

SPECIFICATION

Title of the Invention: Flavor-Enriching Agent

5 Technical Field

The present invention relates to a kokumi-imparting agent and a complex kokumi-imparting agent, which consist of a peptide showing a CaSR agonist activity. Moreover, the present invention also relates to a seasoning which comprises a peptide showing a CaSR agonist activity in a concentration of not less
10 than a predetermined level.

Background Art

The consumers' demands on the taste and palatability of foods have recently been increased due to, for instance, the diversity of the human eating habits. In
15 this connection, the taste and palatability of a food have conventionally been expressed by the five basic tastes, in other words, sweet taste, salty taste, sour taste, bitter taste and umami, but there has correspondingly been increased the needs for the development of an excellent kokumi-imparting agent capable of imparting, to a food, "kokumi". Kokumi means a taste that cannot be expressed
20 only by the five basic tastes but also marginal tastes of the basic tastes, such as thickness, growth (or mouthfullness), continuity and harmony.

On the other hand, the calcium sensing receptor (CaSR) is also referred as the calcium receptor, the signals from the receptor can control a variety of biological functions within the living bodies and the substances possessing such a
25 CaSR agonist activity can be used as a kokumi-imparting agent (see Patent Documents 1 and 2 and Non-patent Document 4 as will be specified below).

There would be a variety of taste-developing patterns in the foregoing "kokumi". In this respect, there has been an intensive need, in particular, for the development of a kokumi-imparting agent capable of imparting the kokumi, to a
30 food, and having such a taste-developing pattern that it can develop or present the

kokumi of the initial taste type one. Moreover, the substance for imparting the kokumi would in general be used in, for instance, foods and accordingly, it should be excellent in its stability. In addition, the substance for imparting the kokumi should be able to be easily produced at a low cost from the industrial standpoint.

5 Accordingly, there have been desired for the search for most of variational compounds possessing the desired CaSR agonist activity to thus find out a substance capable of imparting a kokumi to other substance (foods or beverages), which shows a more excellent kokumi-imparting effect, in particular, a kokumi-imparting effect of the initial taste-imparting type one, which is excellent
10 in the stability and which can easily be produced at a low cost and to thereby provide a kokumi-imparting agent consisting of such a substance as well as a complex kokumi-imparting agent comprising the substance and other substances possessing the CaSR agonist activities in combination.

On the other hand, regarding some γ -glutamyl peptides each carrying a γ
15 -glutamine residue at the N-terminal thereof, there have been known those synthesized as substrates in, for instance, the studies of the enzymatic activities (see Patent Document 3 and Non-patent Documents 1 to 3, specified later), but there have not yet been known any cases in which γ -Glu-Nva is used for a food or exists in nature. In this respect, the whole contents of Patent Documents 1 and 2
20 are incorporated herein as references as if they were, in fact, expressly disclosed in this specification.

Prior Literature

Patent Document:

25 Patent Document 1: International Patent Laid-Open No. 2007/055393, Pamphlet;

Patent Document 2: International Patent Laid-Open No. 2008/139945, Pamphlet;

Patent Document 3: International Patent Laid-Open No. 2007/066430,
30 Pamphlet;

Non-Patent Documents:

Non-Patent Document 1: Molecular Pharmacology (1982), 21(3), 629-36;

Non-Patent Document 2: Agricultural and Biological Chemistry (1981), 45(12), 2839-45;

5 Non-Patent Document 3: Journal of Biological Chemistry (1979), 254(12), 5184-90;

Non-Patent Document 4: The Journal of Biological Chemistry, (2010), 285 (2), 1016-22.

10 Summary of the Invention

It is an object of the present invention to search for most of variational compounds possessing the desired CaSR agonist activity to thus find out a substance capable of imparting a kokumi, which shows a more excellent kokumi-imparting effect, in particular, a kokumi-imparting effect of the initial
15 taste-imparting type one, which is excellent in the stability and which can easily be produced at a low cost and to thereby provide a kokumi-imparting agent consisting of such a substance as well as a complex kokumi-imparting agent comprising the substance and other substances possessing the CaSR agonist activities in combination. It is a further object of the present invention to provide a seasoning
20 which comprises the foregoing substance in a concentration of not less than the predetermined level.

As a result of searching for a variety of compounds, the inventors of this invention have surprisingly found out that γ -Glu-Nva (L- γ -glutamyl-L-norvaline) possesses a high CaSR agonist activity and a quite
25 excellent kokumi-imparting effect and, in particular, the taste-developing (or flavoring) pattern thereof would permit the impartment of a kokumi of the initial taste-imparting type to a subject. Furthermore, the inventors have found that γ -Glu-Nva thus discovered has an extremely high titer, is excellent in the stability and has such a favorable taste-developing pattern that it shows a stronger initial
30 taste-imparting ability, as compared with those observed for γ -Glu-Cys as a

dipeptide similar to the former. Moreover, the inventors have further found that γ -Glu-Nva thus discovered can serve, by itself, as a useful kokumi-imparting agent. Moreover, the inventors have likewise found that a preferred food composition whose kokumi is improved can be obtained by the incorporation of γ -Glu-Nva into a food. In addition, a complex kokumi-imparting agent can be obtained by combining the substance with other substances each showing a CaSR agonist activity. The inventors of this invention have thus completed the present invention.

More specifically, the present invention herein provides a kokumi-imparting agent consisting of γ -Glu-Nva.

Moreover, the present invention likewise provides a food composition containing γ -Glu-Nva (hereunder the food composition will also referred to as "food composition of the present invention"). According to the present invention, there is further provided a complex kokumi-imparting agent which comprises, in combination, (a) γ -Glu-Nva and (b) one or at least two amino acids or peptides selected from the group consisting of γ -Glu-X-Gly wherein X represents an amino acid or an amino acid derivative, γ -Glu-Val-Y wherein Y represents an amino acid or an amino acid derivative, γ -Glu-Abu, γ -Glu-Ala, γ -Glu-Gly, γ -Glu-Cys, γ -Glu-Met, γ -Glu-Thr, γ -Glu-Val, γ -Glu-Orn, Asp-Gly, Cys-Gly, Cys-Met, Glu-Cys, Gly-Cys, Leu-Asp, D-Cys, γ -Glu-Met (O), γ -Glu- γ -Glu-Val, γ -Glu-Val-NH₂, γ -Glu-Val-ol, γ -Glu-Ser, γ -Glu-Tau, γ -Glu-Cys (S-Me) (O), γ -Glu-Leu, γ -Glu-Ile, γ -Glu-t-Leu and γ -Glu-Cys (S-Me).

The present invention would be able to provide a kokumi-imparting agent which is quite excellent in its kokumi-imparting effect and, in particular, has an excellent and unique kokumi-imparting effect of the initial taste-imparting type one represented by, for instance, such a taste-developing pattern that it shows a profile as shown in, for instance, Fig. 1, which is also excellent in the stability and which can easily be prepared at a low cost, as well as a complex kokumi-imparting agent containing the same. In addition, the present invention can likewise provide an excellent food composition which comprises a substance possessing an

excellent kokumi-imparting effect in a concentration of not less than a predetermined level.

The kokumi-imparting agent according to the present invention shows the flavor and/or taste-developing pattern quite similar to that observed for common salt and therefore, when using the kokumi-imparting agent, the latter can impart, to a low salt food or the like, a salty taste-like thick impression and an initial taste-punch (or impact) to the low salt food. Accordingly, the resulting food containing the agent of the present invention can maintain its salty taste impression like that prior to the reduction of the salt content even when the salt content of the food is reduced and therefore, the agent according to the present invention permits the production of a food highly beneficial to health. Examples of such foods include a variety of soups and various kinds of sauces. Especially, if eating a food containing the kokumi-imparting agent according to the present invention, the consumer can feel the salty taste-like thick impression and an initial taste-punch (or impact) immediately after eating the same.

Brief Description of the Drawings

[Figure 1] Fig. 1 shows the taste-developing profile observed for a kokumi-imparting agent of the initial taste type one.

Mode for Carrying out the Invention

The substance, γ -Glu-Nva, used in the present invention comprises L- γ -glutamyl-L-norvaline in which two amino acids are linked to one another through a peptide bond and/or salts thereof, in particular, edible salts thereof.

The substance, γ -Glu-Nva, shows an excellent kokumi-imparting effect and therefore, it can be used as a kokumi-imparting agent. γ -Glu-Nva can be used in such a manner that a food composition to which the kokumi is imparted comprises the dipeptide in an amount (the width of the concentration) ranging from 0.1 ppb by mass to 99.9% by mass, preferably 1 ppb by mass to 10% by mass and more preferably 0.01 ppm by mass to 1% by mass relative to the total mass of

the food composition. In other words, another embodiment of the present invention relates to a food composition comprising γ -Glu-Nva and preferably a food composition comprising γ -Glu-Nva in an amount ranging from 0.1 ppb by mass to 99.9% by mass, preferably 1 ppb by mass to 10% by mass and more preferably 0.01 ppm by mass to 1% by mass. More specifically, the present invention relates to, for instance, a food composition comprising γ -Glu-Nva in an amount of not less than 0.1 ppb by mass, not less than 0.005 ppm by mass, not less than 0.02 ppm by mass or not less than 0.01 % by mass to not more than 99.9% by mass, not more than 90.0% by mass, not more than 50% by mass, not more than 600,000 ppm by mass, not more than 100,000 ppm by mass, not more than 80 ppm by mass, not more than 30 ppm by mass, or not more than 10 ppm by mass, as expressed in terms of the mass thereof.

