more than 75
35 wt%, more preferably more than 90 wt%, most preferably more than 95 wt% (based on

the weight of the gelling system) of one of the group of gelling systems consisting of modified starch, gelatine combined with starch, carrageenan, xanthan combined with a carrageenan, xanthan gum combined with a glucomannan, xanthan gum combined with a galactomannan and agar-agar, low-methoxy pectin. Most preferably, the gelling system comprises more than 50 wt%, preferably more than 75 wt%, more preferably more than 90 wt%, most preferably more than 95 wt% (based on the weight of the gelling system) of a gelling system consisting of xanthan gum combined with a galactomannan.

10 If the gelling system comprises or is modified starch, it is present in an activated form, i.e. in the gelatinised form. Modified starch is preferably present in an amount of from 10 wt% to 30 wt% (weight % based on water content of the edible product).

If the gelling system comprises - more preferably is - xanthan gum combined with a glucomannan, like konjac mannan, the amount of xanthan gum is preferably present in an amount of from 0.1 wt% to 2 wt%, preferably in an amount of from 0.4 wt% to 1.8 wt%, even more preferably of from 0.6 wt% to 1.5 wt%, most preferably of from 0.6 wt% to 1 wt% (weight % based on the water content of the edible product). The glucomannan is preferably present in an amount of from 0.5 wt% to 4 wt%, more preferably of from 0.6 wt% to 2 wt%, even more preferably of from 0.6 wt% to 1.5%, most preferably of from 0.6 wt% to 1 wt% (weight % based on water content of the edible product).

If the gelling system comprises, more preferably, is a combination of gelatine and (gelatinised) starch, gelatine is preferably present in an amount of from 1.5 wt % to 30 wt%, more preferably in an amount of from 6 wt% to 20 wt%, even more preferably of from 12 wt% to 20 wt%, based on the water content of the edible product. The starch is preferably present in an amount of from 0.1 wt% to 10 wt%, more preferably from 1 wt % to 7 wt%, most preferably of from 3 wt% to 6 wt%, based on the water content of the edible product. Starch is present in the activated, i.e. gelatinised form. The gelling may comprise or consist of low-methoxy pectin (LM-pectin). LM pectin may be in amidated or unamidated form. It may be present in 0.6-10 wt% (based on the weight of the water content of the edible product). Ca ions may be used to induce gel formation with LM pectin: preferably at a level of 1 to 10 wt% by weight of the LM-pectin. Alternatively, a pH of less than 3.5 may be used.

If the gelling system comprises, more preferably, is xanthan gum combined with a galactomannan, preferably, the combination of xanthan gum with galactomannan is present in an amount of from 0.1 wt% to 10 wt%, preferably in an amount of from 0.2 wt% to 7 wt%, more preferably in an amount of from 0.5 wt% to 5 wt%, most preferably
5 in an amount of from 0.8 wt% to 3 wt%, based on the weight of the water content of the edible product.

Optimal results were observed for the combination of xanthan gum with galactomannan, when the gelling system comprises xanthan gum combined with
10 anyone of the group consisting of locust bean gum, guar gum and mixtures thereof. Most preferably, the gelling system comprises the combination of xanthan gum and locust bean gum. This combination of xanthan gum with galactomannan, preferably with locust bean gum, is preferably present in an amount of from 0.1 wt% to 10 wt%, preferably in an amount of from 0.2 wt% to 7 wt%, more preferably in an amount of
15 from 0.5 wt% to 5 wt%, most preferably in an amount of from 0.8 wt% to 3 wt, based on the weight of the water content of the edible product.

Taste imparting ingredients

The water-continuous edible product according to the invention preferably contains
20 taste-imparting ingredients other than salt, sugar and the components of the preservative combination. The product may suitably comprise one or more taste imparting ingredients selected from yeast extract; hydrolyzed proteins of vegetables-, soy-, fish-, or meat-origin; liquid or dissolvable extracts or concentrates selected from the group consisting of meat, fish, crustaceans, herbs, fruit, vegetable and mixtures
25 thereof; particles of meat; particles of fish; particles of crustaceans; particles of plant (e.g. herbs, vegetable, fruit); particles of fungi (e.g. mushroom); flavours and mixtures thereof. In the above, where it says "meat" this is preferably to be understood to comprise beef, pork, lamb or chicken (and other fowl). Preferably the plant pieces comprise pieces selected from the group consisting of onion, garlic, leek, carrot,
30 parsley, tomato and mixtures thereof. Preferably the amount of taste-imparting ingredients as set out above is from 1 wt% to 40 wt% (by weight of the edible product). More preferable, the amount of taste-imparting ingredients is present in amounts of from 3 wt% to 35 wt%, even more preferably from 5 wt% to 30% wt%, based on the weight of the total edible product.

