

CHEESE-LIKE FOOD FOR BAKING

Technical Field

[0001]

5 The present invention relates to a cheese-like food
for baking and a method for producing the same.

Background Art

[0002]

10 Various types of fillings are widely used as materials
for improving flavors and appearances of foods, for example,
by putting on the tops of confectionery, baked
confectionery, bread, pizza and the like (as toppings), or
by filling in or sandwiching between these foods. As
15 patent applications relating to fillings showing stringy
properties similar to those of natural cheese, there is
Patent Document 1 filed by the present applicant. This
application does not, however, disclose that the stringy
properties are further provided with heat tolerance. In
20 addition, the stringy properties per se admit of
improvement.

 As a means for providing heat tolerance for a filling,
for example, Patent Document 2 describes that the inclusion
of a whipped fat-and-oil composition is effective. Patent
25 Document 2 does not, however, teach a technique for

providing heat tolerance for a filling such as a cheese-like food.

In addition, Patent Document 3 describes a combination of a sugar, fat-and-oil, starch and a heat-set protein, thought it is topping dough for bakery. Patent Document 3 does not, however, teach any means for providing heat tolerance for specific properties of a cheese-like food.

Prior Art Document

Patent Document

[0003]

Patent Document 1: JP 2006-254742 A

Patent Document 2: WO 06/095505 A

Patent Document 3: JP 2004-57018 A

Disclosure of Invention

Problems to be Solved by the Invention

[0004]

An object of the present invention is to provide a cheese-like food for baking which is substantially free from a natural cheese, wherein the cheese-like food shows stringy properties similar to those of a stringy natural cheese in a heat-melted state, and further has such heat tolerance that the cheese-like food shows no change in appearance or shape even after baking; and a method for

producing the same.

Means for Solving the Problems

[0005]

5 As a result of intensive investigation for the above
problems, the present inventor has found that stringy
properties similar to those of a stringy natural cheese in
a heat-melted state can be provided for a cheese-like food,
even when it is substantially free from a natural cheese,
10 by inclusion, each in a specific amount, of three
components, i.e., a heat-set protein, milk protein, and
etherified tapioca starch; as well as that the stringy
properties are still maintained even at a temperature of
ordinary temperature or lower, at which a stringy natural
15 cheese becomes hard. Further, the present inventor has
found that the cheese-like food has baking tolerance, and
the appearance and shape of the cheese-like food are
therefore hardly changed even after undergoing a baking
process to maintain the same stringy properties as those
20 before heating, thereby completing the present invention.

[0006]

That is, the present invention relates to:

(1) A cheese-like food for baking, which comprises
0.2 to 2% by weight of a heat-set protein, 3.6 to 10% by
25 weight of milk protein and 0.3 to 5.5% by weight of

etherified tapioca starch;

(2) The cheese-like food for baking according to (1), which further comprises 3 to 5% by weight of acetylated tapioca starch;

5 (3) The cheese-like food for baking according to (1), wherein the cheese-like food contains 46 to 96% by weight of a fermentation broth; and

(4) A method for producing the cheese-like food for baking according to (3), wherein a heat-set protein
10 material is added as a raw material of the fermentation broth prior to fermentation.

Effects of the Invention

[0007]

15 According to the present invention, a cheese-like food showing stringy properties similar to those of a stringy natural cheese in a heat-melted state can be obtained even when it is substantially free from a natural cheese. The cheese-like food has such heat tolerance that the
20 appearance and shape thereof are not changed even after baking, and can be preferably used for a baked food.

Best Mode for Carrying Out the Invention

[0008]

25 Hereinafter, the present invention will be described

in detail.

As used herein, "for baking" means being able to preferably use as e.g. a filling for foods prepared by baking such as bread and baked confectionery. Specifically, when the cheese-like food is used for, for example, bread as a filling, it can be filled before baking bread. That is, in a baked food such as bread, the product of the present invention maintains the appearance and shape thereof even when being filled before baking and subjected to a heating (baking) step, and shows natural cheese-like stringy properties even after heating. That is, the product of the present invention has "heat tolerance". As used herein, the heat tolerance indicates that, assuming that an oven is used for preparing baked foods such as bread and confectionery, the shape and properties similar to those of before baking are maintained even after undergoing heating conditions of the oven. More specifically, a cheese-like food which passes the test of "heat tolerance evaluation method" described in Examples hereinafter is evaluated as that having heat tolerance.

