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A method for the production of a transparent protein gel

BACKGROUND OF INVENTION

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1. Field of the Invention

The present invention relates to a method for the production of a transparent protein gel, wherein a transparent protein gel can be produced by steam heating of general protein without being limited to a swallow's nest and furthermore, a high quality of transparent protein gel can be produced using especially a raw material protein of a low price in the form of powder and /or crushed material and/or slurry and/or the like.

15 2. Description of the Prior Art

A transparent protein gel is known as a high-quality food material such as a jellyfish, a shark's fin and a swallow's nest which have been eaten by preference from olden times because of the unique chewy texture. However, some of them are rare and expensive due to the limited resources. Particularly, the price of a petrel's nest is soaring due to the decrease in number by overexploitation and from the standpoint of the conservation of rare animals. Protein gels have been utilized as various soft materials for daily necessities such as a contact lens in recent years. Therefore, many attempts to form a highly value-added and high-quality transparent protein gel using an inexpensive raw material have been accumulated because its application ranges in a wide variety.

The following methods for the production of a transparent

protein gel have been so far known: a method by heating
 [A.M.Hermansson, Soy protein gelation, JAACS, 63, 658-666(1986),
 T.Nakamura, S.Utumi and T.Mori, Mechanism of heat-induced
 gelation and gel properties of soybean 7S globulin, Agric. Biol.
 5 Chem., 50, 1287-1293(1986), Molded feather and production
 thereof (The official gazette of Japanese Unexamined Patent
 Publication No.HEI8-245807)], a method by heating after
 desalination [N.Kitahata, E.Doi, Fragrance J. 8, 81-85(1981)],
 a method by heating under strong alkali or strong acid [N.Kitahata,
 10 E.Doi, Fragrance J. 8, 81-85(1981)], a method by restructuring
 using fatty acid as a core[Yuno Ohta, N.et al., J.Food Sci.,
57, 86-90(1992)], a method by heating with the addition of metal
 salt[Y.Kinegawa, N. Kitabatake, Food Processing Technology,
15(1) 6-15(1995). However, further improvement has been
 15 requested since the components change when protein is dissolved
 in solutions, etc., next, a high-quality transparent protein
 gel can not be obtained and then the above protein gels can
 not be used as a high-quality food material, particularly, as
 a high-class food material.

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SUMMARY OF THE INVENTION

The present invention provides a method for the production
 of a transparent protein gel, wherein a high-quality transparent
 protein gel in arbitrary shapes can be produced by heating by
 25 steam a raw material protein in the form of powder, crushed
 material and flake which can be obtained at a low price.

To solve the above-mentioned subject, the present
 inventors have studied variously, first of all, using a rare
 and expensive swallow's nest and found that a transparent protein

gel can be obtained in the manner that fine scraps of a swallow's nest used as a raw material protein are swelled with distilled water overnight and then the swelled scraps are placed in a closed container, followed by being heated in an autoclave. The present
5 inventors have found the information that the regenerated transparent protein gel thus obtained is superior with the regards to the properties such as degree of transparency, degree of browning, flexibility, smooth texture and flavor. Furthermore, the present inventors have found that the regeneration method
10 of protein according to the present invention can be generally applied to the other proteins such as egg albumin, bovine albumin, lactoglobulin, soybean extract, dried soymilk, hemoglobin and fibrin. The present inventors have accomplished the present invention after further studying.

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Namely, the present invention relates to the following items:

- (1) A method for the production of a transparent protein gel, characterized in that a raw material protein is processed by
20 steam heating under the effect of the swelling pressure of the raw material protein;
- (2) A method for the production as described above in item 1, wherein a raw material protein is non-gel;
- (3) A method for the production as described above in item 1
25 or 2, characterized in that the form of a raw material protein is powder and/or crushed material and/or slurry;
- (4) A method for the production as described above in any of Items 1 to 3, characterized in that the raw material protein is fine scrap of a swallow's nest;