Oil

In accordance with a preferred embodiment, the water-continuous edible product contains 1-30 wt%, more preferably 2-20 wt% and most preferably 3-15 wt% oil. The oil imparts creaminess to the edible product and can serve as a vehicle for lipophilic components, such as vitamins and flavouring components.

The term "oil" as used in the present application encompasses fat. The latter is defined as an oil which is solid at 20°C but liquid above its melting temperature.

Preferably the oil comprises an oil selected from the group consisting of animal fat, butter fat, vegetable oil, fractions of animal fat, fractions of butter fat, fractions of vegetable oil, derivatives of animal fat, derivatives of butter fat, derivatives of vegetable oil and mixtures of all of before mentioned components. More preferably the oil comprises an oil selected from the group consisting of pork fat, chicken fat, beef fat, butter fat, fish oil, sun flower oil, olive oil, palm oil, palm kernel oil, corn oil, cottonseed cake oil, soy bean oil, arachide oil, sesame oil, canola oil, or rapeseed oil, mustard seed oil, their fractions, their derivatives and mixtures thereof.

The oil is usually present in small droplets in the edible product, preferably in emulsified form. This is obtained by applying sufficient shear during the preparation process. Any suitable emulsifier may be used, if needed.

Method of preparation

Another aspect of the present invention relates to a method of preparing the water-continuous edible product as defined herein, said method comprising combining one or aqueous components, a source of AITC and a source of cinnamate, wherein the source of AITC is selected from mustard, horseradish, turnip, cabbage, brussels sprout, kale, collards, cauliflower or a combination thereof; and the source of cinnamate is selected from cinnamon, coffee beans, tea, Yerba mate, cocoa, apples and pears, berries, citrus, grape, Brassica vegetables, spinach, beetroot, artichoke, potato, tomato, celery, faba beans, cereals or a combination thereof.

In accordance with a particularly preferred embodiment, the present method does not comprise the addition of synthetic AITC or synthetic cinnamate.

The source of AITC that is used in the present method is preferably mustard, especially mustard seed oil.

The source of the cinnamate that is employed in the present method is preferably
5 cinnamon.

Process to prepare a ready-to-eat food product

The invention also relates to a process of preparing a ready-to-eat food product said process comprising the steps of

- 10 a) providing a water-continuous edible product as defined herein before;
b) combining 1 part by weight of the edible product with 5 to 40 parts by weight of a hot aqueous liquid or a hot dish.

In accordance with a particularly preferred embodiment, the water-continuous edible
15 product used in this process is a gelled savoury concentrate as defined herein before.

The invention is further illustrated by the following non-limiting examples. It will be clear
20 to the skilled person how to carry out the invention by using equivalent means without departing from the invention.

Examples

Example 1

25 Food concentrates containing allyl isothiocyanate (AITC) and/or potassium cinnamate were prepared on the basis of the recipes shown in Table 1.

Table 1

NaCl	10.8 wt.% (15.1% by weight of water)
Malt extract	4 wt. %
Yeast extract	0.4 wt. %
Glucose	2 wt. %
Sunflower oil	10 wt. %
Xanthan	0.32 wt. % (0.4% by weight of water)
Starch	1.2 wt. % (1.7% by weight of water)
AITC	0, 15 ppm (0, 151 μ mol/kg)

K-cinnamate	0, 40, 110, 150, 300, 600 ppm (0, 215, 591, 805, 1661, 3221 $\mu\text{mol/kg}$)
Water	Balance

The A_w of these concentrates was 0.9. The water content was approximately 71.3 wt.%.

- 5 The concentrates were prepared with the following process.
 1. Water was added into a vessel (Thermomix)
 2. All ingredients except for the gelling agents were mixed with the water at 25°C
 3. Xanthan and Starch were admixed under high speed stirring
 4. pH was set to pH 5 (with HCl or NaOH)
- 10
 5. The mixture was heated up to 80°C and kept at 80°C for 10min.
 6. The heated mixture was hot filled into glass jars and the jars were capped.
 7. The concentrates were allowed to form a gel at 25° C for 24h.

