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(54) **Title:** PREPARATION OF AN EGG WHITE COMPOSITION

(57) **Abstract:** The present invention relates to a process for preparing an egg white composition, wherein egg white is incubated with a protein hydrolysate, wherein the egg white composition is prepared and a food product comprising an egg white composition.



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PREPARATION OF AN EGG WHITE COMPOSITION

5 The present invention relates to a process for the preparation of egg white.

Egg white is a desirable ingredient for many foods such as bakery products, meringues and meat products because of its excellent foaming and gelling properties (J. Food Engineering 83 (2007) 404-413). On an industrial scale, egg white is usually de-sugared and spray-dried followed by a so called hot room treatment of about 4 weeks at
10 about 70-85 degrees Celsius in order to reduce microbial contamination and restore functional property losses due to spray drying. A disadvantage of heating spray-dried egg white is that it is a very time and energy consuming process. The process from egg breaking to sales of spray dried egg white takes about 6 weeks.

15 The aim of the present invention is an improved process for the preparation of egg white with good gelling and foaming properties, which is less time and energy consuming than known in the art.

Summary

20 The present invention relates to a process for preparing an egg white composition, wherein egg white is incubated with a protein hydrolysate, and preparing the egg white composition.

It was surprisingly found that when an egg white composition was prepared according to a process of the present disclosure, the gelling temperature of the egg
25 white composition was increased, compared to egg white that had not been incubated with protein hydrolysate, while maintaining desirable foaming and / or gelling properties.

It was found that the egg white composition prepared by a process as disclosed herein had a gelling temperature that is 1 to 10 degrees Celsius higher, for example 2 to 8, or 3 to 7 degrees Celsius higher, than egg white that had not been incubated with
30 a protein hydrolysate.

An advantage of an egg white composition prepared by a process disclosed herein is that the egg white composition could be pasteurized to achieve sufficient reduction in microbial contamination.

Detailed description

5 The present invention relates to a process for preparing an egg white composition, wherein egg white is incubated with a protein hydrolysate, wherein the egg white composition is prepared. A process as disclosed herein comprises incubating egg white with a protein hydrolysate such that the egg white composition prepared comprises an increased gelling temperature than egg white that has not been treated with protein hydrolysate.

10 Gelling temperature of an egg white (composition) is defined herein as the temperature at which an egg white (composition) starts to form a gel, upon heating of the egg white (composition). In the context of the present invention the wording gelling and gelation have the same meaning and are used interchangeably. Gelling temperature can be measured by rheometry and is the point at which the elastic modulus (G') of a material is larger than the loss or viscosity modulus (G'').
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Egg white as used in a process of the present disclosure is used to indicate the clear liquid contained within an egg. Egg white is usually obtained by separating fresh eggs in yolk and egg white. Egg white may be homogenized before it is used in a process according to the present invention.

20 Egg white may be homogenized by incubating egg white at a temperature of 0-4 degrees Celsius at a pH of the egg white (pH 8.5-9.5). Said incubation step is followed by a step of centrifuging the egg white, resulting in homogenized egg white. Centrifuging egg white may be carried out by any suitable method known in the art.

A protein hydrolysate that is incubated with the egg white in the process of the present disclosure may be any suitable protein hydrolysate. As used herein a protein hydrolysate is a protein that has been hydrolysed by the action of a protease. A protease is an enzyme that hydrolyses peptide bonds between amino acids. A protein consists of one or more polypeptides, which consist of amino acids linked together by peptide bonds.
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30 Any suitable protein may be hydrolysed to obtain a protein hydrolysate that can be used in a process as disclosed herein, for instance derived from egg, egg white, dairy products, vegetable proteins, such as soy, canola, rapeseed, sunflower, pea or legume, wheat, corn, rice, or, meat, collagen, or microbial origin such as yeast or fungi.

Usually, a protein is hydrolysed to certain degree of hydrolysis to prepare a protein hydrolysate. There are several ways to express a degree of hydrolysis (DH) of a protein.

5 A protein hydrolysate may be a protein that has been hydrolysed to a degree of hydrolysis (DH) of between 5 and 55%, for instance between 8 and 50% or between 10 and 48%, expressed as the percentage of cleaved peptide bonds/total number of peptide bonds originally present*100, or as percentage free amino acids / total amount of protein as originally present. A protein hydrolysate may comprise a DH of between 30 and 60%, for instance between 35 and 55%, for instance between 40 and 50%
10 expressed as percentage free amino acids / total amount of protein. A protein hydrolysate may comprise a DH of 5 to 30%, for instance between 8 and 28% for instance between 10 and 25% expressed as percentage cleaved peptide bonds/total number of peptide bonds.

