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(54) Title: FLAVOUR ADDITIVES

(57) Abstract: The present invention relates to the use of one or more nucleotides, one or more amino acids selected from the group consisting of proline, hydroxyproline, glutamic acid, aspartic acid, arginine, cystine, glutamine, isoleucine, lysine, threonine, valine and ornithine and one or more furanones for increasing the palatability of a foodstuff to a companion animal. The invention also relates to a pet foodstuff or supplement comprising one or more nucleotides, one or more amino acids selected from the group consisting of proline, hydroxyproline, glutamic acid, aspartic acid, arginine, cystine, glutamine, isoleucine, lysine, threonine, valine and ornithine and one or more furanones, and also to a method of increasing the palatability of a foodstuff to a companion animal.



Flavour Additives

5 The present invention relates to the use of one or more nucleotides, one or more amino acids selected from the group consisting of proline, hydroxyproline, glutamic acid, aspartic acid, arginine, cystine, glutamine, isoleucine, lysine, threonine, valine and ornithine and one or more furanones for increasing the palatability of a foodstuff to a companion animal. The invention also relates to a pet foodstuff or supplement comprising one or more nucleotides, one or more amino acids selected from the group consisting of proline, 10 hydroxyproline, glutamic acid, aspartic acid, arginine, cystine, glutamine, isoleucine, lysine, threonine, valine and ornithine and one or more furanones, and also to a method of increasing the palatability of a foodstuff to a companion animal.

15 It is well known that many feline and canine companion animals are fussy with their food. An animal will often refuse to eat a foodstuff that it has been accepting over some time, or refuse to eat any more than a minimal amount of a foodstuff. Part of this phenomenon can be driven by subtle changes in the sensory profile of the raw materials. These changes might not be perceived by the human consumer, but due to a difference in the olfactory and gustatory systems, feline and canine companion animals may well perceive these 20 differences. These sensory differences can be due to natural variation of the raw materials used or when materials are in short supply and have to be substituted with alternatives. This can be very frustrating for the owner and can result in the owner perceiving that the animal is unhappy and not enjoying its food. An animal may also fail to ingest its required amount of essential nutrients if not consuming an adequate amount of food available to it. 25 Therefore, it can clearly be seen that there exists a need for a way to encourage companion animals to eat the foodstuff with which it is provided. Many solutions have been suggested to overcome this problem. Most commercially available pet foods are provided in a range of different flavours and/or textures. However, the companion animal owner will know that often a companion animal will suddenly, for no clear reason, refuse the flavour that the 30 owner perceives to be its most preferred. Much research has been carried out on the flavour preferences of companion animals, by offering them a choice of different foodstuffs. The present inventors have taken this research further by studying the key taste receptor in cat, the umami receptor (umami flavour is also referred to as savoury or meat

flavour) and identifying the associated taste mechanisms. They have looked at a range of compounds, volatile and non-volatile, that are found in naturally occurring foodstuffs and established the interactions of these compounds and therefore developed a combination for optimal taste. Of particular interest and importance has been a focus on compounds that
5 interact with and are perceived via the umami and other receptors.

Surprisingly, the inventors have found that companion animals show a strong and consistent preference for certain combinations of compounds, whether presented to the animals in water, a gel or in a model foodstuff. The present invention therefore relates to a
10 use of a combination of compounds that is highly desirable to a companion animal for increasing palatability of a foodstuff to a companion animal. The companion animal is preferably a mammalian companion animal.

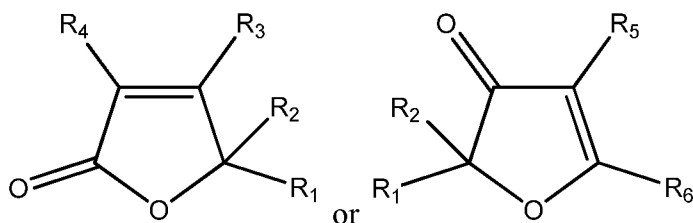
When a companion animal eats its recommended amount of (main meal) foodstuff each
15 day, the animal will receive its required level of vitamins and minerals, and thus is highly likely to remain healthy and happy. Furthermore, the owner is satisfied that the animal is eating well. The inventors have identified certain volatile and non-volatile compounds that are present in natural products that particularly appeal to companion animals in combination. Non-volatile compounds relate to taste, (i.e. they are detected on the
20 tongue); volatile compounds relate to aroma, and are compounds that affect the smell of the food, (i.e. compounds detected in the nose); and some compounds fall within both categories. The combination of both taste and aroma give the food its flavour. Flavour, as used herein, therefore encompasses both the taste and aroma of a foodstuff.

25 The invention, therefore, provides as a first aspect the use of one or more nucleotides, one or more amino acids selected from the group consisting of proline, hydroxyproline, glutamic acid, aspartic acid, arginine, cystine, glutamine, isoleucine, lysine, threonine, valine and ornithine and one or more furanones for increasing the palatability of a foodstuff to a companion animal and, therefore, for use in ensuring an adequate intake of
30 food stuff by a companion animal. The amino acid may be selected from the group consisting of proline, threonine or valine.

The nucleotide may be selected from the group consisting of adenosine monophosphate (AMP), guanosine monophosphate (GMP), inosine monophosphate (IMP), uridine monophosphate (UMP), cytidine monophosphate (CMP), xanthosine monophosphate (XMP) or a mixture of two or more thereof. The nucleotide may be AMP, GMP, or IMP or a mixture thereof. The nucleotide may be GMP alone, or IMP alone, or a mixture of IMP and GMP. The nucleotide may be a mixture of GMP and IMP from about 1% to about 99% of GMP and of from about 1% to about 99% of IMP, more preferably, of from about 20% to about 80% of GMP and of from about 20% to about 80% of IMP or a mixture of about 50% GMP and about 50% IMP.

The amino acid is selected from the group consisting of proline, hydroxyproline, glutamic acid, aspartic acid, arginine, cystine, glutamine, isoleucine, lysine, threonine, valine and ornithine or a mixture of 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 or 12 thereof. Suitably, the amino acid may be selected from the group consisting of proline, threonine and valine. The amino acid is preferably in the amino acid form.

The furanone is suitably as set out in formula I or formula II, below, optionally substituted by hydroxyl, C₁₋₆ alkyl, C₁₋₆ alkoxy.



Formula I

Formula II

Each R₁ and R₂ are independently selected from hydrogen or C₁₋₆ alkyl, preferably hydrogen, methyl or ethyl;

R₃ is hydrogen, hydroxyl or C₁₋₆ alkyl, preferably methyl;

R₄ is hydrogen, hydroxyl or C₁₋₆ alkyl, preferably hydroxyl;

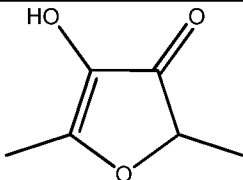
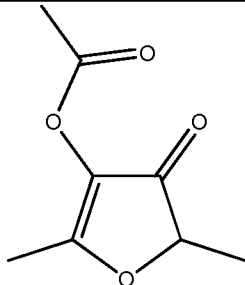
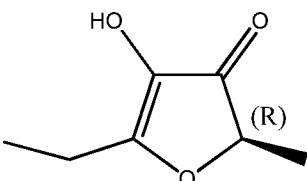
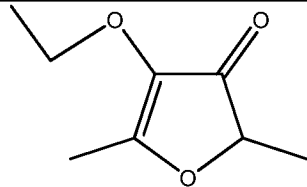
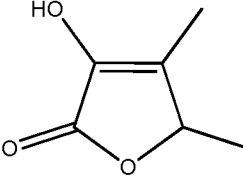
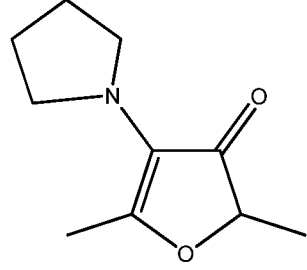
R₅ is hydrogen, hydroxyl, C₁₋₆ alkyl, C₁₋₆ alkoxy, 5 or 6 membered saturated heterocycle or -OC(O)R₇, preferably hydroxyl, -OCH₃, -OCH₂CH₃, -OC(O)CH₃, methyl or pyrrolidine;

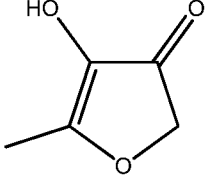
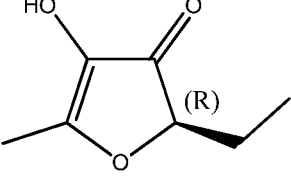
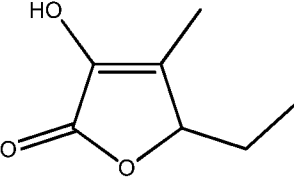
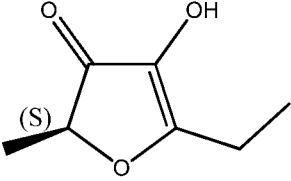
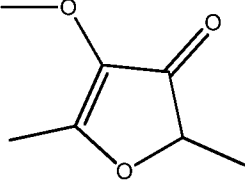
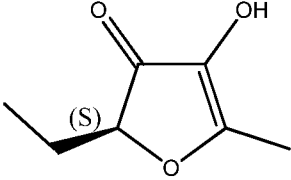
R_6 is hydrogen or C_{1-6} alkyl, preferably hydrogen or methyl;

R_7 is C_{1-6} alkyl, preferably methyl.

5 The furanone may be selected from the group consisting of the furanones set out in Table 1, or a mixture of 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 or 12 thereof. Suitably, the furanone is furaneol, homofuraneol, sotolon, norfuraneol, abhexon, mesifuranone, dimethoxyfuranone, or norfuraneol, as defined in Table 1. Alternatively, the furanone may be selected from the group consisting of furaneol, sotolon and abhexon, as defined herein in Table 1.