The gelled food concentrates so obtained were inoculated with about 1000 cells per ml of a cocktail of 8 different species/strains of yeast, each with a known tolerance against low A_w and high salt. The species represented in the cocktail were: *Candida magnolia*, *Candida parapsilosis*, *Candida versatilis*, *Pichia membranaefaciens*, *Zygosaccharomyces bailli* (2 strains), *Zygosaccharomyces rouxii* (2 strains).

20 Separately aliquots of the same food concentrates were inoculated with about 1000 mould spores per ml of a cocktail of 8 different species/strains of moulds, each with a known tolerance against low A_w and high salt. The species represented in the cocktail were: *Eurotium herbariorum*, *Eurotium amstelodami*, *Penicillium roquefortii*, *Paecilomyces variotii*, *Cladosporium cladosporioides*, *Penicillium brevicompactum*, *Aspergillus tamarii*, *Aspergillus niger*.

The inoculated samples were stored for up to 17 weeks at 25°C.

30 During this storage period the number of live yeast cells was determined at regular intervals to establish the time period (expressed in weeks) after which these numbers had increased by at least a factor 1000. For the determination of mould growth a visual check was done at regular intervals (expressed in weeks). The outcome of these analyses is summarized in Tables 2a (yeast) and 2b (mould).

Table 2a

[AITC] in ppm	Stability against yeast growth (in weeks)					
	[K-cinnamate] in ppm					
	0	40	110	150	300	600
0	1			3	>12	>12
15	3	4	>12	>17	>17	>17

Table 2b

[AITC] in ppm	Stability against mould growth (in weeks)					
	[K-cinnamate] in ppm					
	0	40	110	150	300	600
0	1			1	1	2
15	1	2	>12	>17	>17	>17

5

Example 2

Gelled food concentrates containing allyl isothiocyanate (AITC) and/or potassium cinnamate were prepared in the same way as in Example 1. These gelled food concentrates were inoculated with about 1000 cells per ml of the same cocktail of species/strains of yeast as in Example 1 or with about 1000 spores per ml of the same cocktail of different species/strains of moulds as in Example 1.

The inoculated samples were stored for up to 17 weeks at 25°C.

15

During this storage period the number of live yeast cells was determined at regular intervals to establish the time period (expressed in weeks) after which these numbers had increased by at least a factor 1000. For the determination of mould growth a visual check was done at regular intervals (expressed in weeks). The outcome of these analyses is summarized in Tables 3a (yeast) and 3b (mould). The results for the combinations that are within the scope of claim 1 are shown in ***bold italic***.

20

Table 3a

[AITC] in ppm	Stability against yeast growth (in weeks)								
	[K-cinnamate] in ppm								
	0	40	75	110	150	225	300	600	1200
0	1				3	2	>12	>12	>13
8	1				<i>6</i>	<i>>13</i>	<i>>13</i>		
12	2		4		<i>>13</i>				

15	3	4		>12	>17		>17	>17	
20	>17		>13		>17		>17	>17	

Table 3b

[AITC] in ppm	Stability against mould growth (in weeks)								
	[K-cinnamate] in ppm								
	0	40	75	110	150	225	300	600	1200
0	1				1	1	1	2	4
8	1				2	4	>13		
12	2		4		>13				
15	1	2		>12	>17		>17	>17	
20	>13		>13		>17		>17	>17	

Claims

1. A water-continuous edible product comprising 20-85 wt% water and at least 5 wt%, of dissolved components selected from salts, sugars, sugar alcohols and combinations thereof, and having a water activity in the range of 0.70 to 0.95, said product containing:
 - at least 50 $\mu\text{mol/kg}$ of allyl isothiocyanate (AITC); and
 - 480-2,200 $\mu\text{mol/kg}$ of cinnamate;wherein the AITC and cinnamate are present in respective concentrations [AITC] and [cinnamate] that meet the following requirement: $[\text{AITC}] \leq 230 - (0.064 \times [\text{cinnamate}])$; and wherein [AITC] is the concentration of AITC in the edible product in $\mu\text{mol/kg}$ and [cinnamate] is the concentration of cinnamate in the edible product in $\mu\text{mol/kg}$.
2. Edible product according to claim 1 comprising at most 80 wt%, preferably at most 70 wt% and more preferably at most 65 wt% water.
3. Edible product according to claim 1 or 2 comprising at least 30 wt%, preferably at least 40 wt% and more preferably at least 50 wt% water.
4. Edible product according to any one of the preceding claims, wherein the product has a water activity of at least 0.72, more preferably of at least 0.74 and most preferably of at least 0.75.
5. Edible product according to any one of the preceding claims comprising at least 60 $\mu\text{mol/kg}$, preferably at least 70 $\mu\text{mol/kg}$ of AITC.
6. Edible product according to any one of the preceding claims comprising 530-1,600 $\mu\text{mol/kg}$ of cinnamate.
7. Edible product according to any one of the preceding claims, wherein the product contains at least 5 wt%, preferably at least 8 wt%, more preferably at least 10 wt% salt selected from NaCl, KCl and combinations thereof.