A method to determine the degree of hydrolysis is by using orthophthalic anhydride (OPA), which reacts with any terminal aminogroup, such as described in
15 Nielsen et. al. (2001) J. Food Science Vol.66, No. 5, p. 642-646. The amount of reacted OPA can be quantified using UV/VIS spectrometry. The degree of hydrolysis can be expressed as the value of hydrolysed protein versus intact protein.

In one embodiment egg white is incubated with an amount of 0.0.5 to 10 w/w% protein hydrolysate, for instance 0.1 to 8w/w%, for instance 0.2 to 6w/w%, or 0.8 to
20 4w/w% w/w.

The egg white may be incubated with a protein hydrolysate at any suitable temperature, for instance between 4 and 60 degrees Celsius, for instance between for instance between 10 and 55 degrees Celsius, for instance between 15 and 50 degrees
25 Celsius.

Incubating egg white with a protein hydrolysate may be carried out during 15 min to 15 h, for instance between 30 min and 10 h, for instance between 45 min and 8 h, for instance between 1 h and 6 h. Incubating egg white with a protein hydrolysate during a sufficient length of time to allows dispersing the protein hydrolysate in the egg
30 white to obtain a higher gelling temperature of an egg white composition

In another embodiment a process of the present disclosure comprises incubating egg white with hydrolysed protein at a pH of between 6 and 8, for instance between 6.5 to 7.5.

An egg white composition is defined herein as egg white that has been incubated with a protein hydrolysate.

In one embodiment a process as described herein comprises pasteurizing the egg white composition and obtaining a pasteurized egg white composition.

5 An advantage of pasteurizing a liquid egg white composition is that it reduces microbial contamination and may make the time and energy consuming hot room treatment redundant, or can lower the temperature and/or time needed for a hot room treatment. Consequently, the time from breaking eggs to selling eggs can be shortened with weeks when using the process for preparing an egg white composition according to the present disclosure compared to a process for preparing egg white wherein a hot
10 room treatment is applied.

Another advantage of pasteurizing an egg white composition in the process according to the present invention is that a microbial safe fluid egg white product can be prepared.

15 Pasteurization of an egg white composition may be carried out in any suitable way. Pasteurization may for instance comprise bringing the egg white composition to a temperature of between 60 to 75 degrees Celsius or 62 to 70 degrees Celsius, for instance for 10 sec to 10 min, for instance for 20 sec to 8 min, for instance for 1 min to 6 min.

20 In another embodiment, a process according to the present disclosure comprises a step of spray drying the egg white composition and obtaining a spray-dried egg white composition. Spray drying is a known technology to the skilled person in the art. Spray drying of egg white may be carried out after the egg white is incubated with a protein hydrolysate and heat pasteurized.

25 In one embodiment a process according to the present disclosure further comprises using the egg white composition in the preparation of a food product. Use of an egg white composition according the present disclosure may be particularly suitable in the preparation of a food product that does not undergo a pasteurization step after the egg white composition is added. A suitable food product may for instance be surimi,
30 puddings, pastry, cookies, meringues, cake, glazing on pastry and biscuits, as a binding agent in the meat industry, meat analogues, nougats, batter.

In one aspect the present disclosure relates to an egg white composition obtainable by a process as disclosed herein. An advantage of an egg white

composition according to the present disclosure was that it has an increased gelling temperature.

The present disclosure further relates to the use of a protein hydrolysate to increase the gelling temperature of an egg white composition. A protein hydrolysate is for example a protein hydrolysate as defined herein above.

In another aspect the present invention relates to a process for preparing an egg white composition, wherein a protein hydrolysate is used to increase the gelling temperature of egg white and wherein the egg white composition with an increased gelling temperature is produced. The increase in gelling temperature of egg white composition as compared with untreated egg white may for instance be 1 to 10 degrees Celsius higher, for example 2 to 8, or 3 to 7 degrees Celsius.

In yet another aspect the present invention relates to a food product comprising an egg white composition obtainable by a process according to the present invention. Any suitable food product may comprise an egg white composition of the present disclosure, for instance surimi, puddings, pastry, cookies, meringues, cake, glazing on pastry and biscuits, as a binding agent in the meat industry, meat analogues, nougats, batter.

EXAMPLES

Materials

Egg white preparation

Fresh shell eggs were broken and separated. The egg white was collected in a small buffer tank, from where it was pumped to the fermentation vessel. After that an intermediate buffering step took place at 0-4°C at given pH of the egg white (pH 8.5-9.5). The time period of this buffering step depends on when the egg white is needed for further processing, usually between 1 to 96h. Subsequently, the egg white was pumped through a Westfalia plate centrifuge with 4700 rpm, 8000 liters/h for approximately 11 seconds centrifuge residence time to a fermentation tank. The supernatant obtained after this centrifuge step was the egg white used in these examples.