[0009]

As used herein, a cheese-like food is a generic term referring to a food having stringy properties similar to those of a stringy natural cheese in a heat-melted state (so-called imitation stringy cheese). In particular, the

product of the present invention is characterized in that it shows stringy properties similar to those of a stringy natural cheese even at a temperature of ordinary temperature or lower (3 to 20°C), at which a conventional stringy natural cheese becomes hard. A conventional natural cheese does not have such properties.

[0010]

As used herein, a heat-set protein is a protein having heat coagulable properties. Specifically, examples thereof include soybean-derived proteins and egg-derived proteins. More specifically, examples of soybean-derived protein materials include soybean protein isolate, soybean protein concentrate and defatted soy milk powder. Among these, soybean protein isolate is more preferably used in view of obtaining flavors and excellent properties.

[0011]

Further, examples of the egg-derived proteins include liquid whole egg, liquid egg white, liquid yolk, powdered egg white and powdered yolk. Among these, more preferred are liquid egg white and powdered egg white which are derived from egg white, and further preferred is powdered egg white. In the present invention, some heat-set protein materials can be also used in combination. A combination of soybean protein isolate and powdered egg white is most preferred. In this combination, a desired combination

ratio of soybean protein isolate: powdered egg white is 0.5 to 2 : 0.3 to 1, more desirably 0.9 to 1.6 : 0.3 to 0.7.

Such a combination can provide stringy properties close to those of a natural cheese having best stringiness, and can also provide excellent heat tolerance.

[0012]

The cheese-like food for baking of the present invention is required to contain 0.2 to 2% by weight, more desirably 0.4 to 1.7% by weight of a heat-set protein.

When the amount of a heat-set protein is too large or too small, sometimes, the properties similar to those of a stringy natural cheese in a heat-melted state are hardly obtainable. In particular, when the amount of a heat-set protein is too small, sometimes, heat tolerance is also weakened.

[0013]

The heat-set protein is desirably added as a raw material of a fermentation broth prior to fermentation.

That is, in general, a heat-set protein has a

characteristic flavor and, sometimes, causes coagulation, particularly, at about isoelectric point. On the other hand, when a heat-set protein is added as a raw material of a fermentation broth prior to fermentation, the flavor of the heat-set protein is improved, and the generation of coagulation tends to be improved as well.

[0014]

Examples of materials to be used as milk protein in the present invention include skim milk powder, whole milk powder, total milk protein, sodium caseinate, whey protein, butter milk powder, cow milk, condensed whole milk, condensed skim milk, natural cheese and the like. Among these, skim milk powder and total milk protein are preferably used in view of obtaining excellent properties. Although a natural cheese is a useful material in view of providing an excellent flavor, its cost is relatively high and, sometimes, it can be a cost-increasing factor depending on an amount thereof. In addition, the cheese-like properties depending on a stringy natural cheese itself vary widely depending on a temperature and, sometimes, the product becomes hard particularly at a low temperature. From the viewpoint of obtaining the desired properties of the product of the present invention, the addition of a natural cheese is not essential, and a natural cheese can be used as the occasion may demand.

Total milk protein is a protein obtained by condensing proteins in cow milk by ultrafiltration, followed by spray-drying, which contains both casein protein and whey protein. It is also called as milk protein concentrate or complete milk protein.

[0015]

The cheese-like food is required to contain 3.6 to 10% by weight, more desirably 3.8 to 9% by weight of milk protein. When the amount of milk protein is too much or too little, sometimes, the product hardly shows the desired properties similar to those of a stringy natural cheese.

Many milk proteins have excellent flavors and, a milk protein can be added at any time in any production steps as far as it can be uniformly dispersed into the cheese-like food, i.e., the objective end product, without clumping. However, from the viewpoint of easy, simple and convenient operation, preferably, a milk protein is added together with the heat-set protein as raw materials of a fermentation broth when preparing the fermentation broth.