8. Edible product according to any one of the preceding claims, wherein the product has a pH of at least 3.5, preferably a pH of 4 to 9.
9. Edible product according to any one of the preceding claims, wherein the product contains at least 10 wt% and most preferably at least 12 wt% of dissolved components selected from salts, sugars, sugar alcohols and combinations thereof.
10. Edible product according to claim 9, wherein the product is a gel.
11. Edible product according to claim 10, wherein the product contains a gelling system selected from the group consisting of gelatinised modified starch, gelatine combined with gelatinised starch, xanthan gum combined with a glucomannan, xanthan gum combined with a galactomannan, xanthan gum combined with carrageenan, carrageenan, agar-agar, low-methoxy pectin and mixtures thereof.
12. Edible product according to any one of the preceding claims, wherein the product contains 30-70 wt%, preferably 35-60 wt%, more preferably 40-50 wt% of dry matter.
13. Edible product according to any one of the preceding claims, wherein the product is a gelled product having a pH in of 4.5 to 8 and a water activity in the range of 0.75 to 0.90, said product comprising 50-65 wt% water; 10-18 wt% salt selected from NaCl, KCl and combinations thereof, at least 90 $\mu\text{mol/kg}$ of AITC; and 800-1,200 $\mu\text{mol/kg}$ of cinnamate.
14. A method of preparing a water-continuous edible product according to any one of the preceding claims, said method comprising combining one or aqueous components, a source of AITC and a source of cinnamate, wherein the source of AITC is obtained from mustard, horseradish, turnip, cabbage, brussels sprout, kale, collards, cauliflower or a combination thereof; and the source of cinnamate is obtained from cinnamon, coffee beans, tea, Yerba mate, cocoa, apples and pears, berries, citrus, grape, *Brassica* vegetables, spinach, beetroot, artichoke, potato, tomato, celery, faba beans, cereals or a combination thereof.

15. A process of preparing a ready-to-eat food product said process comprising the steps of
 - a) providing a water-continuous edible product according to any one of claims 1-13;
 - b) combining 1 part by weight of the edible product with 5 to 40 parts by weight of hot aqueous liquid or a hot dish.

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2017/063319

A. CLASSIFICATION OF SUBJECT MATTER INV. A23L3/3535 A23L3/3526 A23L3/3499 A23L3/3517 ADD.		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) A23L		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	P. MICHAEL DAVIDSON ET AL: "Naturally Occurring Antimicrobials for Minimally Processed Foods", ANNUAL REVIEW OF FOOD SCIENCE AND TECHNOLOGY, vol. 4, no. 1, 28 February 2013 (2013-02-28), pages 163-190, XP055382300, US ISSN: 1941-1413, DOI: 10.1146/annurev-food-030212-182535 tables 2-3 Combining natural antimicrobials with processing methods; page 183 Concluding remarks; page 184 ----- -/-	1-15
☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 16 June 2017		Date of mailing of the international search report 28/06/2017
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Oenhausen, Claudia

INTERNATIONAL SEARCH REPORT

International application No

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 101 313 772 A (DONGGUAN GUANGYI FOOD ADDITIVE [CN]) 3 December 2008 (2008-12-03) claims 1-5 -----	1-15
A	CN 101 326 987 A (DONGGUAN GUANGYI FOOD ADDITIVE [CN]) 24 December 2008 (2008-12-24) claims 1-4 -----	1-15
A	JP 2014 054242 A (OGAWA & CO LTD) 27 March 2014 (2014-03-27) paragraph [0023] - paragraph [0024] -----	1-15

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2017/063319

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
CN 101313772	A	03-12-2008	NONE	

CN 101326987	A	24-12-2008	NONE	

JP 2014054242	A	27-03-2014	NONE	