Moreover, the kokumi-imparting agent of the present invention or γ -Glu-Nva can also be used in combination with at least one additional ingredient for seasonings selected from the group consisting of amino acids such as sodium glutamate (MSG), nucleic acids such as inosine monophosphate (IMP), inorganic salts such as sodium chloride, organic acids such as citric acid, and various kinds of yeast extracts to thus provide a favorable seasoning which is improved in its kokumi, as compared with those obtained by the use of such additional ingredients for seasonings individually. When using γ -Glu-Nva in combination with the foregoing additional ingredients for seasonings, the concentration of the former can easily or properly be determined or established by one of ordinary skill in the art after conducting investigations through, for instance, the sensory test.

In the present invention, the term "kokumi" means the taste which cannot be expressed by the five basic tastes or the sweet taste, the salty taste, the sour taste, the bitter taste and the umami and more specifically means the taste in which the marginal tastes of the basic ones such as the thickness, the growth (mouthfullness), the continuity and the harmony are enhanced in addition to the basic tastes. In addition, the term "kokumi-impartment" herein used means that the five basic tastes expressed by the sweet taste, the salty taste, the sour taste,

the bitter taste and the umami are enhanced, while the marginal tastes of the basic tastes such as the thickness, the growth (mouthfullness), the continuity and the harmony associated with the former are simultaneously imparted to a subject. Moreover, this can also be referred to as the flavor-enhancing effect. Therefore,
5 γ -Glu-Nva serving as the kokumi-imparting agent of the present invention can likewise be referred to as a "flavor enhancer". The kokumi-imparting agent according to the present invention or γ -Glu-Nva may also be used as a sweet taste enhancer, a salty taste enhancer, a sour taste enhancer, a bitter taste enhancer or an umami enhancer.

10 Moreover, the taste of a food may vary with the elapse of time after eating the same and the taste of a food after eating the same is in general referred to as the initial taste, the middle taste and the after taste, in order, immediately after eating the food. Although they are indeed the relative concept, but the initial taste, the middle taste and the after taste of a subject are, as a whole, defined to be
15 the taste observed within the term extending from 0 to 2 seconds, 2 to 5 seconds and not less than 5 seconds after eating the same, respectively. The taste observed during the term extending from 0 to 5 seconds is herein referred to as the "initial/middle taste" and that observed during the term extending from 2 to about 30 seconds is referred to as the "middle/after taste" (see the data plotted on Fig. 1).
20 Regarding the evaluation of the taste in case where the taste is divided into three subdivisions, it is difficult for the panelists (persons who eat the food to be examined) to concentrate their attention on the evaluation and the habitually used test comprises the evaluation of the taste while dividing it into two subdivisions.

Moreover, the combined initial taste and middle taste is referred to as the
25 "initial/middle taste" and the combined middle taste and after taste is referred to as the "middle/after taste".

The effects of a substance showing a CaSR activity on the kokumi and the taste-developing pattern can be confirmed by a method, for instance, a human sensory test for the evaluation of taste. An example of such a human sensory test
30 for the evaluation of taste is one illustrated in Examples of this patent application,

but the sensory test for the evaluation of taste usable herein is not restricted to this specific one.

The term "CaSR" used in this specification means the calcium sensing receptor which belongs to the class C of the 7-time transmembrane receptor and which is thus also referred to as "calcium receptor". The term "CaSR agonist" used in this specification means a substance which is linked with the foregoing CaSR to thus activate the receptor CaSR. In addition, the term "activate CaSR" used herein means that a ligand is linked with CaSR to thus activate a protein linked with guanine nucleotide and to transmit signals outputted from the same. Moreover, the ability of a substance to form a linkage with CaSR to thus activate the same is referred to as "CaSR agonist activity".

Now, a method for screening a compound having a CaSR agonist activity will specifically be presented hereunder, but the steps for screening the compound are not limited to those specified below at all.

1) A step for adding a test substance to a CaSR activity-measuring system used for determining the CaSR activity and a step for the determination of the CaSR activity;

2) A step for comparing the CaSR activity observed when adding the test substance to the activity-measuring system with that observed prior to the addition of the substance; and

3) A step for selecting a substance which shows the CaSR agonist activity when it is added to the CaSR activity-measuring system.

The determination of the CaSR activity can likewise be carried out while using, for instance, a measuring system which makes use of cells having an ability of expressing CaSR. The foregoing cells may be those endogeneously expressing CaSR or genetically recombinant cells into which a CaSR-expression gene is exogeneously introduced. The aforementioned CaSR activity-measuring system is not restricted to any specific one inasmuch as it permits the detection of the linkage (or a reaction) between the CaSR-activation substance and CaSR, or it can emit or output a detectable signal in response to the formation of the linkage (or a

reaction) between the CaSR-activation substance and CaSR within the cells, when adding an extracellular ligand (activating substance) specific to CaSR to the foregoing cells having an ability of expressing CaSR. If the CaSR activity is detected through the reaction with a test substance, it would be judged that the test substance shows the desired CaSR-stimulation activity.

An example of the foregoing CaSR preferably used herein is human CaSR encoded by the human CaSR gene registered under the GenBank Accession Number of NM_000388. In this respect, however, the CaSR is not restricted to the protein encoded by the gene having the foregoing sequence of the registered CaSR and it may be any protein capable of being encoded by a gene having not less than 60%, preferably not less than 80% and more preferably not less than 90% of the sequence homology with the foregoing gene sequence, inasmuch as the protein encoded by such a gene possesses the desired CaSR function. In this connection, the CaSR function can be examined by making cells express these genes and then determining any change of an electric current and/or any change in the calcium ion concentration within the cells observed when calcium is added to the system containing the cells.

Regarding the foregoing CaSR, the source thereof is not restricted to any particular one and it may be those derived from the whole kinds of animals including mice, rats and canines, in addition to the foregoing human CaSR.

As has been discussed above, the CaSR activity can be confirmed through the use of the living cells capable of expressing CaSR or a fragment thereof, the cell membranes which can express CaSR or a fragment thereof, or an in vitro system including CaSR or a protein as a fragment thereof.

An example which makes use of such living cells will be given below, but the present invention is by no means limited to this example at all.

CaSR is expressed in cultured cells such as oocytes of xenopus, ovarian cells derived from hamsters, and human fetal renal cells. This expression of CaSR can be carried out by introducing, into a plasmid possessing an exogenous gene, the CaSR gene which has been subjected to the cloning treatment in the form of a

plasmid or cRNA obtained using the same as a template. Usable for the detection of such a reaction may be an electrophysiological means or a fluorescent indicator for the detection of any increase in the calcium concentration within the cells.

The expression of CaSR is initially confirmed by the presence of any response observed when adding calcium or an activator having the specificity thereto. More specifically, usable herein as the desired cells are those in which an intracellular electric current is detected when adding calcium in a concentration of about 5 mM or those in which the emission of fluorescent rays are observed upon the addition of a fluorescent indicator. In this connection, the concentration of calcium added to the cells is variously changed to determine any calcium concentration-dependency of the intensity of the intracellular electric current. Then a test substance is diluted to a concentration ranging from about $1\ \mu\text{M}$ to 1 mM, the resulting dispersion is added to oocytes or cultivated cells and subsequently the CaSR activity in the presence of the foregoing test substance is measured to thus determine the CaSR agonist activity of the test substance.

More specifically, usable herein as such a test for the determination of the CaSR agonist activity is, for instance, the test illustrated in Test Examples disclosed in this specification, but the activity-determining test is not limited to such a specific one at all.

The amino acids or peptides used in the kokumi-imparting agent according to the present invention in combination with γ -Glu-Nva include, for instance, one or at least two amino acids or peptides selected from the group consisting of γ -Glu-X-Gly (wherein X represents an amino acid or an amino acid derivative), γ -Glu-Val-Y (wherein Y represents an amino acid or an amino acid derivative), γ -Glu-Abu, γ -Glu-Ala, γ -Glu-Gly, γ -Glu-Cys, γ -Glu-Met, γ -Glu-Thr, γ -Glu-Val, γ -Glu-Orn, Asp-Gly, Cys-Gly, Cys-Met, Glu-Cys, Gly-Cys, Leu-Asp, D-Cys, γ -Glu-Met (O), γ -Glu- γ -Glu-Val, γ -Glu-Val-NH₂, γ -Glu-Val-ol, γ -Glu-Ser, γ -Glu-Tau, γ -Glu-Cys (S-Me) (O), γ -Glu-Leu, γ -Glu-Ile, γ -Glu-t-Leu and γ -Glu-Cys (S-Me). In this respect, the amino acids may likewise include, for instance, neutral amino acids such as Gly, Ala, Val, Leu, Ile, Ser, Thr, Cys, Met,

Asn, Gln, Pro, Hyp, t-Leu; acidic amino acids such as Asp, Glu; basic amino acids such as Lys, Arg, His; aromatic amino acids such as Phe, Tyr, Trp; as well as homoserine, citrulline, ornithine, α -aminobutyric acid, norvaline, norleucine, and taurine. Moreover, the amino acids used herein may also be artificial amino acids (having non-proteinaceous construction) such as tert-leucine, cyclo-leucine, α -aminoisobutyric acid, L-penicillamine, allothreonine, and allo-isoleucine. In this connection, in the peptide: γ -Glu-X-Gly, X may be the aforementioned amino acid or derivative thereof, but preferably used herein are amino acids or derivatives thereof other than Cys. Among them, preferably used herein in combination with γ -Glu-Nva include, for instance, γ -Glu-Val-Gly, γ -Glu-Abu-Gly, γ -Glu-tLeu-Gly, γ -Glu-Nva-Gly and γ -Glu-Abu.