Table 1

Key Furanones	Additional Furanones
 Furaneol	 Acetoxydimethylfuranone
 (2R)-(+)-Homofuraneol I	 Dimethylethoxyfuranone
 Sotolon	 DMPEF

 Norfuranol	 (2R)-(+)-Homofuranol II
 Abhexon	 (2S)-(-)-Homofuranol I
 Dimethylmethoxyfuranone (Mesifuranone)	 (2S)-(-)-Homofuranol II

Optionally, the invention may also include the use of a pyrophosphate, such as tetra potassium pyrophosphate or a disodium pyrophosphate. Polyphosphates may be included in the composition also, such as sodium tripolyphosphate. The pyrophosphates and/or polyphosphates may be present in the composition at a concentration of 1mM or above. Suitably, the concentration of pyrophosphate and/or polyphosphate may be 5mM, 10mM, 15mM, 20mM, 25mM, 30mM, 40mM, 50mM, 100mM or 500mM.

The invention includes a composition comprising one or more nucleotides, one or more amino acids and one or more furanones, as herein defined, for use in increasing the palatability of a foodstuff to a companion animal. The composition may also comprise a pyrophosphate and/or polyphosphate as herein defined.

The one or more amino acids selected from the group consisting of proline, hydroxyproline, glutamic acid, aspartic acid, arginine, cystine, glutamine, isoleucine,

lysine, threonine, valine and ornithine may be present (individually or as a combination) in an amount of less than 1M, 1mM to 1M, 250mM to 1M, 5mM to 500mM, 10mM to 100mM, 10mM to 50mM or 20mM to 50mM. The amount of amino acid may be less than 200mM, less than 100mM, less than 20mM or less than 10mM. The amino acid(s) may be present in an amount of 25mM.

The one or more nucleotides may be present (individually or as a combination) in an amount of less than 100mM, 0.1mM to 100mM, 0.5mM to 50mM, 1mM to 20mM or 5mM to 10mM. The nucleotide may be present in an amount of greater than 1mM or greater than 2.5mM. The nucleotide may be present in an amount of less than 50mM, less than 20mM or less than 10mM. Most preferably, the one or more nucleotides may be present in an amount of 1mM to 100mM, such as 5mM, or 2mM. The nucleotide(s) may be present in an amount of 5mM.

The one or more furanones may be present (individually or as a combination) at a concentration of greater than 0.005ppm, 0.001ppm to 40ppm, 0.005ppm to 20ppm, 0.001ppm to 5ppm, 1ppm to 10ppm or 2ppm to 5ppm. The furanone(s) may be present in an amount of less than 40ppm. The furanone(s) may be present in an amount of 4ppm.

The one or more nucleotides, the one or more amino acids and the one or more furanones for use in the invention are in addition to those found naturally in meat, vegetable or dairy products that may form part of a food stuff. The nucleotide(s) amino acid(s) and furanone(s) may be added to a pet food during or after manufacture. The nucleotide(s), amino acid(s) and furanone(s) are added in order to enhance or optimise the flavour profile of the basic meat (or other macronutrient) ingredients of the pet food.

The companion animal is preferably a feline animal (cat), or a canine animal (dog) although it may also be a guinea pig, a rabbit, bird or a horse.

The invention also provides as a second aspect a pet foodstuff comprising one or more nucleotides, one or more amino acids selected from the group consisting of proline, hydroxyproline, glutamic acid, aspartic acid, arginine, cystine, glutamine, isoleucine, lysine, threonine, valine and ornithine, and one or more furanones. The foodstuff may be

packaged, wherein the packaging carries written or graphic information indicating that the pet foodstuff is meant to be consumed by a cat or a dog, or a guinea pig, a rabbit, a bird or a horse. The suitable and preferred features of the first aspect also apply to the second aspect, *mutatis mutandis*.

5

The combination of nucleotide, amino acid and furanone may be any set out in Table 2.

The mixture of GMP to IMP may be of from 1 to 99:99 to 1, preferably from 20 to 80:80 to 20, or about 50:50 in all combinations including GMP and IMP in Table 2, provided of course that the total amount of the combination is 100%. The preferred levels of proline, threonine and/or valine and GMP, IMP, GMP/IMP and AMP are as stated above.

10

Table 2

Nucleotides	Amino Acids	Furanones
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Proline	Furaneol
IMP	Proline	Furaneol
GMP	Proline	Furaneol
AMP	Proline	Furaneol
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Proline	Norfuraneol
IMP	Proline	Norfuraneol
GMP	Proline	Norfuraneol
AMP	Proline	Norfuraneol
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Proline	Homofuraneol
IMP	Proline	Homofuraneol
GMP	Proline	Homofuraneol
AMP	Proline	Homofuraneol

GMP from about 1% to about 99% and IMP from about 1% to about 99%	Proline	Abhexon
IMP	Proline	Abhexon
GMP	Proline	Abhexon
AMP	Proline	Abhexon
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Proline	Mesifuranone
IMP	Proline	Mesifuranone
GMP	Proline	Mesifuranone
AMP	Proline	Mesifuranone
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Proline	Sotolon
IMP	Proline	Sotolon
GMP	Proline	Sotolon
AMP	Proline	Sotolon
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Glutamic acid	Furaneol
IMP	Glutamic acid	Furaneol
GMP	Glutamic acid	Furaneol
AMP	Glutamic acid	Furaneol
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Glutamic acid	Norfuraneol
IMP	Glutamic acid	Norfuraneol
GMP	Glutamic acid	Norfuraneol
AMP	Glutamic acid	Norfuraneol

GMP from about 1% to about 99% and IMP from about 1% to about 99%	Glutamic acid	Homofuraneol
IMP	Glutamic acid	Homofuraneol
GMP	Glutamic acid	Homofuraneol
AMP	Glutamic acid	Homofuraneol
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Glutamic acid	Abhexon
IMP	Glutamic acid	Abhexon
GMP	Glutamic acid	Abhexon
AMP	Glutamic acid	Abhexon
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Glutamic acid	Mesifuranone
IMP	Glutamic acid	Mesifuranone
GMP	Glutamic acid	Mesifuranone
AMP	Glutamic acid	Mesifuranone
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Glutamic acid	Sotolon
IMP	Glutamic acid	Sotolon
GMP	Glutamic acid	Sotolon
AMP	Glutamic acid	Sotolon
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Aspartic acid	Furaneol
IMP	Aspartic acid	Furaneol
GMP	Aspartic acid	Furaneol
AMP	Aspartic acid	Furaneol

GMP from about 1% to about 99% and IMP from about 1% to about 99%	Aspartic acid	Norfuraneol
IMP	Aspartic acid	Norfuraneol
GMP	Aspartic acid	Norfuraneol
AMP	Aspartic acid	Norfuraneol
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Aspartic acid	Homofuraneol
IMP	Aspartic acid	Homofuraneol
GMP	Aspartic acid	Homofuraneol
AMP	Aspartic acid	Homofuraneol
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Aspartic acid	Abhexon
IMP	Aspartic acid	Abhexon
GMP	Aspartic acid	Abhexon
AMP	Aspartic acid	Abhexon
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Aspartic acid	Mesifuranone
IMP	Aspartic acid	Mesifuranone
GMP	Aspartic acid	Mesifuranone
AMP	Aspartic acid	Mesifuranone
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Aspartic acid	Sotolon
IMP	Aspartic acid	Sotolon
GMP	Aspartic acid	Sotolon
AMP	Aspartic acid	Sotolon

GMP from about 1% to about 99% and IMP from about 1% to about 99%	Arginine	Furaneol
IMP	Arginine	Furaneol
GMP	Arginine	Furaneol
AMP	Arginine	Furaneol
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Arginine	Norfuraneol
IMP	Arginine	Norfuraneol
GMP	Arginine	Norfuraneol
AMP	Arginine	Norfuraneol
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Arginine	Homofuraneol
IMP	Arginine	Homofuraneol
GMP	Arginine	Homofuraneol
AMP	Arginine	Homofuraneol
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Arginine	Abhexon
IMP	Arginine	Abhexon
GMP	Arginine	Abhexon
AMP	Arginine	Abhexon
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Arginine	Mesifuranone
IMP	Arginine	Mesifuranone
GMP	Arginine	Mesifuranone
AMP	Arginine	Mesifuranone

GMP from about 1% to about 99% and IMP from about 1% to about 99%	Arginine	Sotolon
IMP	Arginine	Sotolon
GMP	Arginine	Sotolon
AMP	Arginine	Sotolon
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Cystine	Furaneol
IMP	Cystine	Furaneol
GMP	Cystine	Furaneol
AMP	Cystine	Furaneol
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Cystine	Norfuraneol
IMP	Cystine	Norfuraneol
GMP	Cystine	Norfuraneol
AMP	Cystine	Norfuraneol
GMP from about 1% to about 100% and IMP from about 1% to about 99%	Cystine	Homofuraneol
IMP	Cystine	Homofuraneol
GMP	Cystine	Homofuraneol
AMP	Cystine	Homofuraneol
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Cystine	Abhexon
IMP	Cystine	Abhexon
GMP	Cystine	Abhexon
AMP	Cystine	Abhexon

GMP from about 1% to about 99% and IMP from about 1% to about 99%	Cystine	Mesifuranone
IMP	Cystine	Mesifuranone
GMP	Cystine	Mesifuranone
AMP	Cystine	Mesifuranone
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Cystine	Sotolon
IMP	Cystine	Sotolon
GMP	Cystine	Sotolon
AMP	Cystine	Sotolon
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Glutamine	Furaneol
IMP	Glutamine	Furaneol
GMP	Glutamine	Furaneol
AMP	Glutamine	Furaneol
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Glutamine	Norfuraneol
IMP	Glutamine	Norfuraneol
GMP	Glutamine	Norfuraneol
AMP	Glutamine	Norfuraneol
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Glutamine	Homofuraneol
IMP	Glutamine	Homofuraneol
GMP	Glutamine	Homofuraneol
AMP	Glutamine	Homofuraneol