As used herein, the amount of each "protein" can be calculated by multiplying the protein content in each protein material to be used and its compounding ratio in the cheese-like food of the present invention.

[0016]

As used herein, etherified tapioca starch is modified tapioca starch in which ether groups are introduced into tapioca starch, and is widely used in the food industry field. In addition, acetylated tapioca starch is modified starch in which acetyl groups are introduced into tapioca starch, and is also widely used in the food industry field.

The cheese-like food is required to contain 0.3 to

5.5% by weight, more desirably 0.3 to 5% by weight of etherified tapioca starch. When the amount of etherified tapioca starch is too much or too little, sometimes, the resulting product hardly shows the desired properties similar to those of a stringy natural cheese.

Although it is essential to use etherified tapioca starch in the present invention, in addition to etherified tapioca starch, acetylated tapioca starch can be also used in combination. In this case, the amount to be used is desirably 3.3 to 5% by weight. The sum of etherified tapioca starch and acetylated tapioca starch is desirably 3 to 6% by weight, more desirably 3.5 to 5.5% by weight.

Since both etherified tapioca starch and acetylated tapioca starch are relatively easily dissolved in water, both tapioca starches can be appropriately added at any time in any production steps.

[0017]

As used herein, a fermentation broth is a broth in which a mixture of raw materials comprising protein materials, sugars and the like is subjected to fermentation using lactic acid bacteria. Such a broth is a useful raw material to provide a characteristic and excellent flavor of a fermented product such as a natural cheese, and it is desirable to use a fermentation broth as a raw material in the present invention. When a fermentation broth is used,

the amount thereof is desirably 46 to 96% by weight, more desirably 48 to 90% by weight in the cheese-like food.

When the amount of the fermentation broth is too much or too little, sometimes, such a broth affects the flavor of the product and the like. On the other hand, in the case where, for example, only properties similar to those of a stringy natural cheese are required, the fermentation broth can be used the occasion may demand.

[0018]

10 As described above, it is preferred that a heat-set protein material and a milk protein material are used as raw materials of a fermentation broth from the viewpoints of a flavor as well as simplicity and convenience of operation.

15 The pH at the end of the fermentation is desirably pH 4 to 6, more desirably pH 4.5 to 5. Although a wide variety of lactic acid bacteria can be used for the fermentation with lactic acid bacteria fermentation, a combination of *Streptococcus cremoris* and *Streptococcus*
20 *lactis* is more preferred from the viewpoint of a flavor.

[0019]

 The present inventor has found for the first time that, although each of the heat-set protein, milk protein and etherified tapioca starch are raw materials having
25 characteristic properties, by combining these materials in

appropriate amounts, the desired properties similar to those of a stringy natural cheese in a heat-melted state can be firstly, and heat tolerance can be exerted as well, thereby completing the present invention. That is, the

5 natural cheese-like food by the present invention can reduce costs as compared with a food containing a natural cheese as a main ingredient. In addition, although the properties depending on those of a stringy natural cheese vary widely depending on a temperature and, sometimes,

10 become hard, particularly, at a low temperature, the properties of the "cheese-like food" of the present invention can be controlled by adjusting the amounts of raw materials to the specific ones. Hence, the product of the present invention makes it possible to express stringiness

15 similar to that of a stringy natural cheese even at room temperature in a baked food such as cooked bread which is distributed and stored at room temperature, which has been difficult in a conventional food containing a stringy

20 natural cheese as a main ingredient. Further, the present invention can contribute to improvement of working efficiency, for example, when using for a baked food such as the above bread, the product of the present invention can be filled into dough before baking because of its heat tolerance.

25 [0020]

Hereinafter, the present invention will be further illustrated in more detail by way of examples using a heat-set protein material and the like as raw materials of a fermentation broth, which are preferred embodiments of the present invention.

1. Preparation of a fermentation broth

Main raw materials used for a fermentation broth include a heat-set protein, milk protein, fat-and-oil, and the like, and a suspension is prepared using the raw materials first. Other raw materials which are generally used to prepare a fermentation broth such as natural cheese and molten salt can be appropriately used as far as they do no affect the desired effects of the present invention.