Methods

Pasteurization

After incubating the egg white with a protein hydrolysate, samples were pasteurized on
5 lab scale in a water bath at 70°C while stirring and measuring the temperature of the
egg white. The egg white was kept for 5 min at 60-65°C and subsequently cooled to 20
degrees Celsius after which the functionality tests were started.

Foam height, capacity and stability

10 To determine foaming properties, 450 ml liquid egg white was whipped in a Hobart
Mixer (model C100) by mixing for 90 sec in the 2nd gear followed by 90 sec in the 3rd
gear. Subsequently, the foam was levelled and used to determine the various foaming
properties. The whipping level was measured with e.g. a knitting needle and ruler. This
resulted in a measure for the foam height. Foaming capacity was determined by
15 weighing 100 ml foam. Foam stability was assessed via a drainage experiment. 75 g
foam was weighed into a funnel with a perforated plate. The dripping albumen was
collected and the amount of liquid (ml) after a dripping time of 70 minutes was
determined.

Gel strength test

20 To determine gel strength, 200 grams liquid egg white was transferred in flexible tubes
(Vinylidene chloride tubes, diameter 30 mm). After closing, these tubes were heated in
a water bath at 90°C for 30 min. After cooling down to 25°C in cold water, the gels
("sausages") were taken out of the tubes and were cut in 30 mm slices. The gel
25 strength was determined by a compression test on a Fudoh rheometer (a plunger with a
5 mm disc was used with a speed of 30 cm/min).

Rheometry

A gelling curve was measured in an Anton Paar MCR301 rheometer. An oscillatory
30 measurement was carried out with a cup and bob geometry (strain = 1%; Freq = 1 Hz).
The storage and loss modulus (G' and G'' respectively) were measured in time as a
function of temperature (40-90°C; temperature increase is 1.5°C per minute). The
crossover of G' and G'' is defined as the temperature where gelling starts: the gelling
point.

Example 1. Addition of yeast hydrolysate to egg white

The pH of egg white prepared as described above under the material section, was adjusted to pH 7, using 0.5 M citric acid. One part of this sample was used as a reference sample. To the other part 1% (w/w) yeast hydrolysate (DH 45% = percentage free amino acids/ total protein amount) was added and incubated at 40°C for 4 hrs. This 1% yeast hydrolysate was made according to Example 4, sample B in WO2008/074793 and contains of 93% yeast hydrolysate (GistexLS, DSM Food Specialties B.V. the Netherlands) and 7% malic acid.

Functionality tests were carried out after incubating egg white with yeast hydrolysate at pH 7.6 (table 1). Foam height of egg white with added yeast hydrolysate was found to be comparable to the reference sample. The gel strength of egg white with yeast hydrolysate was lower compared to untreated egg white which may be due to a lower gel density caused by air bubbles in the egg white gel to which yeast hydrolysate was added.

Table 1: Results functionality tests for untreated egg white and egg white with addition of 1% yeast hydrolysate

	Foam height [mm]	Gel strength [g/cm ²]
Untreated egg white (pH 7.6)	123	348
Egg white with addition of yeast hydrolysate	124	280

Example 2. Addition of lysozyme hydrolysate to egg white

The pH of the egg white was adjusted to pH 7, using 0.5 M citric acid. One part of this sample was used as a reference sample. To the other part 1% (w/w) lysozyme hydrolysate was added and incubated at 40°C for 6 hrs. Lysozyme hydrolysate (DH 22.2% expressed as percentage cleaved peptide bonds/total number of peptide bonds*100) as used in this example was obtained according to a process as described in Example 7 of WO2008/052995.

Functionality tests were carried out after incubating egg white with lysosyme hydrolysate at pH 7.6 before and after pasteurization (Table 2). Pasteurization was carried out as described above. It was found that the foaming capacity of pasteurized

egg white with added lysozyme hydrolysate was much better, i.e. a lower amount of protein is necessary to make 100 ml foam, compared to untreated pasteurized egg white. Also foam height improved significantly. Gel strength of egg white with added lysozyme hydrolysate was lower compared to the reference sample, which might be
 5 due to the presence of air bubbles in the egg white + lysozyme hydrolysate sample. Pasteurization did not negatively impact the functional properties of the egg white with added lysozyme hydrolysate.