GMP from about 1% to about 99% and IMP from about 1% to about 99%	Glutamine	Abhexon
IMP	Glutamine	Abhexon
GMP	Glutamine	Abhexon
AMP	Glutamine	Abhexon
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Glutamine	Mesifuranone
IMP	Glutamine	Mesifuranone
GMP	Glutamine	Mesifuranone
AMP	Glutamine	Mesifuranone
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Glutamine	Sotolon
IMP	Glutamine	Sotolon
GMP	Glutamine	Sotolon
AMP	Glutamine	Sotolon
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Isoleucine	Furaneol
IMP	Isoleucine	Furaneol
GMP	Isoleucine	Furaneol
AMP	Isoleucine	Furaneol
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Isoleucine	Norfuraneol
IMP	Isoleucine	Norfuraneol
GMP	Isoleucine	Norfuraneol
AMP	Isoleucine	Norfuraneol

GMP from about 1% to about 99% and IMP from about 1% to about 99%	Isoleucine	Homofuraneol
IMP	Isoleucine	Homofuraneol
GMP	Isoleucine	Homofuraneol
AMP	Isoleucine	Homofuraneol
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Isoleucine	Abhexon
IMP	Isoleucine	Abhexon
GMP	Isoleucine	Abhexon
AMP	Isoleucine	Abhexon
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Isoleucine	Mesifuranone
IMP	Isoleucine	Mesifuranone
GMP	Isoleucine	Mesifuranone
AMP	Isoleucine	Mesifuranone
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Isoleucine	Sotolon
IMP	Isoleucine	Sotolon
GMP	Isoleucine	Sotolon
AMP	Isoleucine	Sotolon
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Lysine	Furaneol
IMP	Lysine	Furaneol
GMP	Lysine	Furaneol
AMP	Lysine	Furaneol

GMP from about 1% to about 99% and IMP from about 1% to about 99%	Lysine	Norfuraneol
IMP	Lysine	Norfuraneol
GMP	Lysine	Norfuraneol
AMP	Lysine	Norfuraneol
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Lysine	Homofuraneol
IMP	Lysine	Homofuraneol
GMP	Lysine	Homofuraneol
AMP	Lysine	Homofuraneol
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Lysine	Abhexon
IMP	Lysine	Abhexon
GMP	Lysine	Abhexon
AMP	Lysine	Abhexon
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Lysine	Mesifuranone
IMP	Lysine	Mesifuranone
GMP	Lysine	Mesifuranone
AMP	Lysine	Mesifuranone
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Lysine	Sotolon
IMP	Lysine	Sotolon
GMP	Lysine	Sotolon
AMP	Lysine	Sotolon

GMP from about 1% to about 99% and IMP from about 1% to about 99%	Threonine	Furaneol
IMP	Threonine	Furaneol
GMP	Threonine	Furaneol
AMP	Threonine	Furaneol
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Threonine	Norfuraneol
IMP	Threonine	Norfuraneol
GMP	Threonine	Norfuraneol
AMP	Threonine	Norfuraneol
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Threonine	Homofuraneol
IMP	Threonine	Homofuraneol
GMP	Threonine	Homofuraneol
AMP	Threonine	Homofuraneol
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Threonine	Abhexon
IMP	Threonine	Abhexon
GMP	Threonine	Abhexon
AMP	Threonine	Abhexon
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Threonine	Mesifuranone
IMP	Threonine	Mesifuranone
GMP	Threonine	Mesifuranone
AMP	Threonine	Mesifuranone

GMP from about 1% to about 99% and IMP from about 1% to about 99%	Threonine	Sotolon
IMP	Threonine	Sotolon
GMP	Threonine	Sotolon
AMP	Threonine	Sotolon
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Valine	Furaneol
IMP	Valine	Furaneol
GMP	Valine	Furaneol
AMP	Valine	Furaneol
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Valine	Norfuraneol
IMP	Valine	Norfuraneol
GMP	Valine	Norfuraneol
AMP	Valine	Norfuraneol
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Valine	Homofuraneol
IMP	Valine	Homofuraneol
GMP	Valine	Homofuraneol
AMP	Valine	Homofuraneol
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Valine	Abhexon
IMP	Valine	Abhexon
GMP	Valine	Abhexon
AMP	Valine	Abhexon

GMP from about 1% to about 99% and IMP from about 1% to about 99%	Valine	Mesifuranone
IMP	Valine	Mesifuranone
GMP	Valine	Mesifuranone
AMP	Valine	Mesifuranone
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Valine	Sotolon
IMP	Valine	Sotolon
GMP	Valine	Sotolon
AMP	Valine	Sotolon
GMP from about 1% to about 100% and IMP from about 1% to 100%	Ornithine	Furaneol
IMP	Ornithine	Furaneol
GMP	Ornithine	Furaneol
AMP	Ornithine	Furaneol
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Ornithine	Norfuraneol
IMP	Ornithine	Norfuraneol
GMP	Ornithine	Norfuraneol
AMP	Ornithine	Norfuraneol
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Ornithine	Homofuraneol
IMP	Ornithine	Homofuraneol
GMP	Ornithine	Homofuraneol
AMP	Ornithine	Homofuraneol

GMP from about 1% to about 99% and IMP from about 1% to about 99%	Ornithine	Abhexon
IMP	Ornithine	Abhexon
GMP	Ornithine	Abhexon
AMP	Ornithine	Abhexon
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Ornithine	Mesifuranone
IMP	Ornithine	Mesifuranone
GMP	Ornithine	Mesifuranone
AMP	Ornithine	Mesifuranone
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Ornithine	Sotolon
IMP	Ornithine	Sotolon
GMP	Ornithine	Sotolon
AMP	Ornithine	Sotolon
UMP	Proline	Furaneol
XMP	Proline	Furaneol
CMP	Proline	Furaneol
UMP	Proline	Norfuraneol
XMP	Proline	Norfuraneol
CMP	Proline	Norfuraneol
UMP	Proline	Homofuraneol
XMP	Proline	Homofuraneol
CMP	Proline	Homofuraneol
UMP	Proline	Abhexon
XMP	Proline	Abhexon
CMP	Proline	Abhexon
UMP	Proline	Mesifuranone

XMP	Proline	Mesifuranone
CMP	Proline	Mesifuranone
UMP	Proline	Sotolon
XMP	Proline	Sotolon
CMP	Proline	Sotolon
UMP	Glutamic acid	Furaneol
XMP	Glutamic acid	Furaneol
CMP	Glutamic acid	Furaneol
UMP	Glutamic acid	Norfuraneol
XMP	Glutamic acid	Norfuraneol
CMP	Glutamic acid	Norfuraneol
UMP	Glutamic acid	Homofuraneol
XMP	Glutamic acid	Homofuraneol
CMP	Glutamic acid	Homofuraneol
UMP	Glutamic acid	Abhexon
XMP	Glutamic acid	Abhexon
CMP	Glutamic acid	Abhexon
UMP	Glutamic acid	Mesifuranone
XMP	Glutamic acid	Mesifuranone
CMP	Glutamic acid	Mesifuranone
UMP	Glutamic acid	Sotolon
XMP	Glutamic acid	Sotolon
CMP	Glutamic acid	Sotolon
UMP	Aspartic acid	Furaneol
XMP	Aspartic acid	Furaneol
CMP	Aspartic acid	Furaneol
UMP	Aspartic acid	Norfuraneol
XMP	Aspartic acid	Norfuraneol
CMP	Aspartic acid	Norfuraneol
UMP	Aspartic acid	Homofuraneol
XMP	Aspartic acid	Homofuraneol

CMP	Aspartic acid	Homofuraneol
UMP	Aspartic acid	Abhexon
XMP	Aspartic acid	Abhexon
CMP	Aspartic acid	Abhexon
UMP	Aspartic acid	Mesifuranone
XMP	Aspartic acid	Mesifuranone
CMP	Aspartic acid	Mesifuranone
UMP	Aspartic acid	Sotolon
XMP	Aspartic acid	Sotolon
CMP	Aspartic acid	Sotolon
UMP	Arginine	Furaneol
XMP	Arginine	Furaneol
CMP	Arginine	Furaneol
UMP	Arginine	Norfuraneol
XMP	Arginine	Norfuraneol
CMP	Arginine	Norfuraneol
UMP	Arginine	Homofuraneol
XMP	Arginine	Homofuraneol
CMP	Arginine	Homofuraneol
UMP	Arginine	Abhexon
XMP	Arginine	Abhexon
CMP	Arginine	Abhexon
UMP	Arginine	Mesifuranone
XMP	Arginine	Mesifuranone
CMP	Arginine	Mesifuranone
UMP	Arginine	Sotolon
XMP	Arginine	Sotolon
CMP	Arginine	Sotolon
UMP	Cystine	Furaneol
XMP	Cystine	Furaneol
CMP	Cystine	Furaneol

UMP	Cystine	Norfuraneol
XMP	Cystine	Norfuraneol
CMP	Cystine	Norfuraneol
UMP	Cystine	Homofuraneol
XMP	Cystine	Homofuraneol
CMP	Cystine	Homofuraneol
UMP	Cystine	Abhexon
XMP	Cystine	Abhexon
CMP	Cystine	Abhexon
UMP	Cystine	Mesifuranone
XMP	Cystine	Mesifuranone
CMP	Cystine	Mesifuranone
UMP	Cystine	Sotolon
XMP	Cystine	Sotolon
CMP	Cystine	Sotolon
UMP	Glutamine	Furaneol
XMP	Glutamine	Furaneol
CMP	Glutamine	Furaneol
UMP	Glutamine	Norfuraneol
XMP	Glutamine	Norfuraneol
CMP	Glutamine	Norfuraneol
UMP	Glutamine	Homofuraneol
XMP	Glutamine	Homofuraneol
CMP	Glutamine	Homofuraneol
UMP	Glutamine	Abhexon
XMP	Glutamine	Abhexon
CMP	Glutamine	Abhexon
UMP	Glutamine	Mesifuranone
XMP	Glutamine	Mesifuranone
CMP	Glutamine	Mesifuranone
UMP	Glutamine	Sotolon