For dissolution and sterilization, the raw material suspension is maintained at 70 to 80°C for 5 to 30 minutes, and then is subjected to high pressure homogenizer treatment, and the resultant suspension is then cooled to 5 to 20°C. The raw material suspension at this stage is referred to as a primary mixed broth.

[0021]

Next, starter lactic acid bacteria are inoculated in the primary mixed broth. As described above, a combination of *Streptococcus cremoris* and *Streptococcus lactis* is most preferred as the starter lactic acid bacteria. After inoculation, the mixed broth is maintained at 15 to 25°C

for 10 to 20 hours, and is subjected to fermentation until the pH thereof becomes 4 to 6 by fermentation.

Sterilization is carried out by heating at 60 to 90°C for 15 to 60 minutes when the pH reaches a range of 4 to 6.

5 [0022]

2. Preparation of a cheese-like food

If needed, molten salt is added to the fermentation broth obtained in the above Section 1, and the fermentation broth is then heated to 70 to 80°C with stirring. When the
10 temperature reaches 70 to 80°C, fat-and-oil, acetylated tapioca starch and other raw materials are added thereto, and the resultant mixture is further stirred, and further, if needed, milk and the like are added thereto. The resultant mixture is stirred for about 10 to 20 minutes
15 while maintaining the temperature. After that, the mixture is homogenized with a high pressure homogenizer to prepare the desired cheese-like food.

Although it is not essential to use a fermentation broth in the present invention, the illustration is mainly
20 based on the steps wherein fermentation is carried out. When fermentation is not carried out, lactic acid bacteria are not inoculated into a primary mixed broth.

Hereinafter, the present invention will be illustrated by Examples.

Examples

[0023]

Examples 1 to 8, and Comparative Examples 1 to 4

5 Fermentation broths (primary mixed broths) were
prepared in accordance with the formulations as shown in
Table 1. The numbers in the formulations are percent by
weight unless otherwise specified.

Table 1 Formulations of fermentation broths (primary mixed broths)

<Primary mixed broths>	Protein % in raw materials	Example 1	Example 2	Example 3	Example 4	Example 5	Example 6	Example 7	Example 8	Comparative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4
Total milk protein	81	3.9	3.9	3.9	4	6	6	3.9	3.9	3.9	3.9	3.9	3.9
Skim milk powder	34	0.6	0.6	0.6	4	5	5	0.6	0.6	0.6	0.6	0.6	0.6
Whey powder	12.5	3.8	3.8	3.8	4	5	5	3.8	3.8	3.8	3.8	3.8	3.8
Cow milk	3.3	18	18	18	18	18	18	18	18	18	18	18	18
Soy protein isolate	86.5	1		1	1.5	1	1	1			1	1	1
Powdered egg white	86.5	0.5	1	0.5	0.5	0.5	0.5	0.5			0.5	0.5	0.5
Raw egg white	10.5								8				
Vegetable fat-and-oil		14	14	14	9	14	14	14	14	14	14	14	14
Gouda cheese	34	10	10	10	10			10	10	10	10	10	10
Salt		1	1	1	1	1	1	1	1	1	1	1	1
Water		46.55	47.05	46.55	47.35	48.85	48.85	46.55	40.05	48.05	46.55	46.55	46.55
Sodium citrate		0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Sodium polyphosphate		0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Performance of lactic acid fermentation		○	○	○	○	○	×	○	○	○	○	○	○

As the total milk protein, a product manufactured by Ingrelia was used.

As the soy protein isolate, a product manufactured by FUJI OIL CO., LTD. was used.

5 As the vegetable fat-and-oil, a mixture of hydrogenated rape seed oil (melting point: 31°C) and palm oil manufactured by FUJI OIL CO., LTD. was used.

As the whey powder, a product manufactured by SNOW BRAND Co., LTD. was used.