- (5) A method for the production as described above in any of items 1 to 4, wherein a heating temperature is in the range of 90 to 140°C;
- (6) A method for the production as described above in any of
5 items 1 to 5, wherein a steam heating time is in the range of 1 to 30 min;
- (7) A method for the production as described above in any of items 1 to 6, characterized in that a quantity of water added to 1g of raw material protein prior to heating is in the range
10 of 0.1 to 20.0 ml;
- (8) A method for the production as described above in any of items 1 to 7, wherein steam heating of a raw material protein is conducted in a closed space;
- (9) A food or a medical product containing a transparent protein
15 gel produced by a method for the production as described above in any of items 1 to 8;
- (10) A medical product as described above in item 9, which is a lens or an artificial joint;
- (11) A transparent protein gel, which can be produced by a method
20 for the production as described above in any of items 1 to 8;
and
- (12) A regenerated transparent protein gel produced by steam heating.

25 BRIEF DESCRIPTION OF THE DRAWINGS

Fig.1 (a): the result of analysis on the chewy texture of a targeted best swallow's nest commercially available by Texturometer.

(b): the result of analysis on the chewy texture

of a transparent protein gel produced in Example 1 according to the present invention

Fig.2: a questionnaire used for sensory analysis of the targeted product and the regenerated product

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DETAILED DESCRIPTION OF THE INVENTION

The present invention can be applied to general protein such as keratin, collagen, gelatin, gluten, egg albumin, bovine albumin, lactoglobulin, lactoalbumin, hemoglobin, soybean
10 extract and fibroin (silk protein) which may have the form of powder, crushed material, slurry and the like.

These proteins may be non-gel or gel according to the circumstances. They can also be used immediately after producing or gathering or harvesting and can be the so-called fragment,
15 scrap and the like, which are generated in the food processing.

The present inventors have found that a raw material is preferably heated by steam under the effect of swelling pressure thereof other than the exterior pressure.

The present inventors have also found that such a swelling
20 pressure has an effect of dissolving a raw material protein in water sufficiently in a closed condition with a certain volume. Therefore, the present inventors have found that a more transparent protein gel can be obtained for the reason why a swelling pressure thereof can be utilized more efficiently when
25 a raw material protein is heated by steam after having swelled the raw material with water to a certain extent than when a raw material protein is heated by steam after having completely swelled or without swelling. The swelling pressure is preferred to be 10 to 20kg/cm² although it can not be applied

unconditionally since a swelling pressure varies depending on kind of raw material, ratio of water, temperature, container and the like.

It is preferred to add water to a raw material protein for swelling thereof. To 1g of raw material protein, about 0.1 to 20.0 ml of water is added although it can not be applied unconditionally since the degree of transparency varies depending on ratio of the additional water. However, in order to obtain a highly transparent protein gel without browning, relative to 1g of raw material protein, about 1.6 to 3.0ml of water, preferably about 1.75 to 2.5ml of water is added. A flexible and highly transparent protein gel with less browning can be obtained when a raw material protein allows to swell overnight after adding water rather than when water is added to a raw material protein just before steam heating.

In case a swallow's nest is used, to 1.00g of swallow's nest, about 2ml of water is added in order to obtain the most transparent and flexible protein gel.

A transparent protein gel is produced in the manner that a raw material protein, swelled with water or added water, is confined in a narrow space. Such a closed space is given by e.g. an apparatus wherein a sample put between Teflon sheets for prevention from adhesion is further put between pressure-tight boards made of metal and the like and fastened with bolts, or an apparatus wherein a Teflon spacer with notch having the objective shape is additionally inserted between Teflon sheets in the above-mentioned apparatus, or an autoclave and the like. It is preferred to be a closed container such as an autoclave. However, it is not necessarily limited to a pressure-tight

container. Then, spacer, window (notch) and the like are not necessarily required.

A transparent protein gel is produced by heating a raw material protein swelled with water or added water with large heat capacity such as steam. It is preferred to heat a raw material protein in an autoclave wherein heating with moisture is possible since a raw material protein is not dissolved by heating without moisture even if it is heated with a high temperature. However, it is possible to produce a transparent protein gel by heating with large heat capacity.