XMP	Glutamine	Sotolon
CMP	Glutamine	Sotolon
UMP	Isoleucine	Furaneol
XMP	Isoleucine	Furaneol
CMP	Isoleucine	Furaneol
UMP	Isoleucine	Norfuraneol
XMP	Isoleucine	Norfuraneol
CMP	Isoleucine	Norfuraneol
UMP	Isoleucine	Homofuraneol
XMP	Isoleucine	Homofuraneol
CMP	Isoleucine	Homofuraneol
UMP	Isoleucine	Abhexon
XMP	Isoleucine	Abhexon
CMP	Isoleucine	Abhexon
UMP	Isoleucine	Mesifuranone
XMP	Isoleucine	Mesifuranone
CMP	Isoleucine	Mesifuranone
UMP	Isoleucine	Sotolon
XMP	Isoleucine	Sotolon
CMP	Isoleucine	Sotolon
UMP	Lysine	Furaneol
XMP	Lysine	Furaneol
CMP	Lysine	Furaneol
UMP	Lysine	Norfuraneol
XMP	Lysine	Norfuraneol
CMP	Lysine	Norfuraneol
UMP	Lysine	Homofuraneol
XMP	Lysine	Homofuraneol
CMP	Lysine	Homofuraneol
UMP	Lysine	Abhexon
XMP	Lysine	Abhexon

CMP	Lysine	Abhexon
UMP	Lysine	Mesifuranone
XMP	Lysine	Mesifuranone
CMP	Lysine	Mesifuranone
UMP	Lysine	Sotolon
XMP	Lysine	Sotolon
CMP	Lysine	Sotolon
UMP	Threonine	Furaneol
XMP	Threonine	Furaneol
CMP	Threonine	Furaneol
UMP	Threonine	Norfuraneol
XMP	Threonine	Norfuraneol
CMP	Threonine	Norfuraneol
UMP	Threonine	Homofuraneol
XMP	Threonine	Homofuraneol
CMP	Threonine	Homofuraneol
UMP	Threonine	Abhexon
XMP	Threonine	Abhexon
CMP	Threonine	Abhexon
UMP	Threonine	Mesifuranone
XMP	Threonine	Mesifuranone
CMP	Threonine	Mesifuranone
UMP	Threonine	Sotolon
XMP	Threonine	Sotolon
CMP	Threonine	Sotolon
UMP	Valine	Furaneol
XMP	Valine	Furaneol
CMP	Valine	Furaneol
UMP	Valine	Norfuraneol
XMP	Valine	Norfuraneol
CMP	Valine	Norfuraneol

UMP	Valine	Homofuraneol
XMP	Valine	Homofuraneol
CMP	Valine	Homofuraneol
UMP	Valine	Abhexon
XMP	Valine	Abhexon
CMP	Valine	Abhexon
UMP	Valine	Mesifuranone
XMP	Valine	Mesifuranone
CMP	Valine	Mesifuranone
UMP	Valine	Sotolon
XMP	Valine	Sotolon
CMP	Valine	Sotolon
UMP	Ornithine	Furaneol
XMP	Ornithine	Furaneol
CMP	Ornithine	Furaneol
UMP	Ornithine	Norfuraneol
XMP	Ornithine	Norfuraneol
CMP	Ornithine	Norfuraneol
UMP	Ornithine	Homofuraneol
XMP	Ornithine	Homofuraneol
CMP	Ornithine	Homofuraneol
UMP	Ornithine	Abhexon
XMP	Ornithine	Abhexon
CMP	Ornithine	Abhexon
UMP	Ornithine	Mesifuranone
XMP	Ornithine	Mesifuranone
CMP	Ornithine	Mesifuranone
UMP	Ornithine	Sotolon
XMP	Ornithine	Sotolon
CMP	Ornithine	Sotolon
UMP	Hydroxyproline	Furaneol

XMP	Hydroxyproline	Furaneol
CMP	Hydroxyproline	Furaneol
UMP	Hydroxyproline	Norfuraneol
XMP	Hydroxyproline	Norfuraneol
CMP	Hydroxyproline	Norfuraneol
UMP	Hydroxyproline	Homofuraneol
XMP	Hydroxyproline	Homofuraneol
CMP	Hydroxyproline	Homofuraneol
UMP	Hydroxyproline	Abhexon
XMP	Hydroxyproline	Abhexon
CMP	Hydroxyproline	Abhexon
UMP	Hydroxyproline	Mesifuranone
XMP	Hydroxyproline	Mesifuranone
CMP	Hydroxyproline	Mesifuranone
UMP	Hydroxyproline	Sotolon
XMP	Hydroxyproline	Sotolon
CMP	Hydroxyproline	Sotolon
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Hydroxyproline	Furaneol
IMP	Hydroxyproline	Furaneol
GMP	Hydroxyproline	Furaneol
AMP	Hydroxyproline	Furaneol
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Hydroxyproline	Norfuraneol
IMP	Hydroxyproline	Norfuraneol
GMP	Hydroxyproline	Norfuraneol
AMP	Hydroxyproline	Norfuraneol
GMP from about 1% to about 99% and IMP from	Hydroxyproline	Homofuraneol

about 1% to about 99%		
IMP	Hydroxyproline	Homofuraneol
GMP	Hydroxyproline	Homofuraneol
AMP	Hydroxyproline	Homofuraneol
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Hydroxyproline	Abhexon
IMP	Hydroxyproline	Abhexon
GMP	Hydroxyproline	Abhexon
AMP	Hydroxyproline	Abhexon
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Hydroxyproline	Mesifuranone
IMP	Hydroxyproline	Mesifuranone
GMP	Hydroxyproline	Mesifuranone
AMP	Hydroxyproline	Mesifuranone
GMP from about 1% to about 99% and IMP from about 1% to about 99%	Hydroxyproline	Sotolon
IMP	Hydroxyproline	Sotolon
GMP	Hydroxyproline	Sotolon
AMP	Hydroxyproline	Sotolon

It should be noted that taurine is not included as an amino acid in respect of the invention. In fact, taurine is an organic sulfonic acid and lacks the carboxyl group which is characteristic of amino acids i.e. there is no COOH group. However in the art, such as

5 described in US 2006/0286276 and US 2006/286275, taurine is often described as an amino acid, which is incorrect.

The invention also relates to, as a third aspect, a composition comprising one or more nucleotides, one or more amino acids selected from the group consisting of proline,

10 hydroxyproline, glutamic acid, aspartic acid, arginine, cystine, glutamine, isoleucine,

lysine, threonine, valine and ornithine and one or more furanones for use in increasing the acceptance and/or ensuring an adequate intake of a foodstuff in a companion animal. Increasing the palatability leads to increased enjoyment and acceptance of the foodstuff to the animal. Increased acceptance and enjoyment helps to overcome the fussiness of a companion animal with regard to food. Since the animal accepts and enjoys the foodstuff in accordance with the invention, it is more likely to reach its required daily calorie and nutrient intake.

The composition may be for use in increasing the appetising appeal of a foodstuff to an animal in order to encourage an animal to eat a healthy amount of foodstuff. Thus, the use of a composition comprising one or more nucleotides, one or more amino acids selected from the group consisting of proline, hydroxyproline, glutamic acid, aspartic acid, arginine, cystine, glutamine, isoleucine, lysine, threonine, valine and ornithine and one or more furanones in increasing the appetising appeal of a foodstuff; in encouraging a healthy intake of a foodstuff; in ensuring the required intake of nutrients and calories in a companion animal, is included in the present invention. By healthy level it is meant an amount that enables the animal to maintain or achieve an intake contributing to its overall general health in terms of micronutrients, macronutrients and calories. By this it is meant that an animal may eat sufficient calories and receive a nutritionally complete diet without needing to eat excess calories and thus maintaining a healthy balance, such as set out in the "Mars Petcare Essential Nutrient Standards".

As mentioned above, the umami receptor has been studied as a target for flavour compounds. Many studies relating to the activation of the umami receptor focus on the human umami receptor. However, surprisingly the inventors have found that the umami receptor of humans differs in sequence to that of certain companion animals as shown in Figure 18. Moreover, even though certain companion animals have shown preferences according to the art to particular amino acids, these preferences differ from animal to animal. Therefore, it is not possible to predict from work carried out in humans whether a companion animal would have the same response to the same amino acids.

In the human umami receptor, the key active site residues involved in glutamate and IMP binding have been identified by *in silico* modelling and by site-directed mutagenesis.

These studies show that the key residues are at positions H71, T149, S172, D192, Y220, E301 S306 and S385 and the residues are highly conserved in other species. A comparison of the human, pig, mouse and cat sequences showed only two changes in these particular residues (pig L220 and mouse A385).

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The high level of conservation in these active site residues does not fit well with the different amino acid specificity for the umami receptor in the species studied. A study on pig umami receptors identified other residues in the active site that were reported as being important in binding. The amino acids in these locations were conserved between humans and pigs (R277, R307 and H308). On the basis of this similarity, pig umami was proposed as a model for human umami. However, the pig umami receptor showed a wide amino acid specificity (glutamate, alanine, asparagine, glutamine, serine and threonine) compared to the usual glutamate and aspartate ligands that are associated with human umami receptor activation. A report that used some other amino acids (glycine, alanine, serine) at high concentrations (up to 1M) suggested that these compounds delivered a umami sensation in humans but the effect was only monitored using sensory analysis and no receptor studies were reported. Thus it seems that the range of amino acids that activate the human umami receptor are very limited compared to other species and that the residues identified so far do not satisfactorily explain the difference in amino acid specificity between the pig and human umami receptors.

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The invention also provides a method of enhancing the umami flavour/taste of a foodstuff, the method comprising adding to or including in the foodstuff one or more nucleotides, one or more amino acids consisting of proline, hydroxyproline, glutamic acid, aspartic acid, arginine, cystine, glutamine, isoleucine, lysine, threonine, valine and ornithine and one or more furanones.

25

By enhancing it is meant that the umami flavour is detected more strongly/more intensely by the animal. It is thought that the addition of an amino acid complements the effect of the binding of a nucleotide to the umami receptor and vice versa. The addition of a furanone synergistically increases the umami flavour potency.