10 [0024]

"Preparation method of a fermentation broth (a primary mixed broth)"

The vegetable fat-and-oil was heated to 60°C to prepare an oil phase. On the other hand, water was heated
15 to 30°C, and sodium polyphosphate, sodium citrate and salt were dissolved therein, and in the resultant solution, milk, whey powder, total milk protein, soy protein isolate, powdered egg white, skim milk powder, Gouda cheese and the like (depending upon formulations) were dissolved. The
20 resultant mixture was then pre-emulsified at 70 to 80°C for 10 minutes, and then homogenized under pressure of 8000 kPa with a homogenizer, followed by rapidly cooling the mixture to 20°C to obtain a primary mixed broth. Bulk starter (a mixed strain of *Streptococcus cremoris* and *Streptococcus*
25 *lactis*) was then inoculated therein and the primary mixed

broth was fermented at 20°C for 15 hours to obtain a
fermented broth with pH 4.7. This fermented broth was
sterilized by heating at 80°C for 30 minutes to obtain "a
fermentation broth". [Whether to add each ingredient was
5 in accordance with the formulation table. In an example
not carrying out fermentation (Example 6), the primary
mixed broth per se was used for the next step.]

[0025]

Using the above fermentation broths (primary mixed
10 broths), cheese-like food samples were prepared in
accordance with the formulations shown in Table 2.

Table 2 Formulations of cheese-like foods

	Example 1	Example 2	Example 3	Example 4	Example 5	Example 6	Example 7	Example 8	Comparative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4
Fermentation broth (Primary mixed broth)	85	85	50.5	95	85	85	85	85	85	85	85	45
Vegetable fat-and-oil	9.5	9.5	22.5		9.5	9.5	9.5	9.5	9.5	9.5	9.5	8
Etherified tapioca starch	4.5	4.5	4.5	4.5	4.5	4.5	0.5	0.5	4.5			4.5
Acetylated tapioca starch							4	4		4.5		
Waxy corn starch											4.5	
Water	0.72	0.72	22.22	0.22	0.72	0.72	0.72	0.72	0.72	0.72	0.72	42.22
Flavor	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Sodium acetate	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
The sum of heat-set proteins (%)	1.10	0.74	0.66	1.64	1.10	1.10	1.10	0.71	0.00	1.10	1.10	0.58
The sum of milk proteins (%)	6.66	6.66	3.96	8.64	6.61	6.61	6.66	6.66	6.66	6.66	6.66	3.52

As the vegetable fat-and-oil, a mixture of hydrogenated rape seed oil (melting point: 31°C) and palm oil manufactured by FUJI OIL CO., LTD. was used.

As the etherified tapioca starch, the acetylated
5 tapioca starch, and the waxy corn starch, products manufactured by NIPPON STARCH CHEMICAL CO., LTD. were used.
[0026]

"Preparation method of cheese-like food samples"

Water was added to each fermentation broth (primary
10 mixed broth) prepared in accordance with Table 1. Then, after addition of sodium acetate and then the vegetable fat-and-oil dissolved at 60°C, each modified tapioca starch and the like were added.

The resultant mixture was then kneaded at 80°C for 10
15 minutes as it was, and then homogenized under pressure of 100 kg/cm², followed by filling the mixture into a plastic film tube, and the tube was sealed and rapidly cooled to 5°C to obtain a cheese-like food sample.

[0027]

20 "Evaluation method"

Measuring method of hardness

A sample was put into a plastic container (hexagonal
container) with a diameter of 8 cm, and the container was maintained in a refrigerator for 3 to 10 hours (the product
25 temperature: 5°C). Hardness was tested by measuring a

maximum load value using a rheometer manufactured by FUDO INDUSTRY CO., LTD. when a plunger with a diameter of 3 cm was pressed to the sample at a table speed of 5 cm/min. The unit is g/7.065 cm².

5 [0028]

Evaluation method for heat tolerance

A sample filled into a plastic film tube was squeezed out in the shape of a bar with a diameter of 1 cm in an amount of 10 g into a can with a diameter of 8 cm and a
10 depth of 2.5 cm, and the can was closed with a lid. The can was left in an oven set at 200°C for 10 min, and after that, heat tolerance was evaluated by the shape of the sample. Evaluation criterion were as follows: ⊙ was used when a squeezed sample was mostly unchanged after baking;
15 ○ was used when although the sample was spread by heating, the spread area was not more than twice the contact area of the sample which was squeezed out; in the same way, △ was used when the spread area was more than twice the contact area and not more than three times the contact area; and ×
20 was used when the spread area was more than three times the contact area. The samples evaluated as ⊙ and ○ were judged to have heat tolerance and would pass the test.