The heating temperature is in the range of about 95 to 140°C, preferably in the range of about 110 to 125 °C and the heating time is in the range of about 3 to 30 min., preferably in the range of about 5 to 15 min. Too high heating temperature and prolonged heating time are not preferable for some food since the color of protein turns brown.

With regards to a swallow's nest, the most transparent protein gel is obtained when it is heated at 120 °C for 10 min. The pressure during heating by steam can be either an ordinary pressure or a higher pressure. The increase in pressure is preferably about 0.1 to 20 atm. by a pressure gauge.

A transparent protein gel with arbitrary shapes can be obtained by using an autoclave with a specific shape. There can be usually obtained a film-like shape or a sheet-like shape. Either shape can be changed to a fine noodle-like shape by cutting with a cutter and the like. The thickness and length of a transparent protein gel can be changed arbitrarily by forming with a container or cutter and the like. Thus obtained transparent protein gel is of high industrial utility value, e.g. due to

the resistance to sterilization by heat after the process of charging containers with protein such as bottling.

A transparent protein gel is produced by altering the physical properties of a raw material protein by changing
5 conditions such as concentration, pressure and temperature.

By this steam-heating process, hydrophobic groups buried in the interior of protein molecule are exposed on the surface and subject to hydrophobic interaction. Consequently, aggregation, precipitation and gelification are caused by ionic
10 bond, hydrogen bond, hydrophobic bond, intermolecular force, intermolecular and intramolecular interaction such as covalent bond.

With regards to a protein gel, there is an opaque gel or a transparent gel of three-dimensional networks.

15 After repeating various experiments by try and error, the present inventors have invented a method of the production for a highly transparent protein gel or a regenerated protein gel which is of a high commercial value in the following points:

- 20 1) Less browning in the steam-heating process
- 2) Superior transparency
- 3) Sufficient length
- 4) Good appearance
- 5) Superior flexibility
- 25 6) Good chewy texture
- 7) Excellent fragrance

Foods according to the present invention are characterized in that a transparent protein gel is contained as the component

substance. The other substances, e.g. foods or food components known per se and the like can also be contained.

Those other components are not specially restricted. The foods according to the present invention are, e.g. gelatin gel, egg
5 white, soybean curd, cheese, jelly, soup of swallow's nest, soup of shark's fin and the like.

Moreover, a transparent protein gel is utilized for various purposes in the medical field. For instance, it is utilized for the pharmaceutical preparation technology for improving the
10 difficulty in dissolving a freeze-dried pharmaceutical preparation in an injectable solution using vitrification of a transparent protein gel (metastable state between liquid and solid), an artificial lens, medical plasters and pressure sensitive adhesives, a part of cartilage of an artificial joint
15 and the like. Furthermore, it is utilized for a soft contact lens, water-sustained release particles for a disposable portable body warmer, gel permeation chromatography as a kind of chromatography and the like.

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EXAMPLES

Example 1

1.0g of egg albumin powder (Wako Pure Chemical Industries.Ltd.Lot.TPG6626) was put in a petri dish and 1.0ml of purified water was added dropwise and softly to swell it
25 sufficiently. The swelled sample was inserted between Teflon boards using a stainless steel container and was heated by steam in an autoclave. A Teflon spacer of 0.5mm thickness with a window of 5cm x 5cm was used. The heating condition was set at 121°C for 15 min. After heating, the properties of egg albumin were

found to be a yellowish white, transparent, flexible gel sheet of 5cm x 5cm.

Example 2

5 Two kinds of flake-like swallow's nest, (1) DF794 sample (without heating) and (2) DF881 sample (pre-treatment with warm water at 80 °C) were heated by steam as follows.

Properties:

10 (1) DF794 sample: a pale brown flake-like sample of about 3 x 5 mm containing powder, (2) DF881 sample: a mixture of porous board-like material, crushed material and powder, lighter in color than DF794 sample.