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The present invention also provides a method of increasing an animal's preference for a foodstuff, the method comprising the addition of a nucleotide, an amino acid selected from the group consisting of proline, hydroxyproline, glutamic acid, aspartic acid, arginine, cystine, glutamine, isoleucine, lysine, threonine, valine and ornithine and a furanone to the foodstuff. Also provided is a method of enhancing the umami flavour of a foodstuff, the method comprising the addition of a nucleotide, an amino acid selected from the group consisting of proline, hydroxyproline, glutamic acid, aspartic acid, arginine, cystine, glutamine, isoleucine, lysine, threonine, valine and ornithine and a furanone to the foodstuff. A method of increasing the meaty (savory) flavour of a foodstuff is also achieved by the use of a nucleotide, an amino acid selected from the group consisting of proline, hydroxyproline, glutamic acid, aspartic acid, arginine, cystine, glutamine, isoleucine, lysine, threonine, valine and ornithine and a furanone as described herein. The combination of the three components enables them to work in synergy to enhance umami flavour perception.

As a further aspect, the invention relates to a process for producing a pet foodstuff comprising one or more nucleotides, one or more amino acids selected from the group consisting of proline, hydroxyproline, glutamic acid, aspartic acid, arginine, cystine, glutamine, isoleucine, lysine, threonine, valine and ornithine and one or more furanones, the method comprising the steps of adding and mixing one or more nucleotides, one or more amino acids selected from the group consisting of proline, hydroxyproline, glutamic acid, aspartic acid, arginine, cystine, glutamine, isoleucine, lysine, threonine, valine and ornithine and one or more furanones with a pet foodstuff. The addition and/or mixing may be carried out prior to, during or after formulating, processing or packaging the foodstuff. The addition and/or mixing of the nucleotide, amino acid and furanone may be sequential or simultaneous.

All features of all aspects apply to all other aspects, *mutatis mutandis*.

The inventors have found that the addition of one or more nucleotides, one or more amino acids selected from the group consisting of proline, hydroxyproline, glutamic acid, aspartic acid, arginine, cystine, glutamine, isoleucine, lysine, threonine, valine and ornithine and one or more furanones to a pet food product significantly increases the preference of a

companion animal for the foodstuff. The animals show a strong preference for a foodstuff or water comprising one or more nucleotides, one or more amino acids selected from the group consisting of proline, hydroxyproline, glutamic acid, aspartic acid, arginine, cystine, glutamine, isoleucine, lysine, threonine, valine and ornithine and one or more furanones over a foodstuff or water having none, or one or two of these compounds. This overcomes the difficulties associated with fussy animals and ensures an animal eats the entirety of the recommended daily amount of foodstuff provided to it, resulting in the health and wellbeing of the animal as well as the peace of mind of the owner.

The advantage, therefore, of a three component mixture for inclusion in a foodstuff is several-fold: an animal will be encouraged to eat the foodstuff on a consistent and long term basis; the synergistic effect means that a lower amount of each of the ingredients needs to be included in a foodstuff, meaning cost effective use of each of the nucleotide, amino acid and furanone.

Without wishing to be bound by theory, the present inventors believe that the umami taste receptor on the tongue of an animal can detect a nucleotide and that an amino acid selected from the group consisting of proline, hydroxyproline, glutamic acid, aspartic acid, arginine, cystine, glutamine, isoleucine, lysine, threonine, valine and ornithine is detected by an alternative site on the umami receptor or by another receptor or receptors. Thus, the effect of combining both a nucleotide and such an amino acid in the composition provides more than an additive effect of each component individually to the animal, since more than one taste receptor mechanisms are activated and provide sensory feedback to the animal. This effect is further complemented by the addition of a furanone. The umami receptor is a heterodimeric transmembrane protein receptor and is also referred to in the art as T1R1/T1R3.

The present application shows that through *in silico* modelling of a non-human umami receptor and *in vitro* assays using a umami receptor the inventors have found that a subset of amino acids are able to bind to the umami receptor; however, the amino acids of the present invention, namely proline, hydroxyproline, glutamic acid, aspartic acid, arginine, cystine, glutamine, isoleucine, lysine, threonine, valine and ornithine exert their effect through a different mechanism. It has been shown that each of the amino acids of the

present invention are palatable to an animal and thus, the amino acids of the invention bind to an alternative binding site or receptor or receptors in order to be perceived by the animal.

5 The nucleotides of the invention activate the umami receptor. As can be seen in Figure 13, the receptor could be described in terms of a Venus Fly Trap, wherein the binding site consists of a structure similar to 'jaws', which close upon being bound by the nucleotide according to the invention. It is postulated that once the amino acid of the invention and the nucleotide has bound to their respective receptors, the furanone interacts synergistically
10 to increase the umami flavour perception. This interaction may occur by cross talk between binding sites or receptors or during the transduction and neural processes.

The flytrap domain consists of two lobes, an upper lobe and a lower lobe that are connected by a region known as the hinge, (Figure 13). The flytrap may transition from an
15 open conformation to a closed conformation upon binding of a nucleotide.

The present inventors have shown that the amino acids according to the invention, namely proline, hydroxyproline, glutamic acid, aspartic acid, arginine, cystine, glutamine, isoleucine, lysine, threonine, valine, ornithine and taurine do not activate the primary
20 T1R1/T1R3 umami receptor site (as shown in Figure 10). *In vivo* tests have indicated that animals respond positively to these amino acids as tastants. Therefore, by activating two separate receptors/ pathways by the use of a nucleotide and an amino acid of the invention, the flavour experience for the animal is enhanced. Therefore, through careful research and investigation, combinations of tastants have been identified that are effective due to their
25 ability to act separately but in a complementary manner to provide an increased perception of flavour to the animal. Previously, combinations of tastants have been used in the art without the consideration of whether they act on the same receptor or not. Clearly, two tastants that have an effect via the same binding site on a receptor will not contribute in an enhanced manner to the overall flavour of a foodstuff. By determining that the amino
30 acids of the invention do not compete with the nucleotide or furanone of the invention, the inventors have established that palatability is increased, as shown by the *in vivo* experiments described herein.

Thus, the combination of a nucleotide and an amino acid of the invention appear to work together in a complementary manner and thus, increasing the perception of both compounds by the animal on the taste receptors when they are delivered together in a composition. Again, without wishing to be bound by theory, it appears that the amino acid
5 selected from the group consisting of proline, hydroxyproline, glutamic acid, aspartic acid, arginine, cystine, glutamine, isoleucine, lysine, threonine, valine and ornithine and the nucleotide do not compete with each other in binding to the umami receptor since the amino acids appear to bind to an alternative receptor or receptors

10 Therefore, the use of the particular amino acids of the invention enhances the perception of flavour by the animal, which is further enhanced by the addition of a furanone.

It is noted that Yoshi *et al.*, (*Synergistic Effects of 5'-Nucleotides on Rat Taste Responses to Various Amino Acids*, *Brain Research*, 367 (1986) 45-51), conclude that a synergistic
15 effect is seen between the amino acids and nucleotides. However, the experiments described were not carried out *in vivo*, but rather utilised *in vitro* nerve signalling.

Notably, it was assumed that a nerve response was concluded to be a positive response.

However, as it is well known in the art, a nerve response can also be a negative response for an animal i.e. *in vivo* a nerve response could be a negative taste perception. Further, it
20 can be seen that the amino acids discovered to be most responsive are not those that correlate to the information provided by the present invention. This is almost certainly due to the 'artificial' environment in which the amino acids were tested by Yoshi *et al.*,

US patent US3524747 describes the addition of a minimum of seven amino acids to a
25 foodstuff to impart a "meaty" flavour. However, although a combination of seven amino acids could be contemplated by the present invention, the knowledge obtained by the inventors (that certain amino acids with a nucleotide and a furanone enhances the palatability of a foodstuff) enables fewer than seven amino acids to be utilised to increase the palatability of a foodstuff.

30 It is notable that none of the prior art known to the inventors contemplates the use of a nucleotide and amino acid, (particularly, an amino acid selected from the group consisting of proline, hydroxyproline, glutamic acid, aspartic acid, arginine, cystine, glutamine,

isoleucine, lysine, threonine, valine and ornithine) together with a furanone for enhancing the flavour of a foodstuff for a companion animal. As mentioned, these particular amino acids are not thought to bind to the umami receptor, rather they work in a synergistic way with a different mechanism of action, whereas other amino acids do appear to bind to the umami receptor.

The nucleotide, amino acid and furanone according to the present invention may be incorporated into any product which an animal, such as a dog or a cat, may consume in its diet. Thus, the invention covers standard food products, supplements, pet food, drinks, snacks and treats. The food product is preferably a cooked product. It may incorporate meat or animal derived material (such as beef, chicken, turkey, lamb, blood plasma, marrowbone etc. or two or more thereof). The food stuff alternatively may be meat free (preferably including a meat substitute such as soya, maize gluten or a soya product) in order to provide a protein source. The product may contain additional protein sources such as soya protein concentrate, milk proteins, gluten etc. The product may also contain a starch source, such as gelatinised starch, such as one or more grains (e.g. wheat, corn, rice, oats, barely etc) or may be starch free. A typical dry commercial cat and dog food contains about 10-70% crude protein, about 10-60% fat and the remainder being carbohydrate, including dietary fibre and ash. A typical wet, or moist product contains (on a dry matter basis) about 40% fat, 50% protein and the remainder being fibre and ash. The present invention is particularly relevant for a pet foodstuff as herein described which is sold as a diet, foodstuff or supplement for a cat or dog. In the present text the terms "domestic" dog and "domestic" cat mean dogs and cats, in particular *Felis domesticus* and *Canis domesticus*. Preferably, the pet foodstuff will meet the macronutrient requirements of an animal preferably a ratio of protein: fat: carbohydrate of approximately 50:40:10 for feline animals and 30:60:10 for a canine animal.