[0029] Evaluation method for stringiness

Into a hexagonal container with a diameter of 8 cm,
25 200 g of a sample adjusted to 5°C was put, and the whole of

the sample was homogenized by stirring three times using a spoon with a maximum width of 3 cm. The spoon was then picked up, and a stretch of the sample was measured.

The same operation was carried out three times, and
5 each stretch was measured and the average was calculated. When the average of stretches was not less than 8 cm, ⊙ was used; O was used for not less than 5 cm and less than 8 cm; Δ was used for not less than 3 cm and less than 5 cm; × was used for not less than 1 cm and less than 3 cm;
10 and ×× was used for less than 1 cm. The samples evaluated as ⊙, O and Δ were judged to have excellent stringiness and would pass the test.

[0030] Evaluation method for flavors

A sensory evaluation test was carried out by 5
15 panelists.

The panelist ate samples adjusted to a temperature of 5°C, and shred cheese was used as a control. A sample having the approximately same flavor was scored 5 points, and a sample hardly having a cheese flavor was scored 1
20 point, and points between them were given depending on the strength of the cheese flavor. Points obtained from each member were averaged.

[0031] Evaluation method for textures

A sensory evaluation test was carried out by 5
25 panelists.

The panelist ate samples adjusted to a temperature of 5°C, and textures were decided on the basis of stringiness like cheese. A sample having the same stringiness as that of natural cheese was scored 5 points, a sample not having stringiness at all was scored 1 point, and points between them were given depending on the strength of stringiness. The points were averaged. Samples having an average of not less than 3 points would pass the test.

[0032] Results

10 Evaluation results are shown in Table 3.

Table 3 Evaluation results

	Example 1	Example 2	Example 3	Example 4	Example 5	Example 6	Example 7	Example 8	Comparative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4
Hardness (g/7.065 cm ²)	400	400	200	400	400	300	300	400	300	400	400	40
Heat tolerance evaluation (200°C, 10 min)	○	○	○	○	○	○	○	○	×	○	○	×
Stringiness	⊙	⊙	○	○	○	○	△	⊙	⊙	×	xx	×
Flavor evaluation	5	5	5	5	4.2	4.2	5	5	5	5	5	5
Texture evaluation	5	5	3.2	3.2	5	5	3	5	5	1.2	1.4	1.2

In the texture evaluation, although the temperature of samples were gradually elevated to room temperature (20°C) over time, extreme changes associated with that were not confirmed.

5 Consideration

Table 3 revealed that a cheese-like food containing heat-set proteins, milk proteins and etherified tapioca starch showed excellent properties similar to those of stringy natural cheese. The compounding amount was
10 preferably 0.2 to 2% by weight of a heat-set protein, 3.6 to 10% by weight of milk protein, and 0.3 to 5.5% by weight of etherified tapioca starch.

In addition, flavors and workability were excellent by using heat-set proteins and milk proteins as raw materials
15 for a fermentation broth. The flavors became more excellent by carrying out lactic acid fermentation.

When heat-set protein was not used, satisfying heat-tolerance could not be obtained.

20 Industrial Applicability

[0033]

The present invention relates to a cheese-like food which has properties similar to those of a stringy natural cheese in a heat-melted state, even in the case of
25 substantially containing no such a natural cheese, and a

method for producing the same. The present invention
relates to a cheese-like food for baking, which can be used
by filling into a baked food such as bread prior to baking,
and which has such a novel texture that the cheese-like
5 food shows stringiness even after cooling down, and a
method for producing the same.

CLAIMS

1. A cheese-like food for baking, which comprises
0.2 to 2% by weight of a heat-set protein, 3.6 to 10% by
5 weight of milk protein and 0.3 to 5.5% by weight of
etherified tapioca starch.

2. The cheese-like food for baking according to
claim 1, which further comprises 3 to 5% by weight of
10 acetylated tapioca starch.

3. The cheese-like food for baking according to
claim 1, wherein the cheese-like food contains 46 to 96% by
weight of a fermentation broth.

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4. A method for producing the cheese-like food for
baking according to claim 3, wherein a heat-set protein
material is added as a raw material of the fermentation
broth prior to fermentation.

20