In particular, the kokumi-imparting agent according to the present invention consists of γ -Glu-Nva and this agent has a unique and excellent initial taste type kokumi-imparting effect and the taste-developing (flavoring) profile as shown in Fig. 1. Accordingly, it is preferred that γ -Glu-Nva is used in combination with a peptide such as γ -Glu-Val-Gly, which shows a taste-developing profile different from that of the former.

In the specification of this patent application, each amino acid (residue) is expressed in terms of the following abbreviated form:

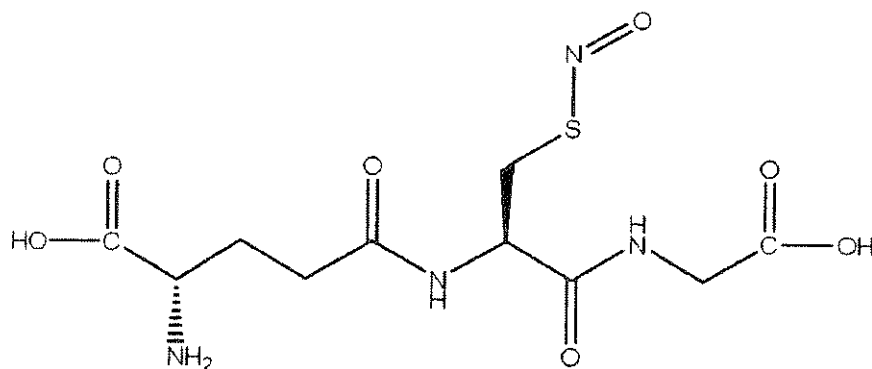
- (1) Gly: glycine;
- (2) Ala: alanine;
- (3) Val: valine;
- (4) Leu: leucine;
- (5) Ile: isoleucine;
- (6) Met: methionine;
- (7) Phe: phenylalanine;
- (8) Tyr: tyrosine;
- (9) Trp: tryptophane;
- (10) His: histidine;
- (11) Lys: lysine;

- (12) Arg: arginine;
(13) Ser: serine;
(14) Thr: threonine;
(15) Asp: aspartic acid;
5 (16) Glu: glutamic acid;
(17) Asn: asparagine;
(18) Gln: glutamine;
(19) Cys: cysteine;
(20) Pro: proline;
10 (21) Orn: ornithine;
(22) Sar: sarcosine;
(23) Cit: citrulline;
(24) N-Val: (or Nva): norvaline (2-aminovaleric acid);
(25) N-Leu (or Nle): norleucine;
15 (26) Abu: α -aminobutyric acid;
(27) Tau: taurine;
(28) Hyp: hydroxy-proline;
(29) t-Leu: tert-leucine;
(30) Cle: cyclo-leucine;
20 (31) Aib: α -amino-isobutyric acid (2-methyl-alanine);
(32) Pen: L-penicillamine;
(33) allo-Thr: allothreonine;
(34) allo-Ile: allo-isoleucine.

Furthermore, the term "amino acid derivative" used herein means a variety
25 of derivatives of the foregoing amino acids and specific examples thereof include
special amino acids and artificial amino acids, amino alcohols, or amino acids
whose side chains of amino acids such as terminal carboxyl groups, amino groups
and/or thiol group of cysteine are substituted with a variety of substituents.
Examples of such substituents include an alkyl group, an acyl group, a hydroxyl
30 group, an amino group, an alkylamino group, a nitro group, a sulfonyl group or a

variety of protective groups. Thus, examples of such amino acid derivatives include Arg (NO₂): N- γ -nitro-alanine, Cys (SNO): S-nitro-cysteine, Cys (S-Me): S-methyl cysteine, Cys (S-allyl): S-allyl cysteine, Val-NH₂: valine-amide, and Val-ol: valinol (2-amino-3-methyl-1-butanol). In the meantime, the peptide: γ -Glu-Cys(SNO)-Gly used herein is one represented by the following structural formula and the symbol: "(O)" appearing in the foregoing formulas: γ -Glu-Met (O) and γ -Glu-Cys (S-Me) (O) means that these peptides each have a sulfoxide structure. The symbol "(γ)" of γ -Glu means that another amino acid is linked with the glutamic acid through the carboxyl group situating at the γ -position of the latter.

[Chemical Formula 1]



S-Nitrosoglutathione (GNSO)

The γ -Glu-Nva and the amino acids and peptides used in combination in the present invention may be commercially available ones if they can be purchased on the market, or can be obtained according to any known technique such as (1) chemical synthetic methods or (2) a method which makes use of an enzyme reaction, but it would be more convenient to use a chemical synthetic technique. The γ -Glu-Nva used in the present invention is very short in its length since it includes only two amino acid residues and therefore, it is more convenient to adopt a chemical synthetic technique. More specifically, it can be produced simply and at a low cost as compared with any tripeptide comprising three amino acid residues and accordingly, the use of this dipeptide is quite advantageous from the industrial standpoint. In addition, when chemically synthesizing the γ -Glu-Nva used in

the present invention and the amino acids and peptides used in combination therewith, the preparation thereof may be carried out by synthesizing or semi-synthesizing these oligo-peptides while using a peptide-synthesis device. As such a method for chemically synthesizing these peptides, usable herein may be, for instance, the solid-phase peptide-synthesis technique. The peptide thus produced can subsequently be purified according to the usual techniques such as the ion-exchange chromatography technique, the reversed phase high performance liquid chromatography technique, or the affinity chromatography technique. Such a solid phase peptide-synthesis technique and the subsequently used peptide-purification technique are well known in the field of this art.

Alternatively, when producing the γ -Glu-Nva used in the present invention and the amino acids and peptides used in combination therewith, while making use of an enzyme reaction, the preparation thereof may be carried out by the use of the method disclosed in the pamphlet of International Patent Laid-Open WO 2004/011653. More specifically, they can be prepared by reacting an amino acid or a peptide, in which one of the terminal carboxyl group thereof is esterified or aminated, with another amino acid whose amino group is in its free state (for instance, an amino acid whose carboxyl group is protected) in the presence of a peptide-forming enzyme and then purifying the resulting dipeptide or tripeptide. Examples of such peptide-forming enzymes are cultures of microorganisms showing the ability of producing a peptide; the cell bodies of microorganisms isolated from the culture; or a product obtained by processing the cell bodies of the microorganisms; or a peptide-forming enzyme originated from the microorganisms. In the meantime, it is herein construed that the disclosure of WO 2004/011653 is included in the description of this specification.

In addition to the foregoing enzymatic production methods and chemical synthesis methods, the peptides used in the present invention are often included in naturally occurring products, for instance, plants such as vegetables and fruits, microorganisms such as yeast and other natural resources. When they are present in naturally occurring substances, they can be isolated from the same and

the resulting isolated products can likewise be used in the present invention.

The kokumi-imparting agent or the complex kokumi-imparting agent according to the present invention can be used as a seasoning without any particular post-treatment or can be mixed with carriers acceptable for foods and beverages or ingredients for other seasonings to thus give various seasonings. Examples of such other ingredients for seasonings include spices, saccharides, sweeteners, edible fibers, vitamins, amino acids such as sodium glutamate (MSG), nucleic acids such as inosine monophosphate (IMP), inorganic salts such as sodium chloride, and organic acids such as citric acid as well as various kinds of yeast extracts.

Incidentally, low salt foods preferred as food compositions each comprising the kokumi-imparting agent or the complex kokumi-imparting agent according to the present invention are, by nature, those containing common salt and, in particular, foods whose common salt content is reduced.

Examples of such low salt foods include dairy products such as butter and cheese; animal oils and fats-containing and/or vegetable oils and fats-containing foods such as margarine, sauces and roux; emulsified foods such as dressings and mayonnaise; various kinds of curry and stew; and a variety of soups containing meat extracts or essences of meat and/or cream. Moreover, such low salt foods likewise include, for instance, fermented or brewed foods such as miso and soy sauce; processed vegetable foods such as salted vegetables and pickles; meat-processed products such as hams and sausage; processed marine products such as boiled fish paste, dried marine products and foods boiled down in soy; cooked meat balls, hamburger steak; fried foods; and grilled chicken. Among these, preferred low salt foods are those having a common salt concentration, upon eating the same, ranging from 0.01 to 0.5% by mass.

If the kokumi-imparting agent of the present invention is incorporated into the foregoing low salt foods, the foods would be able to give, to the consumer, a salty taste-like thick impression and an initial taste-punch (or impact) at the initial stage, when they eat these low salt foods.