As can be seen from the examples, below, it has been surprisingly found that an amino acid selected from the group consisting of proline, hydroxyproline, glutamic acid, aspartic acid, arginine, cystine, glutamine, isoleucine, lysine, threonine, valine and ornithine, a nucleotide and a furanone of the invention provide a greater than additive effect when presented to an animal. In other words, the preference of a companion animal for the combination of a nucleotide, an amino acid selected from the group consisting of proline,

hydroxyproline, glutamic acid, aspartic acid, arginine, cystine, glutamine, isoleucine, lysine, threonine, valine and ornithine and a furanone is greater than an additive effect of the preference for any or each of the individual compounds. The addition of a furanone increases this preference to a greater extent. That is, inclusion of a furanone increases preference by more than the additive effect of the preference for the furanone alone.

Thus, the unexpected benefit of the combination of one or more nucleotides, one or more amino acids and one or more furanones is increased palatability. Without wishing to be bound by theory, the present inventors believe that this is due to the different receptors and/or binding sites for a nucleotide and for the amino acid; and the enhancing effect of furanone, as described above.

The invention will now be described in reference to the following Figures and Examples in which:

- Figure 1 shows the results in a difference test of a composition comprising 25mM proline + 2.5mM IMP with a composition comprising 25mM proline;
- Figure 2 shows the results in a difference test of a composition comprising 25mM proline + 2.5mM IMP with a composition comprising 2.5mM IMP;
- Figure 3 shows the results in a difference test of a composition comprising 25mM threonine + 2.5mM GMP with a composition comprising 25mM threonine;
- Figure 4 shows the results in a difference test of a composition comprising 25mM threonine + 2.5mM GMP with a composition comprising 2.5mM GMP;
- Figure 5 shows the results in a difference test of a composition comprising 25mM valine + 2.5mM AMP with a composition comprising 25mM valine; and
- Figure 6 shows the results in a difference test of a composition comprising 25mM valine + 2.5mM AMP with a composition comprising 2.5mM AMP;
- Figure 7 shows the results in a difference test of a composition comprising 25mM proline + 2.5mM Ajitide + 4ppm fureneol with a composition comprising 25mM proline + 2.4mMAjitide;
- Figure 8 shows the results in a difference test of a composition comprising 25mM threonine + 2.5mM Ajitide + 4ppm fureneol with a composition comprising 25mM threonine + 2.5mM Ajitide;

Figure 9 shows the results in a difference test of a composition comprising 25mM proline + 2.5mM GMP + fureneol with a composition comprising 25mM proline + 2.5mM GMP; Figure 10 shows the resulting dose response curves of each amino acid of the invention that were screened *in vitro* for their ability to activate the T1R1/T1R3 receptor in the presence of 0.2mM IMP. Figure 11 shows the dose response curves of nucleotides of the invention that were screened *in vitro* for their ability to activate the T1R1/T1R3 receptor in the presence of 20mM alanine. The corresponding EC₅₀ values are shown in the table. Figure 12 shows the predicted structure of the T1R1/T1R3 umami receptor. Figure 13 shows a schematic of the predicted structure of the umami receptor; and Figure 14 shows a sequence alignment of the human, feline, canine, mouse and rat umami receptors.

Examples

All amino acids of the examples are in the L-form. Ajitide is a 50:50 mixture of GMP:IMP.

Example 1

Cats were allowed access to water containing either 25mM proline + 2.5mM IMP with a composition comprising 25mM proline The methodology used a 2-bottle choice test with 24 cats (the final number of cats for each test can vary due to data being discarded by spillage, etc.). Cats were housed individually during trial periods and had free access to water available between testing periods. The test involved a choice test between the tastant/ mixture at a given concentration dissolved in deionised water versus deionised water only or another tastant/ mixture. Control was made for positional bias (e.g. A/ B exposure 1 and B/ A exposure 2) and evaporation loss. The testing time was 36 hours (i.e. 18 hours per day, allowing a two-day crossover). Following two consecutive days of each testing, cats had two consecutive days of rest. Cats were offered a dry diet as a single meal at the start of the test period for one hour, calculated to meet the individual requirements for each cat.

The results are shown in the table below, and in Figure 1.

Analysis of Intake g

ANOVA Table for Fixed Effects

Factor	Degrees of Freedom		F-value	P-value
	Numerator	Denominator		
Product Difference	1	23	40.20	0.0000

* a value of 0.000 indicates a value of less than 0.0001.

Table of Mean Product Difference, Standard Error & 95% Confidence Intervals

Product Difference	Mean	Standard Error	95% Confidence	
			Lower	Upper
Proline - Pro + IMP	-34.25	5.40	-45.42	-23.08

It can be seen that the amount of proline+IMP intake was on average 34.25g more than proline alone intake, i.e. the combination of proline and IMP was significantly preferable to the animals over proline alone.

5

Example 2

The difference test was carried out as for Example 1, however, the composition containing 25mM proline + 2.5mM IMP was compared with a composition containing 2.5mM IMP only.

10

Results are shown in the table below and in Figure 2.

Analysis of Intake g

ANOVA Table for Fixed Effects

Factor	Degrees of Freedom		F-value	P-value
	Numerator	Denominator		
Product Difference	1	23	45.83	0.0000

Table of Mean Product Difference, Standard Error & 95% Confidence Intervals

Product Difference	Mean	Standard Error	95% Confidence Interval	
			Lower	Upper
Pro + IMP - IMP	37.95	5.61	26.35	49.54

It can be seen that proline+IMP had a significantly higher intake, on average of 37.95g, than IMP alone; i.e. the composition comprising both proline and IMP was preferable to the animals over IMP only.

- 5 The results of example 1 and 2 together show that a combination of histidine and IMP is significantly preferable than either of the compounds alone.

Example 3

- 10 A difference test was carried out as described in example 1 to compare a composition containing 25mM threonine + 2.5mM GMP with a composition containing 25mM threonine only.

The results are shown in the table below and in Figure 3.

Analysis of Intake g

ANOVA Table for Fixed Effects

Factor	Degrees of Freedom		F-value	P-value
	Numerator	Denominator		
Product Difference	1	23	16.58	0.0005

Table of Mean Product Difference, Standard Error & 95% Confidence Intervals

Product Difference	Mean	Standard Error	95% Confidence Interval	
			Lower	Upper
Threonine - Thr + GMP	-43.77	10.75	-66.01	-21.53

15

It can be seen that the intake of threonine+GMP was, on average, 43.77g more than the intake of threonine alone, and shows that the animals significantly prefer the combination of threonine and GMP to threonine alone.

Example 4

- 20 The difference test was carried out as described in example 3; however the composition containing 25mM threonine + 2.5mM GMP was compared with a composition containing 2.5mM GMP only.

- 25 The results are shown in the table below and in Figure 4.

Analysis of Intake g

ANOVA Table for Fixed Effects

Factor	Degrees of Freedom		F-value	P-value
	Numerator	Denominator		
Product Difference	1	23	38.69	0.0000

Table of Mean Product Difference, Standard Error & 95% Confidence Intervals

Product Difference	Mean	Standard Error	95% Confidence Interval	
			Lower	Upper
Thr + GMP - GMP	24.34	3.91	16.24	32.43

5 It can be seen that the intake of threonine+GMP was, on average, 24.34g more than the intake of GMP alone, and shows that the animals significantly prefer the combination of threonine + GMP to GMP alone.

The results of example 3 and 4 together show that a combination of threonine and GMP is significantly preferable to either of the compounds alone.

10

Example 5

A difference test was carried out as described in example 1 to compare a composition containing 25mM valine + 2.5mM AMP with a composition containing 25mM valine alone.

15

The results are shown in the table below and in Figure 5.

Analysis of Intake g

ANOVA Table for Fixed Effects

Factor	Degrees of Freedom		F-value	P-value
	Numerator	Denominator		
Product Difference	1	22	26.94	0.0000

Table of Mean Product Difference, Standard Error & 95% Confidence Intervals

Product Difference	Mean	Standard Error	95% Confidence Interval	
			Lower	Upper
Valine - Val + AMP	-25.82	4.97	-36.14	-15.50

It can be seen that the intake of valine+AMP was, on average, 25.82g more than the intake of valine alone, and shows that the animals significantly prefer the combination of valine + AMP to valine alone.

Example 6

The difference test was carried out as described in example 5 to compare a composition containing 25mM valine + 2.5mM AMP with a composition containing 2.5mM AMP.

The results are shown in the table below, and in Figure 6.

Analysis of Intake g

ANOVA Table for Fixed Effects

Factor	Degrees of Freedom		F-value	P-value
	Numerator	Denominator		
Product Difference	1	23	13.70	0.0012

Table of Mean Product Difference, Standard Error & 95% Confidence Intervals

Product Difference	Mean	Standard Error	95% Confidence Interval	
			Lower	Upper
Val + AMP - AMP	13.96	3.77	6.16	21.77

It can be seen that the intake of valine+AMP was, on average, 25.92g more than the intake of AMP alone, and shows that the animals significantly prefer the combination of valine + AMP to AMP alone.

- 5 The results of example 5 and 6 together show that a combination of valine and AMP is significantly preferable to either of the compounds alone.

Example 7

- 10 The difference test was carried out as described in example 1 to compare a composition containing 25mM proline + 2.5mM Ajitide + 4ppm fureneol with a composition containing 25mM proline + 2.5mM Ajitide.

The results are shown in the table below, and in Figure 7.

ANOVA Table for Fixed Effects

Factor	Degrees of Freedom		F-value	P-value
	Numerator	Denominator		
Product Difference	1	24	11.74	0.0022

Table of Mean Product Difference, Standard Error & 95% Confidence Intervals

15

Product Difference	Mean	Standard Error	95% Confidence Interval	
			Lower	Upper
Pro + Aji + Fur - Pro + Aji	18.00	5.25	7.15	28.84

It can be seen that the intake of proline + Ajitide + fureneol was, on average, 18.00g more than the intake of proline + Ajitide, and shows that the animals significantly prefer the combination of proline + Ajitide + fureneol to proline and Ajitide alone.