To each 1.0g sample weighed, 10 ml each of purified water was added to swell sufficiently. The swelled samples were
15 set in stainless steel containers in the same manner as described in Example 1 and were heated by steam in an autoclave. Consequently, transparent gel-like films were formed in the both samples regardless of different pre-treatment. DF794 sample (without heating) was softer.

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Example 3

A trial to form a transparent gel sheet was carried out using a swallow's nest with a larger stainless steel container. Namely, 2 sheets of Teflon board inserted a Teflon spacer (4.5
25 x 12cm window, 0.5mm thickness) were set between 2 sheets of 1cm thickness stainless steel board (20 x 10cm). 1.3g of a flake-like sample was taken and added dropwise 2.6 ml of purified water and softly to moisten. The apparatus was fastened with bolts or clips after 5 min. and heated by steam in an autoclave.

The heating condition was set at 121 °C for 15min.

After finishing, a transparent flexible film of a swallow's nest was obtained. The film taken out was cut to an irregular fine needle-like shape with scissors or a pie cutter. The cut sample was transferred to a glass bottle and added 50 ml of 7 % sugar solution, followed by steam sterilization in an autoclave after capping the bottle. The heating condition was set at 121°C for 7 min. After finishing the sterilization, the finely cut sample remains transparent and a noodle-like shape. It can resist transportation and storage since no breaking of shape occurs due to vibration. Thus obtained transparent protein gel can be utilized industrially since the appearance after bottling and sterilization and the chewy texture are similar to a commercially available swallow's nest.

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Example 4

In order to obtain a dried fine string-like swallow's nest, the gel sheet of a swallow's nest obtained in Example 3 was cut finely as it is in a flexible state. Any of cutting measures by scissors, cutter, noodle machine, pasta machine and the like can be employed. A finely cut swallow's nest was dried in a circulation dryer. The dried material is well preserved. When it is soaked in water, the obtained material can be used with the former flexibility and transparency. The dried material can be directly put in a soup and the like.

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Example 5

Using the fine string-like dried regenerated swallow's nest obtained in Example 4, a Chinese soup with a swallow's

nest(crab powder and soybean curd with swallow's nest) was prepared.

The materials for 2 persons are given below.

- 5 Crab (frozen) 40 g
 A swallow's nest produced by steam heating
10g (washed in water)
 Sake1 small-spoonful
 (Mix the above materials in advance)
- 10 Cotton-soybean curd.1/3 pc. (100g)
 Boiled bamboo shoot.30g
 Dried shiitake mushroom. . .1 pc.
 Mitsuba.5g
 Egg.1pc.
- 15 Chinese soup stock.adequately e.g. for 2 or 2 1/2
 persons
 Sake. 1/2 large spoonful
 Salt. 3/5 small spoonful
 Soy sauce.1 small spoonful
- 20 Dogtooth violet starch. . . .a little over 1 large spoonful
 Water.2 large spoonful

- (1) As for the sample of swallow's nest, wash it in water if
 it is in syrup and sprinkle sake on it. As for frozen crab,
 25 thaw it, loosen roughly and sprinkle sake on it. As for
 cotton-soy bean curd, cut it into 1cm cubes. place them
 on a plate, wash in hot water and drain them. As for boiled
 bamboo shoot and dried shiitake mushroom soaked in water
 and cut off its stem, cut them to 1cm cubes.

As for mitsuba, cut it to 3cm length. As for egg, break it into a small bowl and loosen it. Heat oil in a pan, place crab and a swallow's nest squeezed juice from them softly, fry them lightly, then add boiled bamboo shoot and dried
 5 shiitake mushroom, and fry them all.

- (2) Add the warmed Chinese soup stock to (1), heat the mixture skimming off the scum sometimes, flavor it with sake and salt and make thick soup by adding a dogtooth violet starch suspended in water softly after boiling up.
- 10 (3) Add cotton-soybean curd to (2), mix gently, raise the cooking temperature and pour loosened egg gradually and linearly. Add soy sauce when the solidified egg comes up to the surface of soup softly, stop heating and place mitsuba on the surface. Charge retort pouches with the soup and
 15 sterilize them by heating although it is eatable as it is.