In addition, if viewing the present invention from a different standpoint, herbs and spices derived from the plants belonging to Labiatae (mint family) or foods to which these herbs and spices derived from the plants belonging to Labiatae are added, are likewise preferred as the food compositions comprising the kokumi-imparting agent or the complex kokumi-imparting agent according to the present invention. Examples of herbs derived from the plants belonging to Labiatae include anis, oregano, sage, thyme, Japanese mint, peppermint, bergamot, marjoram, mint, lavender and rosemary in addition to beefsteak plant and basil, but the present invention is not restricted to these specific ones at all. In case of the foods each containing such herbs and/or spices derived from the plants belonging to Labiatae and the kokumi-imparting agent or the complex kokumi-imparting agent according to the present invention, the foregoing foods are preferably those containing the herbs and/or spices in an amount ranging from 0.01 to 10% by mass as expressed in terms of the solid content thereof, observed upon eating the same.

Examples of such foods each containing γ -Glu-Nva and the herbs and/or spices derived from the plants belonging to Labiatae are sauces, dressings, soups, snack foods or meat-processed products (such as hams and sausage).

Moreover, if viewing the present invention from a different standpoint, foods containing miso are also preferred in the present invention as the food composition comprising the kokumi-imparting agent or the complex kokumi-imparting agent according to the present invention. Examples of such miso include those prepared using malted rice, malt (malted barley) and malted soybeans as well as blended miso obtained by blending at least two of them, but the present invention is not restricted to these specific ones. Such foods containing miso are not restricted to particular ones, inasmuch as they contain miso, but there can be listed, for instance, miso soups, various kinds of processed foods which comprise miso as a seasoning, seasoned miso, miso-containing soups for Chinese noodles and miso-containing sauces. In case of foods which contain miso and the kokumi-imparting agent or the complex kokumi-imparting agent according to the

present invention, preferred are the foregoing miso-containing foods in which the miso or the like is present in an amount ranging from 0.01 to 99.9% by mass as expressed in terms of the solid content thereof, upon eating the same.

Further, if viewing the present invention from a different standpoint, also preferred as the food compositions comprising the kokumi-imparting agent or the complex kokumi-imparting agent according to the present invention are tomato-containing foods. Such tomato-containing foods are not restricted to specific ones inasmuch as they contain tomato, but specific examples thereof include tomato sauces, tomato catsups, tomato pastes, and a variety of tomato-containing soups. In case of foods containing tomato and the kokumi-imparting agent or the complex kokumi-imparting agent according to the present invention, the foregoing tomato-containing foods preferably contain tomato or the like in an amount ranging from 0.01 to 99.9% by mass as expressed in terms of the solid content thereof, observed when eating the same.

The γ -Glu-Nva used in the present invention and the amino acids or peptides used in combination therewith may likewise include those in their salt form. If the γ -Glu-Nva used in the present invention and the amino acids or peptides used in combination therewith are present in their salt form, the salts are not restricted to specific ones insomuch as they are pharmacologically acceptable and soluble ones, and specific examples thereof include ammonium salts, salts with alkali metals such as sodium and potassium, salts with alkaline earth metals such as calcium and magnesium, aluminum salts, zinc salts, salts with organic amines such as triethylamine, ethanolamine, morpholine, pyrrolidine, piperidine, piperazine and dicyclo-hexylamine, and salts with basic amino acids such as arginine and lysine, for the acidic groups such as carboxyl groups. Moreover, examples of the foregoing compounds likewise include salts with inorganic acids such as hydrochloric acid, sulfuric acid, phosphoric acid, nitric acid and hydrobromic acid; salts with organic acids such as acetic acid, citric acid, benzoic acid, maleic acid, fumaric acid, tartaric acid, succinic acid, tannic acid, butyric acid, hibenzoic acid, pamoic acid, enanthic acid, decanoic acid, theoclic acid, salicylic

acid, lactic acid, oxalic acid, mandelic acid and malic acid; and salts with organic sulfonic acids such as methanesulfonic acid, benzenesulfonic acid and p-toluenesulfonic acid, for the basic groups of the compounds.

The kokumi-imparting agent, the food composition or the complex
5 kokumi-imparting agent according to the present invention can be used in any form such as dried powders, pastes, and solutions, without any restriction in the physical properties thereof.

The kokumi-imparting agent, the food composition or the complex
kokumi-imparting agent according to the present invention can be used for
10 incorporating into, for instance, a variety of foods and beverages such as foods, beverages and seasonings.

If the kokumi-imparting agent, the food composition or the complex
kokumi-imparting agent according to the present invention is used for
incorporating into, for instance, a variety of foods and beverages such as foods,
15 beverages and seasonings, the ultimate amount of γ -Glu-Nva and that of the amino acid or peptide used in combination therewith are not restricted to any specific one inasmuch as they can ensure the achievement of the desired effects of the present invention, but the amount of γ -Glu-Nva and/or that of the amino acid or peptide each fall within the range of from about 0.1 ppb by mass to 99.9% by
20 mass and preferably about 1 ppb by mass to 10% by mass and more preferably about 0.01 ppm by mass to 1% by mass on the basis of the total mass of each corresponding food, beverage, seasoning or the like.

A variety of foods such as foods, beverages or seasonings, which comprise the
incorporated kokumi-imparting agent, food composition or complex
25 kokumi-imparting agent according to the present invention, may further comprise, for instance, any solid or liquid carrier and/or appropriate seasoning ingredients, which are acceptable for foods and beverages.

As the foregoing carriers, there can be listed, for instance, glucose, lactose, saccharose, starch, mannitol, dextrin, fatty acid glycerides, polyethylene glycol,
30 hydroxyethyl starch, ethylene glycol, polyoxyethylene sorbitan fatty acid esters,

gelatine, albumin, amino acids, water, and physiological saline.

The aforementioned ingredients for seasoning are not restricted to any particular one and they may be any ones currently used in this field, but specific examples thereof are those already described above.

5 The contents of the foregoing carriers, other seasoning ingredients or the like are not restricted to specific ones.

Among the foregoing seasoning ingredients, the yeast extract is not particularly restricted in any of the cell bodies of microorganisms, from which the extract is originated, the conditions of cultivating the microorganisms and the
10 methods for the extraction thereof and accordingly, any yeast extract can be used in the products of the present invention. Furthermore, these yeast extracts may be ones which are subjected to, for instance, a heat-treatment, a treatment with an enzyme, a concentration treatment and/or a treatment for converting the same into powder.

15 The kokumi-imparting agent, the food composition or the complex kokumi-imparting agent according to the present invention can be used in any form such as dried powders, pastes, and solutions, without any restriction in the physical properties thereof.

The kokumi-imparting agent, the food composition or the complex
20 kokumi-imparting agent according to the present invention can be used for incorporating into, for instance, a variety of foods and beverages such as foods, beverages and seasonings.

According to the present invention, there is also provided a method for the preparation of a variety of foods and beverages, which comprises the step of adding,
25 to a variety of intermediates used for the production of various kinds of foods and beverages, γ -Glu-Nva in such a manner that the resulting foods and beverages contain γ -Glu-Nva in an amount ranging from 1 ppb by mass to 99.9% by mass. In this respect, the various kinds of foods and beverages are preferably low salt foods.

30 The present invention also provides a method for the preparation of a

variety of foods or beverages, which comprises the step of incorporating the food composition of the present invention into intermediates used for preparing various kinds of foods or beverages. In this connection, the various kinds of foods or beverages are preferably low salt foods.

5 Regarding the method for preparing an intermediate used for preparing other foods or beverages according to the present invention, it is preferred that the method comprises the steps of adding the flavor enhancer consisting of γ -Glu-Nva to a food ingredient (such as umami-imparting ingredient, hydrolyzates of proteins, or herbs and/or spices) while admixing them together and, depending on
10 necessity, further cooking the resulting mixture of the food ingredients to thus form foods or beverages or intermediates for preparing the same.

In this respect, the step for the addition of the flavor enhancer consisting of γ -Glu-Nva to the food ingredient preferably comprises the step of controlling the concentration of γ -Glu-Nva in the intermediate used for preparing a food or
15 beverage to a level ranging from 0.005 to 600,000 ppm by mass and preferably 0.1 to 100,000 ppm by mass.

In addition, it is also preferred that the method further comprises the step of adding an intermediate for preparing foods or beverages to other food ingredients (such as agricultural products, marine products, livestock products, dairy products,
20 or processed products thereof) while controlling the concentration of γ -Glu-Nva in the resulting foods or beverages to a level of from 0.005 to 30 ppm by mass and preferably 0.05 to 10 ppm by mass.

Moreover, the step for adding the flavor enhancer consisting of γ -Glu-Nva to the food ingredient, while mixing them together preferably comprises the step of
25 controlling the concentration of γ -Glu-Nva in the resulting foods or beverages to a level of from 0.005 to 30 ppm by mass and preferably 0.05 to 10 ppm by mass.

In the foregoing production method, it is preferred that the foods or beverages are those comprising herbs and/or spices derived from the plants belonging to *Labiatae* (such as sauces, dressings, soups, snack foods or
30 meat-processed products). In this case, each food or beverage preferably

comprises 0.005 to 30 ppm by mass of γ -Glu-Nva; 0.01 to 10% by mass of the herbs and/or spices derived from the plants belonging to *Labiatae*; and other food ingredients.

Moreover, in the foregoing production method, it is preferred that the food or beverage is one comprising miso. In this case, each food or beverage preferably comprises 0.02 to 80 ppm by mass of γ -Glu-Nva; 0.01 to 99.9% by mass (or more preferably 0.1 to 90.0% by mass) of miso; and other food ingredients.