20

Example 8

The difference test was carried out as described in example 1 to compare a composition containing 25mM threonine + 2.5mM Ajitide + 4ppm fureneol with a composition containing 25mM threonine + 2.5mM Ajitide.

25

The results are shown in the table below, and in Figure 8.

ANOVA Table for Fixed Effects

Factor	Degrees of Freedom		F-value	P-value
	Numerator	Denominator		
Product Difference	1	23	37.91	0.0000

Table of Mean Product Difference, Standard Error & 95% Confidence Intervals

Product Difference	Mean	Standard Error	95% Confidence Interval	
			Lower	Upper
Thr + Aji + Fur - Thr + Aji	38.39	6.23	25.49	51.28

- 5 It can be seen that the intake of threonine + Ajitide + fureneol was, on average, 38.39g more than the intake of threonine + Ajitide, and shows that the animals significantly prefer the combination of threonine + Ajitide + fureneol to threonine + Ajitide alone.

Example 9

- 10 The difference test was carried out as described in example 1 to compare a composition containing 25mM proline + 2.5mM GMP + 4ppm fureneol with a composition containing 25mM proline + 2.5mM GMP.

The results are shown in the table below, and in Figure 9.

15

ANOVA Table for Fixed Effects

Factor	Degrees of Freedom		F-value	P-value
	Numerator	Denominator		
Product Difference	1	24	83.57	0.0000

Table of Mean Product Difference, Standard Error & 95% Confidence Intervals

Product Difference	Mean	Standard Error	95% Confidence Interval	
			Lower	Upper
Pro + GMP + Fur - Pro + GMP	40.99	4.48	31.74	50.25

It can be seen that the intake of proline + GMP + fureneol was, on average, 40.99g more than the intake of proline + GMP, and shows that the animals significantly prefer the combination of proline + GMP + fureneol to proline + GMP alone.

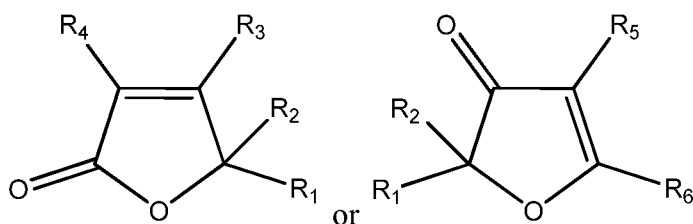
- 5 The results of example 7, 8 and 9 together show that the addition of fureneol significantly increases the palatability.

Example 10

- 10 *In vitro* screening was carried out in order to establish which amino acids bind or do not bind to the known umami binding site. The results of the testing of the amino acids of the present invention are shown in figure 10. It can be seen that none of the amino acids of the present invention activate the umami receptor.

CLAIMS:

1. Use of one or more nucleotides, one or more amino acids selected from the group consisting of proline, hydroxyproline, glutamic acid, aspartic acid, arginine, cystine,
5 glutamine, isoleucine, lysine, threonine, valine and ornithine and one or more furanones for increasing the palatability of a foodstuff to a companion animal.
2. The use according to claim 1, wherein the one or more nucleotides is/are selected from the group consisting of CMP, XMP, UMP, AMP, GMP and IMP.
- 10 3. The use according to claim 3, wherein the one or more nucleotides is a mixture of GMP and IMP.
4. The use according to any one of claims 1 to 4, wherein the one or more furanones
15 is/are a compound according to formula I or formula II



Formula I

Formula II

wherein each R₁ and R₂ are independently selected from hydrogen or C₁₋₆ alkyl, preferably hydrogen, methyl or ethyl;

R₃ is hydrogen, hydroxyl or C₁₋₆ alkyl, preferably methyl;

R₄ is hydrogen, hydroxyl or C₁₋₆ alkyl, preferably hydroxyl;

R₅ is hydrogen, hydroxyl, C₁₋₆ alkyl, C₁₋₆ alkoxy, 5 or 6 membered saturated heterocycle or -OC(O)R₇, preferably hydroxyl, -OCH₃, -OCH₂CH₃, -OC(O)CH₃, methyl or pyrrolidine;

R₆ is hydrogen or C₁₋₆ alkyl, preferably hydrogen or methyl;

R₇ is C₁₋₆ alkyl, preferably methyl.

5. The use according to any one of claims 1 to 5, wherein the one or more furanone is selected from the group consisting of furaneol, homofuraneol, sotolon, norfuraneol, abhexon, mesifuranone or dimethoxyfuranone, as defined in Table 1.
- 5 6. The use according to any one of claims 1 to 5, wherein the nucleotide, the amino acid and the furanone are in addition to any nucleotides, amino acids and furanones that may be found in any meat, vegetable or dairy component of the foodstuff.
7. The use according to any one of claims 1 to 6, wherein the one or more nucleotide
10 is present in an amount of less than 100 mM.
8. The use according to any one of claims 1 to 8, wherein the one or more amino acid is present at an amount of less than 1M.
- 15 9. The use according to any one of claims 1 to 8, wherein the one or more furanone is present at an amount of less than 40ppm.
10. One or more nucleotides, one or more amino acids selected from the group consisting of proline, hydroxyproline, glutamic acid, aspartic acid, arginine, cystine,
20 glutamine, isoleucine, lysine, threonine, valine and ornithine and one or more furanones for use in increasing the acceptance of a pet foodstuff in a companion animal.
11. A nucleotide, an amino acid or a furanone for use according to claim 9, wherein the acceptance is a preference for a foodstuff comprising the nucleotide, amino acid and
25 furanone over a foodstuff that does not comprise a nucleotide, an amino acid and a furanone.
12. A pet foodstuff comprising one or more nucleotides, one or more amino acids selected from the group consisting of proline, hydroxyproline, glutamic acid, aspartic acid,
30 arginine, cystine, glutamine, isoleucine, lysine, threonine, valine and ornithine, and one or more furanones.

13. A pet foodstuff according to claim 12, wherein the one or more nucleotide, the one or more amino acid and the one or more furanone are in a combination selected from the group consisting of:

GMP between 1 to 99% and IMP between 1 to 99%	Proline	Furaneol
GMP between 1 to 99% and IMP between 1 to 99%	Threonine	Furaneol
GMP between 1 to 99% and IMP between 1 to 99%	Valine	Furaneol
GMP between 1 to 99% and IMP between 1 to 99%	Proline	Sotolon
GMP between 1 to 99% and IMP between 1 to 99%	Threonine	Sotolon
GMP between 1 to 99% and IMP between 1 to 99%	Valine	Sotolon
IMP	Proline	Furaneol
IMP	Threonine	Furaneol
IMP	Valine	Furaneol
IMP	Proline	Sotolon
IMP	Threonine	Sotolon
IMP	Valine	Sotolon
GMP	Proline	Furaneol
GMP	Threonine	Furaneol
GMP	Valine	Furaneol
GMP	Proline	Sotolon
GMP	Threonine	Sotolon
GMP	Valine	Sotolon

5

14. A method for increasing acceptance of a foodstuff in a companion animal comprising allowing the animal access to a foodstuff comprising at least one nucleotide, at least one amino acid selected from the group consisting of proline, hydroxyproline, glutamic acid, aspartic acid, arginine, cystine, glutamine, isoleucine, lysine, threonine, valine and ornithine and one or more furanones as defined in any one of claims 12 or 13.

10

15. A process of preparing a pet foodstuff comprising at least one nucleotide, at least one amino acid selected from the group consisting of proline, hydroxyproline, glutamic acid, aspartic acid, arginine, cystine, glutamine, isoleucine, lysine, threonine, valine and

ornithine, and one or more furanones the process comprising the steps of adding and mixing at least one nucleotide, at least one amino acid and one or more furanones with a pet foodstuff.

5 16. A process of preparing a pet foodstuff according to claim 15, wherein the process comprises combining one or more pet food ingredient; the at least one amino acid; the at least one nucleotide, wherein the amino acid, one or more furanones, nucleotide and furanones are added together or separately, and wherein the amino acid, the nucleotide and the furanones together provide no more than 30 wt% of the dry matter that is contained in
10 the foodstuff.

17. A process according to any one of claims 15 or 16, wherein the one or more pet food ingredients include one or more of the edible materials selected from meat, animal fat, blood plasma, marrowbone, vegetable protein, vegetable fat, milk protein, grains and
15 starch, wherein the one or more edible ingredients provide at least 60 wt % of the dry matter that is contained in the pet foodstuff.

18. A method for increasing the palatability of a foodstuff, the method comprising adding to a foodstuff during or after manufacture at least one nucleotide, at least one amino
20 acid selected from the group consisting of proline, hydroxyproline, glutamic acid, aspartic acid, arginine, cystine, glutamine, isoleucine, lysine, threonine, valine and ornithine, and one or more furanones.

19. A pet foodstuff produced by the methods of claims 15 to 18.
25

Figure 1

L-proline 25 mM + IMP 2.5 mM vs. L-proline 25 mM.