10 **Table 2:** Results functionality tests for untreated egg white and egg white with addition of lysozyme hydrolysate

	Foam capacity [g/100 ml]	Foam height [mm]	Drainage [ml/75 g foam/70 min]	Gel strength [g/cm ²]
Untreated egg white (pH 7.6) – before pasteurization	Not determined	123	Not determined	348
Egg white with addition of lysozyme hydrolysate – before pasteurization	6.2	157	20	298
Untreated egg white (pH 7.6) – after pasteurization	41.9	20	Not determined	388
Egg white with addition of lysozyme hydrolysate – after pasteurization	7.9	142	5	293

Example 3. Addition of egg white hydrolysate to egg white

15 The resulting supernatant egg white after centrifugation was used as such as a reference sample. The other part was split and for one part the egg white was hydrolysed using 1% subtilisin (Alcalase AF 2.4L Novozymes, Lotnr. RM094811 U-09124) for 20 hrs at 50°C. The enzyme was inactivated at 80°C for 20 min. After that this solution was mixed with an Ultra turrax for 3 min. 1% (w/w) of this Alcalase
 20 hydrolysed egg white (DH 13.7%, cleaved peptide bond / total peptide bonds*100) was added to intact egg white and incubated at 40°C for 4 hrs.

Example 4. Gelling temperature of egg white compositions

Egg white compositions comprising yeast hydrolysate, lysozyme hydrolysate or egg white hydrolysate were prepared as described in Examples 1 to 3 with the exception that the pH of all egg whites was adapted to 7.0 by using 0.5 M citric acid, before addition of hydrolysates. Subsequently, the gelling temperature was determined by rheometry as described above. The difference in gelling temperature is given in Table 3 below.

Table 3: Difference in gelling temperature (°C) between reference egg white and egg white with added hydrolysate

Hydrolysate added	<i>Difference</i> in gelling temperature (°C) between reference egg white and egg white with added hydrolysate
Yeast hydrolysate 1%	4°C
Lysozyme hydrolysate (unpasteurized)	6°C
Egg white hydrolysate	4°C

The results show that an egg white composition according to the present invention has similar foaming characteristics as untreated egg white and still has good gelling properties, and higher a higher gelling temperature.

CLAIMS

1. Process for preparing an egg white composition, wherein egg white is incubated with a protein hydrolysate, and preparing the egg white composition.
5
2. Process according to claim 1 or use according to claim 12, wherein the protein hydrolysate has a degree of hydrolysis (DH) of between 5 and 55%.
- 10 3. Process according to claim 1 or 2, wherein egg white is incubated with an amount of 0.05 to 10 w/w% protein hydrolysate.
4. Process according to any one of the claims 1 to 3, wherein the egg white is incubated with the protein hydrolysate at a temperature of between 4 and 60
15 degrees Celsius.
5. Process according to any one of the claims 1 to 4, wherein the egg white is incubated with the protein hydrolysate during 15 min to 15 h.
- 20 6. Process according to any one of the claims 1 to 5 wherein the incubation is performed at a pH of between 6 and 8.
7. Process according to any one of the claims 1 to 6, further comprising a step of pasteurizing the egg white composition and obtaining a pasteurized egg white
25 composition.
8. Process according to any one of the claims 1 to 7, wherein the pasteurization comprises bringing the egg-white composition to a temperature of 60 to 75 degrees Celsius.
- 30 9. Process according to any one of the claims 1 to 8, further comprising a step of spray drying the egg white composition and obtaining a spray dried egg white composition.

10. Process for the preparation of a food product comprising using an egg white composition obtainable by a process according to any one of the claims 1 to 7, and preparing the food product.

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11. Egg white composition obtainable by a process according to any one of the claims 1 to 9.

12. Use of a protein hydrolysate to increase the gelling temperature of an egg white composition.

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13. Process for producing an egg white composition, wherein a protein hydrolysate is used to increase the gelling temperature of egg white and wherein the egg white composition with an increased gelling temperature is produced.

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14. A food product comprising an egg white composition according to claim 11.

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INTERNATIONAL SEARCH REPORT

International application No

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A. CLASSIFICATION OF SUBJECT MATTER
 INV. A23J3/30 A23L1/32
 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)

A23J 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, FSTA, 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	US 6 383 533 B1 (SOEDA TAKAHIKO [JP] ET AL) 7 May 2002 (2002-05-07) column 3, line 27 - line 50; example 5 column 2, line 37 - line 67 -----	1-11,13, 14
X A	US 2 752 248 A (PHILIP BLICK ET AL) 26 June 1956 (1956-06-26) column 3, line 52 - line 64; examples -----	1-11,13, 14 12
X	JP 1 108961 A (Q P CORP) 26 April 1989 (1989-04-26) abstract -----	1-11,13, 14
X A	US 5 096 728 A (RAPP HAROLD [US]) 17 March 1992 (1992-03-17) column 2, line 21 - line 31 column 2, line 55 - line 65 claims 3-9,16; examples -----	12 1-11,13, 14



Further documents are listed in the continuation of Box C.



See patent family annex.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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