Furthermore, in the foregoing production method, it is preferred that the food or beverage is one comprising tomato. In this case, each food or beverage preferably comprises 0.02 to 80 ppm by mass of γ -Glu-Nva; 0.01 to 99.9% by mass (or more preferably 0.1 to 90.0% by mass) of tomato; and other food ingredients.

Moreover, the present invention also provides a method for enhancing flavor of foods or beverages comprising the step of adding a composition containing γ -Glu-Nva to foods or beverages in an amount ranging from 0.01 to 50% by mass. In this connection, it is preferred that the flavor-enhancing is a kokumi-imparting step.

The present invention will hereunder be described in more detail with reference to the following Examples, but the present invention is not restricted to these specific Examples at all.

Example

(Synthetic Example 1): Synthesis of γ -Glu-Nva (γ -L-glutamyl-L-norvaline):

There were dissolved, in methylene chloride (CH_2Cl_2 , 60mL), Boc-Nva · DCHA (t-butoxycarbonyl-L-norvaline dicyclohexyl-ammonium salt, 3.39 g, 8.49mM) and benzyl alcohol (1.01 g, 9.34mM). Then there were added, to the resulting solution, DMAP (4-dimethylaminopyridine, 0.21 g, 0.2 eq., 1.70mM) and WSC · HCl (1-ethyl- 3-(3-dimethylaminopropyl)-carbodiimide hydrochloride, 1.81 g, 1.1 eq., 9.34mM), while maintaining the reaction solution at 0 °C. The temperature of the reaction solution was gradually raised and stirred at room temperature overnight (16 hours). Then the reaction solution was concentrated

under reduced pressure, ethyl acetate (500mL) was added to the resulting residue, the organic phase was raised to a temperature of 50°C, it was then washed with water (100mL), twice with a 5% aqueous solution of citric acid (100mL), with a saturated common salt solution (100mL), twice with a 5% aqueous solution of sodium hydrogen carbonate (100mL) and with a saturated common salt solution (100mL), and then the organic phase was dried over anhydrous magnesium sulfate. The magnesium sulfate was removed through filtration and the filtrate was concentrated under reduced pressure. Crystals were precipitated in the course of the concentration under reduced pressure and therefore, the crystals were collected through filtration followed by the drying of them under reduced pressure to give crystals of Boc-Nva-OBzl (2.41 g, 7.83mM).

To Boc-Nva-OBzl combined with separately synthesized Boc-Nva-OBzl (2.68 g, 8.72mM), there was added a 4N HCl/dioxane solution (43.6mL) and the mixture was stirred at room temperature for one hour. The reaction system was concentrated under reduced pressure to remove the dioxane, n-hexane (30mL) was added to the resulting residue and then the resulting mixture was concentrated under reduced pressure. In this respect, the latter two steps were repeated three times to thus obtain H-Nva-OBzl · HCl in a quantitative yield.

The resulting H-Nva-OBzl · HCl was dissolved in methylene chloride (60mL) and the resulting reaction solution was maintained at 0°C. To the reaction solution, there were added Z-Glu-OBzl (N- α -carbobenzoxy-L-glutamic acid α -benzyl ester, 3.24 g, 8.72mM), triethylamine (1.34mL, 1.1 eq., 9.59mM), HOBT · H₂O (1-hydroxybenzotriazole hydrate, 1.47 g, 1.1 eq., 9.59mM) and WSC · HCl (1.84 g, 1.1 eq., 9.59mM). The temperature of the reaction solution was gradually raised and stirred at room temperature overnight (16 hours). Then the reaction solution was concentrated under reduced pressure, ethyl acetate (200mL) was added to the resulting residue, and the organic phase was then washed with water (80mL), twice with a 5% aqueous solution of citric acid (80mL), with a saturated common salt solution (80mL), twice with a 5% aqueous solution of sodium hydrogen carbonate (80mL) and with a saturated common salt solution (80mL),

and then the organic phase was dried over anhydrous magnesium sulfate. The magnesium sulfate was removed through filtration and the filtrate was concentrated under reduced pressure. The resulting residue was recrystallized from ethyl acetate and n-hexane, the crystals thus obtained were collected through
5 filtration and dried under reduced pressure to give crystals of Z-Glu(Nva-OBzl)-OBzl (4.05 g).

To a mixed solution of ethanol (150mL) and water (30mL), there were added Z-Glu(Nva-OBzl)-OBzl (4.05 g) and 5% palladium on carbon (5% palladium/carbon, 0.70 g) and a catalytic reducing reaction was carried out at 50°C overnight (14
10 hours) in a hydrogen gas atmosphere. Water (50mL) was added to the reaction system in small portions during the reaction. The palladium/carbon was removed from the reaction system through filtration and the resulting filtrate was concentrated under reduced pressure. The residue was recrystallized from a small amount of water and ethanol to thus give γ -Glu-Nva (1.50 g) as white
15 crystals. Further, the crystals were dissolved in water (100mL) followed by the lyophilization of the solution to give γ -Glu-Nva (1.27 g, 5.16mM) as white powder. The characteristic values thereof will be given below:

ESI-MS: (M+H)⁺ = 247.1; (M-H)⁻ = 245.2.

¹H-NMR (400 MHz, D₂O): δ (ppm): 0.77 (3H, t, J=7.3 Hz), 1.18-1.33 (2H, m), 1.50-
20 1.73 (2H, m), 1.97-2.08 (2H, m), 2.36 (2H, dd, J=6 and 8.4Hz), 3.68 (1H, t, J=8.4Hz), 4.15 (1H, dd, J=5.2 and 8.8Hz).

(Synthetic Example 2): Synthesis of γ -Glu-Nle (γ -L-glutamyl-L-norleucine)
(Comparative Example):

There were dissolved, in methylene chloride (CH₂Cl₂, 30mL), Boc-Nle •
25 0.2AcOEt (t-butoxycarbonyl-L-norleucine • 0.2M ethyl acetate, 0.51 g, 2.00mM) and benzyl alcohol (0.24 g, mM). Then there were added, to the resulting solution, DMAP (4-dimethylaminopyridine, 0.05 g, 0.2 eq., 0.40mM) and WSC • HCl (1-ethyl-3-(3-dimethylaminopropyl)-carbodiimide hydrochloride, 0.43 g, 1.1 eq., 2.20mM), while maintaining the reaction solution at 0°C. The temperature of the reaction
30 solution was gradually raised and stirred at room temperature overnight (16

hours). Then the reaction solution was concentrated under reduced pressure, ethyl acetate (100mL) was added to the resulting residue, the organic liquid was then washed with water (30mL), twice with a 5% aqueous solution of citric acid (30mL), with a saturated common salt solution (30mL), twice with a 5% aqueous solution of sodium hydrogen carbonate (30mL) and then with a saturated common salt solution (30mL), and then the organic phase was dried over anhydrous magnesium sulfate. The magnesium sulfate was removed through filtration and the filtrate was concentrated under reduced pressure to thus give Boc-Nle-OBzl (0.61 g, 1.90mM) as an oily product.

To Boc-Nle-OBzl (0.61 g, 1.90mM), there was added a 4N HCl/dioxane solution (9.40mL) and the mixture was stirred at room temperature for one hour. The reaction system was concentrated under reduced pressure to remove the dioxane, n-hexane (5.0mL) was added to the resulting residue and then the resulting mixture was concentrated under reduced pressure. In this connection, the latter two steps were repeated three times to thus obtain H-Nle-OBzl · HCl in a quantitative yield.

The resulting H-Nle-OBzl · HCl was dissolved in methylene chloride (30mL) and the resulting reaction solution was maintained at 0°C. To the reaction solution, there were added Z-Glu-OBzl (N- α -carbobenzoxyl-L-glutamic acid α -benzyl ester, 0.70 g, 1.90mM), triethylamine (0.29mL, 1.1 eq., 2.10mM), HOBT · H₂O (1-hydroxybenzotriazole hydrate, 0.32 g, 1.1 eq., 2.10mM) and WSC · HCl (0.41 g, 1.1 eq., 2.10mM). The temperature of the reaction solution was gradually raised and stirred at room temperature overnight (16 hours). Then the reaction mixture was concentrated under reduced pressure, ethyl acetate (100mL) was added to the resulting residue, and the organic phase was then washed with water (30mL), twice with a 5% aqueous solution of citric acid (30mL), with a saturated common salt solution (30mL), twice with a 5% aqueous solution of sodium hydrogen carbonate (30mL) and with a saturated common salt solution (30mL), and then the organic phase was dried over anhydrous magnesium sulfate. The magnesium sulfate was removed through filtration and the filtrate was

concentrated under reduced pressure. The resulting residue was recrystallized from ethyl acetate and n-hexane, the crystals thus obtained were collected through filtration and dried under reduced pressure to give crystals of Z-Glu(Nle-OBzl)-OBzl (0.91 g).

To a mixed solution of ethanol (50mL) and water (10mL), there were added Z-Glu(Nle-OBzl)-OBzl (4.05 g) and 5% palladium on carbon (5% palladium/carbon, 0.40 g) and a catalytic reducing reaction was carried out at 50°C overnight (14 hours) in a hydrogen gas atmosphere. Water (10mL) was added to the reaction system in small portions during the reaction. The palladium/carbon was removed from the reaction system through filtration and the resulting filtrate was concentrated under reduced pressure. The residue was recrystallized from a small amount of water and ethanol to thus give γ -Glu-Nle (0.29 g) as hygroscopic crystals. Further, the crystals were dissolved in water (30mL) followed by the lyophilization of the solution to give γ -Glu-Nle (0.13 g, 0.50mM) as white powder.