Example 6

Using collagen powder, a protein gel sheet was formed. 1g of collagen powder (Nitta Gelatin Co., pig skin powder treated
 20 with acid [G powder]) was weighed, transferred to a 10 ml-beaker and 1.0 ml of purified water was added gently. The mixture was set in a flange type closed container with Teflon sheets and a spacer with a window (0.5mm thickness) and heated by steam in an autoclave (121 °C , 15min.). After finishing the heating,
 25 the gel was cooled to about room temperature and taken out. A colorless and highly transparent protein gel sheet was obtained.

Experiment 1

The heating method for producing a transparent protein

gel sheet from flakes of a swallow's nest was studied. As the heating methods, a closed container apparatus (autoclave), boiled water, an electric dryer and a hot plate were used.

The results are shown in table 1. The heating is preferably carried out under the effect of swelling pressure of a raw material protein. The information that swelling pressure and water are needed for the production of a transparent protein gel sheet from flakes of a swallow's nest has been found. Furthermore, it has been found that it is possible to produce a transparent protein gel sheet from flakes of a swallow's nest by putting the raw material protein directly into boiling water although it is preferred to set flakes of a swallow's nest with water in the above apparatus. However, the heating by an electric dryer and a hot plate went wrong.

Table 1

Heating Method	Autoclave 121 °C (1.1 kg/cm ² , 5min.)		Boiling Water 100 °C 30min.	Electric Dryer 120 °C 15min.	Hot Plate 131 °C 30min.
Closed Container	Used	Petri dish	Used	Used	Used 4kg/ cm ² pressure
Forming of Transparent gel Sheet	○	×	△	×	×

○ : Good

△ : Fair

× : Bad

Experiment 2

The heating conditions for the production of a transparent protein gel sheet from flakes of a swallow's nest were studied in the same manner as described in Example 1 except that the
5 heating conditions in an autoclave were changed.

The results shown in Table 2 indicate that the optimum heating conditions and the effect of swelling pressure are needed. However, the evaluation of transparency was carried out according to a conventional method by visual inspection. The networks
10 with gray gradient tints were printed by a word processor. The network % with the lightest gray tint which can be discriminated from a plain white paper was determined as transparency.

Table 2

Heating Conditions	Forming of Sheet	Transparency	Flexibility	Browning
Autoclave Heating 121 °C, 5 min (Thickness 0.5mm)	Formed	0 to 5%	A little Solid, but Flexible Cut by scissors Can be bent	Yellow Clear, less browning
Autoclave Heating 110 °C, 5 min (Thickness 0.5mm)	Formed	5 to 10%	Flexible	Yellow Clear
Autoclave Heating 105 °C, 5 min (Thickness 0.5mm)	Formed	10%	Flexible	No browning
Autoclave Heating 105 °C, 5 min (Thickness 1mm)	Formed	12.5%	Flexible	No browning
Autoclave Heating 100 °C, 5 min (Thickness 0.5mm)	Formed	10 to 12.5%	Flexible, but a little thick	Yellow Clear
Autoclave Heating 95 °C, 5 min Pressure 0 (Thickness 0.5mm)	Formed About 95% of the whole Ununiform	10%	Flexible, but easily torn-off	No browning
Autoclave Heating 90 °C, 5 min Pressure 0 (Thickness 0.5mm)	Formed About 90% Of the whole	10%	Soft and easily torn-off	No browning
Autoclave Heating 121°C , 5min (in a petri dish)	Not formed	Opaque	Soft and flakes as it is	A little browning

Experiment 3

The present inventors have proved that the present invention which relates to the production of a transparent protein gel sheet can be applied to general protein. Namely, after having conducted the experiment in the same manner as described in Example 1, a transparent protein gel sheet similar to a swallow's nest has been obtained with regards to egg albumin powder, bovine albumin, lactoalbumin powder, hemoglobin powder, dried powder of soybean extract protein and fibroin (silk protein). The results are shown in Table 3.