The characteristic values thereof will be given below:

ESI-MS: $(M+H)^+ = 261.1$; $(M-H)^- = 259.0$.

1H -NMR (400 MHz, D_2O): δ (ppm): 0.79 (3H, t, $J=7.1$ Hz), 1.18-1.30 (4H, m), 1.60-1.70 (1H, m), 1.70-1.80 (1H, m), 2.04-2.10 (2H, m), 2.38-2.44 (2H, m), 3.73 (1H, t, $J=6.3$ Hz), 4.19 (1H, dd, $J=5.0$ and 8.8Hz).

(Test Example 1): Preparation of CaSR-Expression Plasmid

A CaSR-expression plasmid was prepared according to the following procedures:

There were synthesized synthetic oligo DNA used for the PCR procedures (i.e., forward primer (Sequence No. 3: ACTAATACGACTCACTATAGGGACCATGGCA- TTTTATAGCTGCTGCTGG) and reverse primer (Sequence No. 4: TTATGAATT- CACTACGTTTTCTGTAAACAG) on the basis of the DNA sequence registered at NCBI (CaSR (calcium receptor): NM_000388, Sequence Nos. 1 and 2).

The PCR procedures were carried out under the conditions specified below using cDNA (available from Clontech Company) derived from human kidney as a

material, while using the foregoing primers and Pfu Ultra DNA Polymerase (available from Stratagene Company): The reaction system was processed at 94°C for 3 minutes and then at 94°C for 30 seconds, at 55°C for 30 seconds and at 72°C for 2 minutes, wherein these steps were repeated over 35 times and the system was finally reacted at 72°C for 7 minutes. The reaction system was then subjected to electrophoresis treatment through agarose as a support, the agarose was stained with a DNA-staining agent and then it was irradiated with UV light rays to detect whether the cDNA was surely amplified by the PCR procedures or not. At the same time, the electrophoresis pattern was compared with the DNA marker whose electrophoretic size had been known to thus confirm the chain lengths of the PCR products.

Plasmid vector pBR322 was cleaved with a restriction enzyme EcoRV (available from Takara Co., Ltd) and the gene fragment amplified by the PCR procedures was ligated with the plasmid vector at the cleaved site, using Ligation Kit (available from Promega Company). The cells of Escherichia coli DH5 α strain were transformed with this reaction solution, followed by the selection of the transformants containing the plasmid in which the PCR-amplified product had been cloned and further the PCR-amplified product was confirmed by the DNA-base sequence analysis.

This recombinant plasmid was used for the establishment of a human CaSR-expression plasmid hCaSR/pcDNA3.1.

(Test Example 2): Evaluation of CaSR Agonist Activity

293E Cells (EBNA1-expression HEK293 cells, ATCC No. CRL-10852) were cultivated in DMEN/Ham's-F12 (3.15/mL glucose-containing Dulbecco's modified Eagle medium, available from Nakaraitesk Company) supplemented with 10% fetal calf serum, in the presence of 200 μ g/mL of G418 (available from Genetisin). The cultured cells were inoculated in F25 flask at a density of 3×10^6 cells/10 mL, the flask was allowed to stand over 24 hours in a CO₂ incubator (5% CO₂, 37°C), and then the human CaSR-expression plasmid hCaSR/pcDNA3.1 was transformed or transfected with a reagent for transfection Fugene6 (available from Roche

Company). The transfected plasmid was maintained in a CO₂ incubator over 6 to 7 hours, then the cells were recovered using a 10% fetal calf serum-containing DMEM/ Ham's-F12 and the cells were inoculated in each well of a poly-D-lysine coat 96-well plate (BD-Biocoat) at a density of 70,000 cells/well.

5 The 96-well plate was allowed to stand over 24 hours in a CO₂ incubator, then the culture medium was removed from each well of the 96-well plate in which the cells were inoculated, followed by the addition, to each well, of a Ca²⁺ fluorescent indicator Calcium 4 Assay Kit (available from Molecular Devices Company) dissolved in Assay Buffer (containing 146mM of NaCl, 5mM of KCl, 10 1mM of MgSO₄, 1 mg/mL of glucose, 20mM of HEPES (pH 7.2) and 0.75 to 1.25mM of CaCl₂) in an amount of 200 μ l/well, and subsequently allowing the 96-well plate to stand at 37°C for one hour and then at room temperature for 10 minutes so that the indicator was incorporated into the cells.

To each well of the 96-well plate, there was added each test compound 15 dissolved in a 0.1% BSA-containing Assay Buffer in an amount of 50 μ l/well and then any change of the intensity of fluorescence was monitored over 3 minutes using FLEX Station (available from Molecular Devices Company).

(Method for the Determination of EC₅₀):

The difference (RFU (Max-Min)) between the maximum and minimum 20 fluorescent intensities observed for each well before and after the addition of each specific test compound was determined by the automatic calculation using FLEX Station. The activity rate was calculated while the RFU (Max-Min) value observed when adding the compound at the maximum concentration was defined to be 100% and the RFU (Max-Min) value observed when using the 0.1% 25 BSA-containing Assay Buffer free of any test compound was defined to be 0%, followed by subjecting the resulting data to the curve-fitting procedures using the spreadsheet software Xfit or Graph-Pad-Prism to thus determine the EC₅₀ which was the concentration of the compound at the activity rate of 50%. The results thus obtained are summarized in the following Table 1.

30 In addition, the same EC₅₀-determining procedures used above were

repeated except for using other dipeptides as Comparative Examples. The results thus obtained are summarized in the following Table 2.

Table 1

Compound	EC ₅₀ , μ M
γ -Glu-Nva	0.12
γ -Glu-Nle	4.41

5

Table 2

Compound	EC ₅₀ , μ M
γ -Glu-Abu	0.21
γ -Glu-Ala	1.24
γ -Glu-Val	1.03
γ -Glu-tLeu	3.06
γ -Glu-Cys	0.16
γ -Glu-Ser	11
γ -Glu-Thr	6.97
γ -Glu-Aib	15.4

When comparing with other dipeptides, γ -Glu-Nva was found to have a strong CaSR agonist activity comparable to that observed for γ -Glu-Cys. It has been known that a low molecular weight peptide possessing a CaSR agonist activity is useful as a kokumi-imparting agent (see Patent Document 1 specified above) and accordingly, it is suggested that γ -Glu-Nva would be able to serve as a particularly excellent kokumi-imparting agent.

Example 1: Evaluation of Kokumi-Imparting Activity

In this example, γ -Glu-Nva was inspected for the intensity of its kokumi-imparting activity according to a quantitative sensory evaluation test.

This quantitative sensory evaluation test was carried out according to the

following procedures: The intensity of the kokumi-imparting activity observed for each test compound was determined as a value observed when blending 0.00001 to 0.5 g/dL of the corresponding test compound to the distilled water containing sodium glutamate (0.05 g/dL), inosinic acid monophosphate (0.05 g/dL), and sodium chloride (0.5 g/dL). In this connection, when a sample showed an acidic nature upon the dissolution of the test compound as compared with the test compound-free control, the pH value of the sample was adjusted, using NaOH, to a level of the pH value (observed for the control) ± 0.2 prior to the practical use of the sample in the evaluation. The evaluation criteria are assumed to be as follows: control: 0 point; strong: 3 points; very strong: 5 points. Moreover, to make more clear the criteria, the initial taste and the middle/after taste of γ -Glu-Val-Gly were set at 3.0 points, respectively. The scoring or rating was carried out using the method of line scale and more specifically, it was carried out by writing each corresponding score on a straight line on which points corresponding to -5 ~ 0 ~ 5 had been indicated. The panelists used in this test were defined to be persons who had been engaged in the development of seasonings for foods over not less than one year of the cumulative time period and who could judge that the difference in the titer between γ -Glu-Cys-Gly and γ -Glu-Val-Gly added to a solution having umami/ salty taste is about 10 times (while confirming the ability of these persons at regular intervals). The evaluation was carried out at n (the number of panelists used) = 4. In this connection, the term "initial taste" means the taste-development detected during the term extending from 0 to 2 seconds after the sample is kept in the panelist's mouth, while the term "middle/after taste" means the taste-development detected thereafter. The test compound widely showed the kokumi-imparting activity over the foregoing range of concentration thereof added. However, the results observed for typical concentrations thereof are summarized in the following Table 3.

In addition, γ -Glu-Val-Gly, γ -Glu-Cys, γ -Glu-Val, γ -Glu-Ala and γ -Glu-Ser were likewise inspected for their kokumi-imparting effect according to the same procedures used above. The results obtained are also listed in Table 3.

Table 3

Compound	Conc. (g/dL)	Intensity of kokumi		Sensory Evaluation Profile
		Initial Taste	Middle/After Taste	
Control	--	0	0	--
γ -Glu-Val-Gly	0.001	3.0	3.0	Mainly, the mellowness, the dense-feeling, and the growth were enhanced.
γ -Glu-Nva	0.0001	3.6	2.8	Mainly the initial and middle tastes were enhanced.
γ -Glu-Cys	0.01	3.1	3.1	Mainly the middle and after tastes were enhanced and the sample gave out a slight odor of sulfur.
γ -Glu-Val	0.01	3.1	2.4	The after taste was quite weak.
γ -Glu-Ala	0.2	4.5	4.3	Mainly the tastes similar to the sour and sweet tastes were enhanced on and after the initial taste stage.
γ -Glu-Ser	0.2	3.6	3.0	The initial taste was strong, but off-flavor were recognized.

Thus, it was found that γ -Glu-Nva possesses an excellent kokumi-imparting activity and that it is also excellent in the rising of the initial taste with respect to the taste-developing or seasoning pattern. This excellent rising of the initial taste observed for γ -Glu-Nva is one of extremely advantageous points thereof as compared with that observed for γ -Glu-Cys. Moreover, γ -Glu-Nva is also excellent in its stability and this is also an advantageous point as compared with γ -Glu-Cys. Regarding the kokumi-imparting activity, γ -Glu-Nva has a high titer superior to those of the conventionally known dipeptides. In addition, γ -Glu-Nva has a short chain length since it comprises only two amino acid residues. Accordingly, it can relatively easily be prepared at a low cost as

compared with the preparation of any tripeptide comprising 3 amino acid residues and accordingly, the agent of the present invention is likewise quite advantageous from the industrial standpoint.

Example 2: Effect of γ -Glu-Nva on Basil:

γ -Glu-Nva is an initial taste type dipeptide. However, it was found that when eating the dipeptide, it expressed its kokumi-imparting effect and action, slightly later as compared with the conventionally known initial taste type dipeptide showing high titers such as γ -Glu-Abu and γ -Glu-Val. On the other hand, it was also found that if comparing this dipeptide with the conventional middle/after taste type tripeptides such as γ -Glu-Cys-Gly (glutathione) and γ -Glu-Val-Gly, the dipeptide could quite immediately express the kokumi-imparting effect. The inventors of this invention have taken note of this point and have searched for herbs and/or spices which may be synchronized with the time at which γ -Glu-Nva can express its kokumi-imparting effect and activity to thus enhance the taste of the former and the inventors have investigated them in detail. In this connection, such characteristics have not been recognized by other γ -Glu peptides having high kokumi-imparting effect and activity.

More specifically, the sensory evaluation test was carried out according to the following procedures: Commercially available typical herb/spice in powdery form was dispersed in water in a concentration of 0.5% by mass to thus form a herb/spice solution. This solution was admixed with γ -Glu-Nva, γ -Glu-Cys-Gly, or γ -Glu- Abu as a test compound. According to the paired comparison test, the panelists were requested to comparatively evaluate the following three samples and to judge that "either of them was preferred since it could enhance the flavor and taste of the herb/spice solution without changing the balance between them": (1) 0.02% by mass of γ -Glu-Cys-Gly whose kokumi-imparting activity was identical to 0.00015% by mass of γ -Glu-Nva; (2) 0.00015% by mass of γ -Glu- Abu, the amount of which was identical to 0.00015% by mass of γ -Glu-Nva; (3) 0.003% by mass of γ -Glu- Abu whose kokumi-imparting activity was identical to that observed for 0.00015% by mass of γ -Glu-Nva. The panelists used in this test

were defined to be persons who had been engaged in the development of seasonings for foods over not less than one year of the cumulative time period and who could judge that the difference in the titer between γ -Glu-Cys-Gly and γ -Glu-Val-Gly added to a solution having umami/salty taste is about 10 times (while confirming the ability of these persons at regular intervals). The evaluation was carried out at N (the number of panelists used) = 9.

The following Table 4 shows the number of panelists who judged that 0.00015% by mass of γ -Glu-Nva was "rather preferred since it could enhance the flavor and taste of the herb/spice solution without changing the balance between them". The herbs and/or spices derived from the plants belonging to Labiatae certainly showed the desired effects, but the results observed for basil are shown as the typical example thereof.

From the results thus obtained, it could be concluded as follows: γ -Glu-Nva shows such a remarkable effect that it can significantly and extremely enhance the flavor and taste of the herbs and/or spices derived from the plants belonging to Labiatae even in cases where the titers of the kokumi are identical to one another like the cases of (1) and (3).

Table 4

N=9

Sample	Conc. (wt%)	Sample	Conc. (wt%)	No. of Panelists*
(1) γ -Glu-Nva	0.00015	γ -Glu-Cys-Gly	0.02	9/9**
(2) γ -Glu-Nva	0.00015	γ -Glu-Abu	0.00015	9/9**
(3) γ -Glu-Nva	0.00015	γ -Glu-Abu	0.003	8/9***

*: The number of panelists who judged that γ -Glu-Nva was rather preferred since it could enhance the flavor and taste of the solution of basil belonging to Labiatae, without changing the balance between them.

**: The result indicates that γ -Glu-Nva is rather preferred since it can enhance the flavor and taste of the solution of basil belonging to Labiatae, without changing the balance between them, at a significant level of 1%.

***: The result indicates that γ -Glu-Nva is rather preferred since it can enhance the flavor and taste of the solution of basil belonging to Labiatae, without changing the balance between them, at a significant level of 5%.

The foregoing results clearly indicate that γ -Glu-Nva shows the following quite remarkable effect: it can “enhance and make, more favorable, the flavor and taste of herbs and/or spices derived from the plants belonging to Labiatae without changing the balance between them”, when comparing them with those observed for γ Glu peptides having high kokumi-imparting activities such as γ -Glu-Cys-Gly and γ -Glu-Abu at concentrations capable of exhibiting the same kokumi- imparting activities. Examples of the herbs and/or spices derived from the plants belonging to Labiatae include a variety of plants, in addition to beefsteak plant and basil, anis, oregano, sage, thyme, Japanese mint, peppermint, bergamot, marjoram, mint, lavender and rosemary and they have widely been used, throughout the world, in, for instance, seasonings, soups, sauces, processed meat products, cooked and processed products and confectionery, including Italian meals. As has been discussed above, γ -Glu-Nva would permit the improvement of the flavor and taste of foods which make use of herbs and/or spices derived from the plants belonging to Labiatae, at a low cost, while using the same only in a trace amount and therefore, the use thereof is quite advantageous from the industrial standpoint.

Example 3: Effect of γ -Glu-Nva on Miso:

γ -Glu-Nva is an initial taste type dipeptide. However, it was found that when eating the dipeptide, it expressed its kokumi-imparting effect and action, slightly later as compared with other known initial taste type dipeptide showing high titers such as γ -Glu-Abu and γ -Glu-Val. On the other hand, it was also found that if comparing this dipeptide with the conventional middle/after taste type tripeptides such as γ -Glu-Cys-Gly (glutathione) and γ -Glu-Val-Gly, the dipeptide could quite immediately express the kokumi-imparting effect. The inventors of this invention have taken note of this point and have searched for seasonings or the like which may be synchronized with the time at which γ

-Glu-Nva can express its kokumi-imparting effect and activity to thus enhance the taste of the former and the inventors have investigated them in detail. In this connection, such characteristics have not been recognized by other γ -Glu peptides having high kokumi-imparting effect and activity.

5 More specifically, the sensory evaluation test was carried out according to the following procedures: Commercially available miso (ingredients: soybeans and barley) for popular use was dispersed in hot water in a concentration of 10.0% by mass to thus form a solution of miso. This solution was admixed with γ -Glu-Nva, γ -Glu-Cys-Gly, or γ -Glu-Abu as a test compound. According to the
10 paired comparison test method (pair test), the panelists were requested to comparatively evaluate the following three samples and to judge that "either of them was preferred or favorable since it could enhance the flavor and taste of the solution of miso without changing the balance between them": (1) 0.02% by mass of γ -Glu-Cys-Gly whose kokumi-imparting activity was identical to 0.0004% by
15 mass of γ -Glu-Nva; (2) 0.0004% by mass of γ -Glu- Abu, the amount of which was identical to 0.0004% by mass of γ -Glu-Nva; (3) 0.003% by mass of γ -Glu-Abu whose kokumi-imparting activity was identical to that observed for 0.0004% by mass of γ -Glu-Nva. The panelists used in this test were defined to be persons who had been engaged in the development of seasonings for foods over not less
20 than one year of the cumulative time period and who could judge that the difference in the titer between γ -Glu-Cys-Gly and γ -Glu-Val-Gly added to a solution having umami/salty taste is about 10 times (while confirming the ability of these persons at regular intervals). The evaluation was carried out at N (the number of panelists used) = 9.

25 The following Table 5 shows the number of panelists who judged that 0.0004% by mass of γ -Glu-Nva was "rather preferred since it could enhance the flavor and taste of the solution of miso without changing the balance between them".

From the results thus obtained, it could be concluded as follows: γ -Glu-Nva
30 shows such a remarkable effect that it can significantly and extremely enhance the

flavor and taste of the miso even in cases where the titers of the kokumi were identical to one another like the cases of (1) and (3).

Table 5

N=9

Sample	Conc. (wt%)	Sample	Conc. (wt%)	No. of Panelists*
(1) γ -Glu-Nva	0.0004	γ -Glu-Cys-Gly	0.02	8/9**
(2) γ -Glu-Nva	0.0004	γ -Glu-Abu	0.0004	9/9***
(3) γ -Glu-Nva	0.0004	γ -Glu-Abu	0.003	9/9***

5 *: The number of panelists who judged that γ -Glu-Nva was rather preferred since it could enhance the flavor and taste of the solution of miso, without changing the balance between them.