Table 3

Water/ Protein (ml/g)	Egg albumin	Bovine albumin	Lactoal- bumin	Hontoufu (Soybean extract protein)	Hemo- globin (Bacto)
1	Yellow- ish white sheet, Clear 10% of the whole, Trans- parency 5%	Not tested	Not tested	Uniform semi- trans- parent Sheet, Trans- parency Not more than 5%	Dark red semi- trans- parent sheet
1.5	Yellow- ish white Sheet, Clear partly, Trans- parency 7.5%	Yellow clear sheet, Trans- parency Not more than 5%	Milky- white Sheet, Trans- parency Not more than 10%	Uniform semi- trans- parent Sheet, Trans- parency 5%	Dark red semi- trans- parent sheet

Experiment 4

In order to produce a preferable protein gel sheet, the ratio of protein and water and the heating conditions are important.

- 5 The ratio of protein and water was studied in the same manner as described in Example 1 except that the heating temperature was in the range of 90 to 140°C (range in an autoclave). The results are shown in Table 4. It has been found that the ratio of water is preferred to be 80 to 1000%.

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Table 4

Additional amount of water	Degree of swelling	Properties of gel after heating in an autoclave	Size of gel sheet (cm x cm)
20%	Swelled partly	Dry transparent gel	3.5 x 4.1
30%	Swelled partly	Dry transparent gel	3.6 x 4.0
50%	Swelled half	Dry :Soft (50:50) transparent gel	4.8 x 5.0
66%	Swelled half	Wholly soft transparent sheet	6.8 x 7.0
80%	Swelled almost wholly	Wholly soft transparent sheet, More transparent than 66%	6.5 x 6.5
1000%	Swelled wholly	Wholly soft transparent sheet, More transparent than 80%	7.5 x 7.5

- Additional amount of water: ml of water added to 1.00g of a swallow's nest is shown as %.

Experiment 5

The transparency depends on the ratio of protein and water. Therefore, the additional ratio of water for the production of a transparent protein gel of egg albumin was studied in the same manner as described in Example 1 except the ratio of protein and water. As for egg albumin, the ratio (water/ protein) was preferred to be in the range of 1 to 3.

Table 5

Water/ Protein (ml/g)	Formation of gel sheet	Transparency	Browning
1	Formed	About 10% of the whole	Browning
1.5	Formed	Partly clear	Yellowish white
1.6	Formed	Partly clear	Less browning
1.75	Milky-white sheet	Transparency 10 to 12.5%	No browning
2	Milky-white sheet	Transparency 10 to 12.5%	No browning
2.5	White semi-transparent sheet	Transparency 10 to 12.5%	No browning
3	White semi-transparent sheet	Transparency 15 to 20%	No browning

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Experiment 6

1.00g of flakes of a swallow's nest (Cave B, 1.680- 6.200mm particles) was weighed, transferred to a 20ml beaker, added 10 ml of distilled water and allowed to stand overnight for sufficient swelling in a refrigerator. Then, the whole sample

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was placed in a closed container and heated in an autoclave with the conditions shown in the table. A spacer (0.5mm thickness) with a window of 5cm square was used. The heating conditions for the production of a transparent gel sheet of a swallow's nest was studied in the same manner as described in Example 1 except the heating conditions. The results are shown in Table 6.