10 **: The result indicates that γ -Glu-Nva is rather preferred since it can enhance the flavor and taste of the solution of miso, without changing the balance between them, at a significant level of 5%.

***: The result indicates that γ -Glu-Nva is rather preferred since it can enhance the flavor and taste of the solution of miso, without changing the balance between them, at a significant level of 1%.

15 The foregoing results clearly indicate that γ -Glu-Nva shows the following quite remarkable effect: it can “enhance and make, more favorable, the flavor and taste of miso without changing the balance between them”, when comparing them with those observed for γ Glu peptides having high kokumi-imparting activities such as γ -Glu-Cys-Gly and γ -Glu-Abu, at concentrations capable of exhibiting the same kokumi-imparting activities. Miso has widely been used in, for instance, 20 seasonings, soup or broth, sauces and cooked and processed products. As has been discussed above, γ -Glu-Nva would permit the improvement of the flavor and taste of foods which make use of miso, at a low cost, while using the same only in a trace amount and therefore, the use thereof is quite advantageous from the industrial standpoint.

25 Example 4: Effect of γ -Glu-Nva on Tomato Catsup:

γ -Glu-Nva is an initial taste type dipeptide. However, it was found that when eating this dipeptide, it expressed its kokumi-imparting effect and action, slightly later as compared with other known initial taste type dipeptide showing high titers such as γ -Glu-Abu and γ -Glu-Val. On the other hand, it was also found that if comparing this dipeptide with the conventional middle/after taste type tripeptides such as γ -Glu-Cys-Gly (glutathione) and γ -Glu-Val-Gly, the dipeptide could quite immediately express the kokumi-imparting effect. The inventors of this invention have taken note of this point and have searched for seasonings or the like which may be synchronized with the time at which γ -Glu-Nva can express its kokumi-imparting effect and activity to thus enhance the taste of the former and the inventors have investigated them in detail. In this connection, such characteristics have not been recognized by other γ -Glu peptides having high kokumi-imparting effect and activity.

More specifically, the sensory evaluation test was carried out according to the following procedures: Commercially available tomato catsup for popular use was dispersed in hot water in a concentration of 33.3% by mass to thus form a solution of tomato catsup. This solution was admixed with γ -Glu-Nva, γ -Glu-Cys-Gly, or γ -Glu-Abu as a test compound. According to the paired comparison test method (pair test), the panelists were requested to comparatively evaluate the following three samples and to judge that "either of them was preferred or favorable since it could enhance the flavor and taste of the solution of tomato catsup without changing the balance between them": (1) 0.02% by mass of γ -Glu-Cys-Gly whose kokumi-imparting activity was identical to 0.0004% by mass of γ -Glu-Nva; (2) 0.0004% by mass of γ -Glu- Abu, the amount of which was identical to 0.0004% by mass of γ -Glu-Nva; (3) 0.003% by mass of γ -Glu-Abu whose kokumi-imparting activity was identical to that observed for 0.0004% by mass of γ -Glu-Nva. The panelists used in this test were defined to be persons who had been engaged in the development of seasonings for foods over not less than one year of the cumulative time period and who could judge that the difference in the titer between γ -Glu-Cys-Gly and γ -Glu-Val-Gly added to a

solution having umami/salty taste was about 10 times (while confirming the ability of these persons at regular intervals). The evaluation was carried out at N (the number of panelists used) = 9.

The following Table 6 shows the number of panelists who judged that 0.0004% by mass of γ -Glu-Nva was “rather preferred or favorable since it could enhance the flavor and taste of the solution of tomato catsup without changing the balance between them”. Other sauces or the like comprising tomato as an ingredient certainly showed the desired effects. However, the results observed for tomato catsup are shown in Table 6 as the typical example thereof.

From the results thus obtained, it could be concluded as follows: γ -Glu-Nva shows such a remarkable effect that it can significantly and extremely enhance the flavor and taste of the tomato even in cases where the titers of the kokumi were identical to one another like the cases of (1) and (3).

Table 6

N=9

Sample	Conc. (wt%)	Sample	Conc. (wt%)	No. of Panelists*
(1) γ -Glu-Nva	0.0004	γ -Glu-Cys-Gly	0.02	9/9**
(2) γ -Glu-Nva	0.0004	γ -Glu-Abu	0.0004	9/9**
(3) γ -Glu-Nva	0.0004	γ -Glu-Abu	0.003	9/9**

*: The number of panelists who judged that γ -Glu-Nva was rather preferred since it could enhance the flavor and taste of the solution of tomato catsup, without changing the balance between them.

**: The result indicates that γ -Glu-Nva is rather preferred since it can enhance the flavor and taste of the solution of tomato catsup, without changing the balance between them, at a significant level of 1%.

The foregoing results clearly indicate that γ -Glu-Nva shows the following quite remarkable effect: it can “enhance and make, more favorable, the tomato flavor and taste of, for instance, seasonings and sauces comprising tomato without changing the balance between them”, when comparing them with those observed

for γ Glu peptides having high kokumi-imparting activities such as γ -Glu-Cys-Gly and γ -Glu-Abu, at concentrations capable of exhibiting the same kokumi-imparting activities. Tomato has widely been used in, for instance, seasonings, soup or broth, sauces and cooked and processed products. As has
5 been discussed above, γ -Glu-Nva would permit the improvement of the flavor and taste of foods which make use of tomato, at a low cost, while using the same only in a trace amount and therefore, the use thereof is quite advantageous from the industrial standpoint.

What is claimed is:

1. A kokumi-imparting agent consisting essentially of γ -Glu-Nva.

2. A complex kokumi-imparting agent comprising, in combination,

5 (a) γ -Glu-Nva; and

(b) one or at least two amino acids or peptides selected from the group consisting of γ -Glu-X-Gly wherein X represents an amino acid or an amino acid derivative, γ -Glu-Val-Y wherein Y represents an amino acid or an amino acid derivative, γ -Glu-Abu, γ -Glu-Ala, γ -Glu-Gly, γ -Glu-Cys, γ -Glu-Met, γ -Glu-Thr, γ -Glu-Val, γ -Glu-Orn, Asp-Gly, Cys-Gly, Cys-Met, Glu-Cys, Gly-Cys, Leu-Asp, D-Cys, γ -Glu-Met (O), γ -Glu- γ -Glu-Val, γ -Glu-Val-NH₂, γ -Glu-Val-ol, γ -Glu-Ser, γ -Glu-Tau, γ -Glu-Cys (S-Me) (O), γ -Glu-Leu, γ -Glu-Ile, γ -Glu-t-Leu and γ -Glu-Cys (S-Me).

15 3. A food composition comprising γ -Glu-Nva in an amount ranging from 0.1 ppb to 99.9% by mass.

4. The food composition as set forth in claim 3, wherein it comprises 0.005 to 30 ppm by mass of γ -Glu-Nva; 0.01 to 10% by mass of herbs and/or spices derived from the plants belonging to Labiatae; and any other food ingredients.

20 5. The food composition as set forth in claim 3, wherein it comprises 0.02 to 80 ppm by mass of γ -Glu-Nva; 0.01 to 99.9% by mass of miso; and any other food ingredients.

6. The food composition as set forth in claim 3, wherein it comprises 0.02 to 80 ppm by mass of γ -Glu-Nva; 0.01 to 99.9% by mass of tomato; and any other food ingredients.

25 7. A method for preparing a food or beverage, or an intermediate used for preparing a food or beverage comprising the steps of:

adding a flavor enhancer consisting essentially of γ -Glu-Nva to food ingredients, while mixing them together; and

optionally cooking the resulting mixture of the food ingredients.

30 8. The method for preparing a food or beverage, or an intermediate used for

preparing a food or beverage as set forth in claim 7, wherein the step for the adding the flavor enhancer consisting essentially of γ -Glu-Nva to food ingredients comprises the step of controlling the concentration of γ -Glu-Nva in the intermediate used for preparing a food or beverage to a level ranging from 0.005 to 600,000 ppm by mass.

9. The method for preparing a food or beverage as set forth in claim 8, wherein the method further comprises the step of adding an intermediate for preparing a food or beverage to other food ingredients while controlling the concentration of γ -Glu-Nva in the resulting food or beverage to a level ranging from 0.005 to 30 ppm by mass.

10. The method for preparing a food or beverage as set forth in claim 8, wherein the step for adding the flavor enhancer consisting essentially of γ -Glu-Nva to the food ingredients, while mixing them together comprises the step of controlling the concentration of γ -Glu-Nva in the resulting food or beverage to a level of from 0.005 to 30 ppm by mass.

11. The method for preparing a food or beverage as set forth in any one of claims 7 to 10, wherein the food or beverage is a food containing herb and/or spice derived from a plant belonging to Labiatae.

12. The method for preparing a food or beverage as set forth in any one of claims 7 to 10, wherein the food or beverage is a food containing miso.

13. The method for preparing a food or beverage as set forth in any one of claims 7 to 10, wherein the food or beverage is a food containing tomato.

14. A food or beverage, or an intermediate used for preparing a food or beverage, characterized in that it is prepared according to the method as set forth in any one of claims 7 to 13.

15. A method for enhancing the flavor and/or taste of a food or beverage, comprising the step of adding a composition containing γ -Glu-Nva to a food or beverage.

16. The method as set forth in claim 15, wherein the flavor and/or taste-enhancing step is a kokumi-imparting step.