Table 6

Temperature °C	110			115			121		
Pressure G atm.	0.4			0.7			1.1		
Time min.	5	10	15	5	10	15	5	10	15
Transparency	○	△	○	○	○	○	○	○	○
Formation of sheet	△	△	△	×	△	○	×	○	○
Flexibility	○	○	○	△	○	○	○	○	○
Browning	○	○	○	○	○	○	○	○	○
Total Evaluation	△	△	○	×	○	○	○	◎	◎

◎: Excellent, ○: Good, △: Fair ×: Bad

(Remarks) Measure of evaluation

- 1) Transparency: ○ (2.5%), △ (5%) The networks with gray gradient tints were printed by a word processor. The network with the lightest gray tint which can be discriminated from a plain white paper was determined as transparency.
- 2) Formation of sheet: evaluated by the state of connection among flakes
- 3) Flexibility: ○(Flexible and can be bent repeatedly), △

(Flexibility is inferior to ○), ×(Dry and easily broken)

4) Browning: ○(No browning or very slight browning), △(Slight browning), ×(Browning, definitely observed)

5) Total evaluation: Totally evaluated in order of Transparency,
5 Formation of sheet, Flexibility and Browning.

Experiment 7

The best bottled swallow's nest in syrup commercially available was used as a targeted product. As for a regenerated
10 transparent protein gel produced according to the present invention, the chewy texture was analyzed instrumentally as follows. The results are shown in Fig. 1.

The conditions of analysis:

Texturometer (Zenken Co. GTX-2-1N type)

15 Platform: flat plate

Plunger: Lucite 18mm

Clearance: 0.05mm

Voltage: Targeted product 6 V, Regenerated product 3 V

Chart speed: 750 mm/M

20 As clearly shown in Fig.1, since the pattern of a regenerated product is the same as that of a targeted product, the both products were evaluated as the same chewy texture.

Experiment 8

25 The sensory analysis on the targeted product and the regenerated product used in Experiment 7 was carried out using a questionnaire shown in Fig.2 by 5 panelists. The results are shown in Table 7. Although the both products were almost same in transparency, the regenerated product was superior to the

targeted product in Browning, Length and General appearance.

Table 7

Evaluation Gel	Properties				Texture	
	Trans- parency	Brown- ing	Length	General appear- ance	Chewy Texture	Aroma
Targeted product	Semi- Trans- parent	Very bad	Bad	Bad	Good	Good
Regen- erated Product	Semi- Tras- parent	Good	Good	Fair	Good	Good

5

INDUSTRIAL APPLICABILITY

A high quality of transparent protein gel can be produced using a raw inexpensive material protein in the form of powder and /or crushed material and/or slurry and/or the like according to the present invention.

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A transparent protein gel produced by a method according to the present invention can be distributed as protein foods in the market since the transparency and the shape do not change even after the sterilization by steam and high pressure. Furthermore, the dried product can also be used widely as foods since it returns to a transparent gel with water. Moreover, since a high-class food material such as a swallow's nest can be produced from inexpensive materials, it is useful for the prevention of overexploitation of a high class food material and from the standpoint of the conservation of rare animals.

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What is claimed is:

1. A method for the production of a transparent protein gel, characterized in that a raw material protein is processed by steam heating under the effect of the swelling pressure of
5 the raw material protein.

2. A method for the production as claimed in claim 1, wherein a raw material protein is non-gel.

3. A method for the production as claimed in claim 1 or 2, characterized in that the form of a raw material protein is
10 powder and/or crushed material and/or slurry.

4. A method for the production as claimed in any of claims 1 to 3, characterized in that the raw material protein is fine scraps of a swallow's nest.

5. A method for the production as claimed in any of claims
15 1 to 4, wherein a heating temperature is in the range of 90 to 140°C.

6. A method for the production as claimed in any of claims 1 to 5, wherein a steam heating time is in the range of 1 to 30 min.

20 7. A method for the production as claimed in any of claims 1 to 6, characterized in that a quantity of water added to 1g of raw material protein prior to heating is in the range of 0.1 to 20.0 ml.

8. A method for the production as claimed in any of claims
25 1 to 7, wherein steam heating of a raw material protein is conducted in a closed space.

9. A food or a medical product containing a transparent protein gel produced by a method for the production as claimed in any of claims 1 to 8.

10. A medical product as claimed in claim 9, which is a lens or an artificial joint.

11. A transparent protein gel which can be produced by a method for the production as claimed in any of claims 1 to
5 8.

12. A regenerated transparent protein gel produced by steam heating.