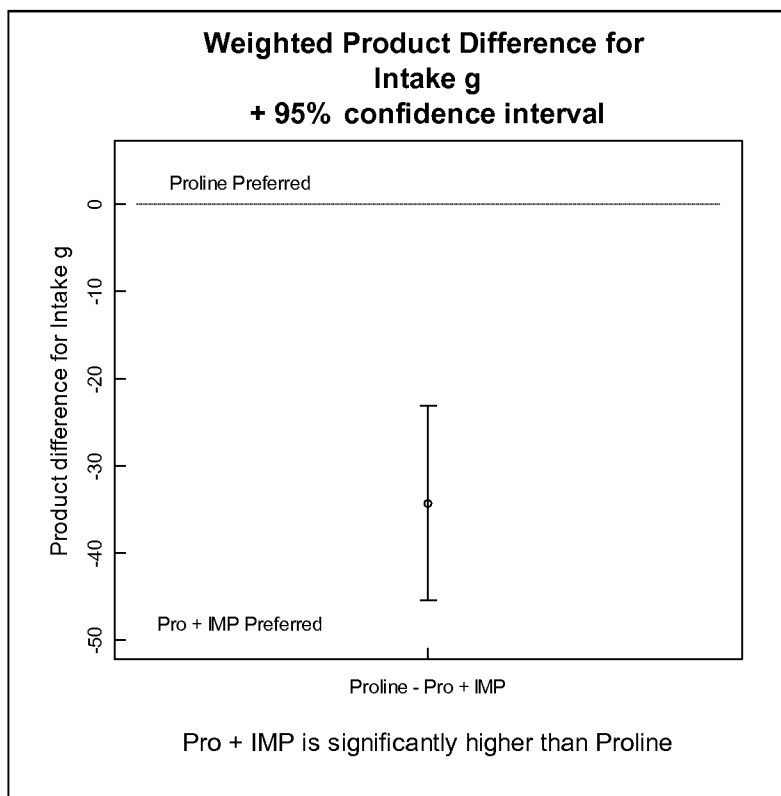


Figure 2

L-proline 25 mM + IMP 2.5 mM vs. IMP 2.5 mM.

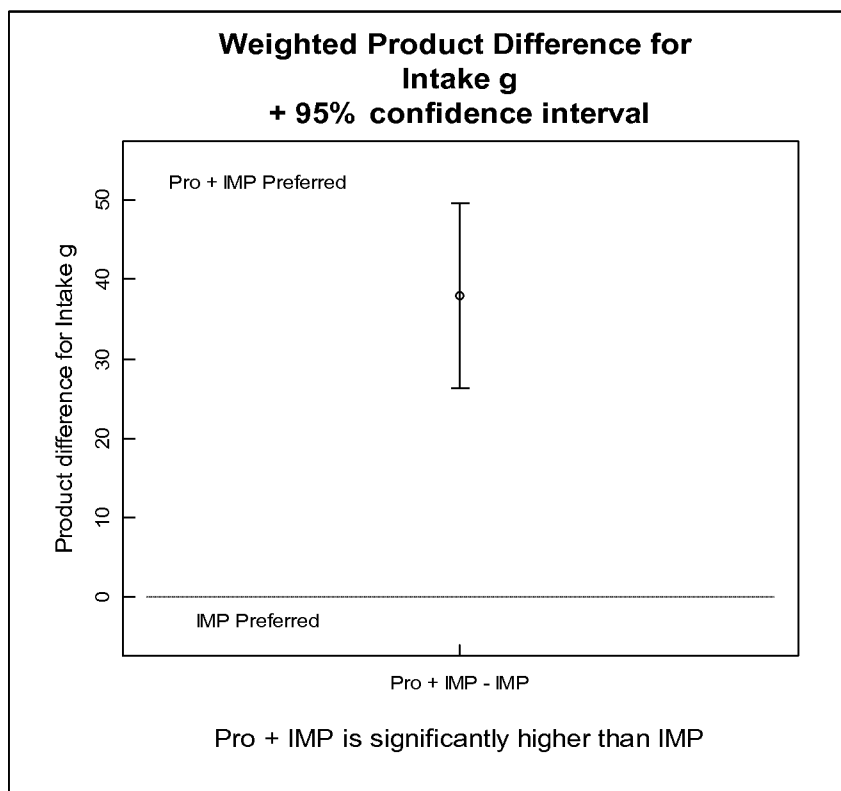


Figure 3

L-threonine 25 mM + GMP 2.5 mM vs. L-threonine 25 mM.

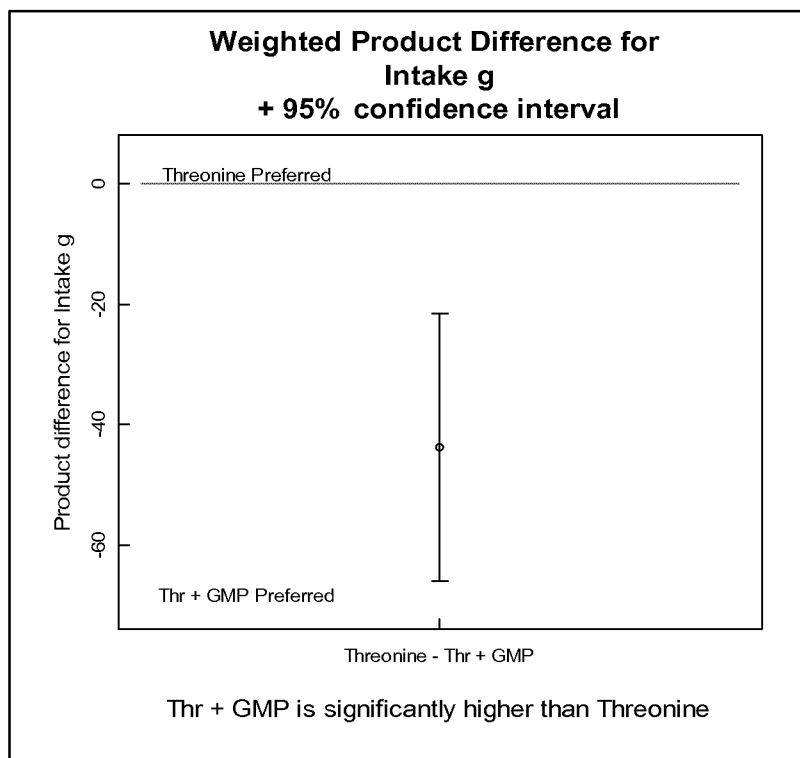


Figure 4

L-threonine 25 mM + GMP 2.5 mM vs. GMP 2.5 mM.

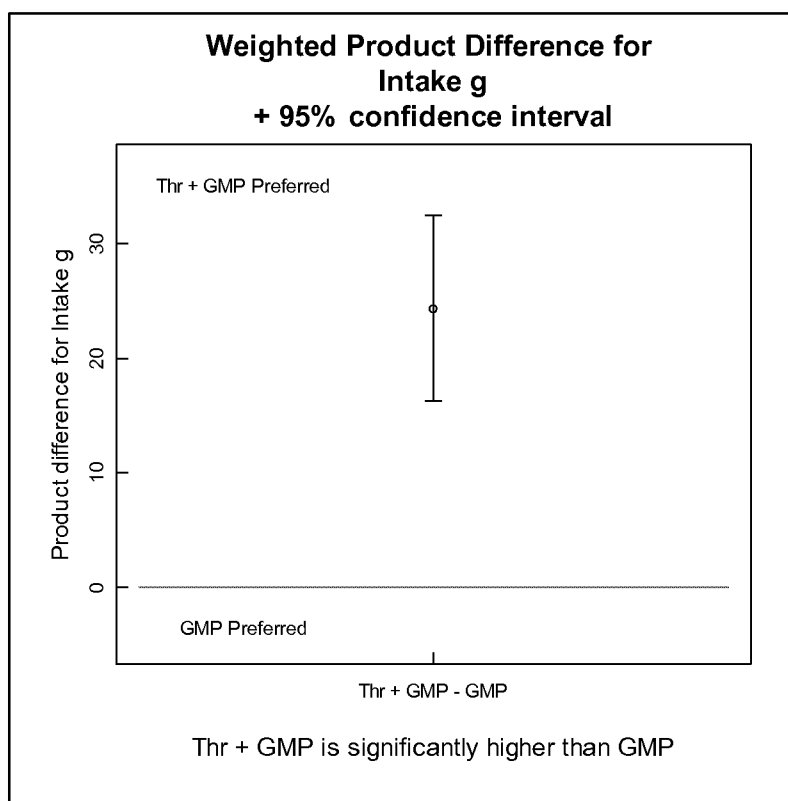


Figure 5

L-valine 25 mM + AMP 2.5 mM vs. L-valine 25 mM.

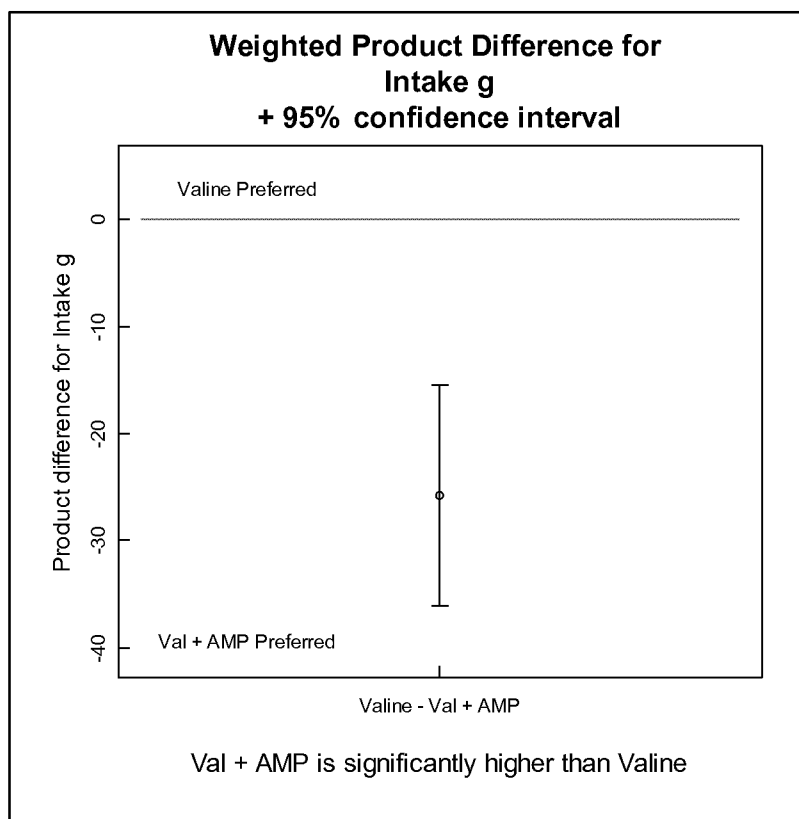


Figure 6

L-valine 25 mM + AMP 2.5 mM vs. AMP 2.5 mM.

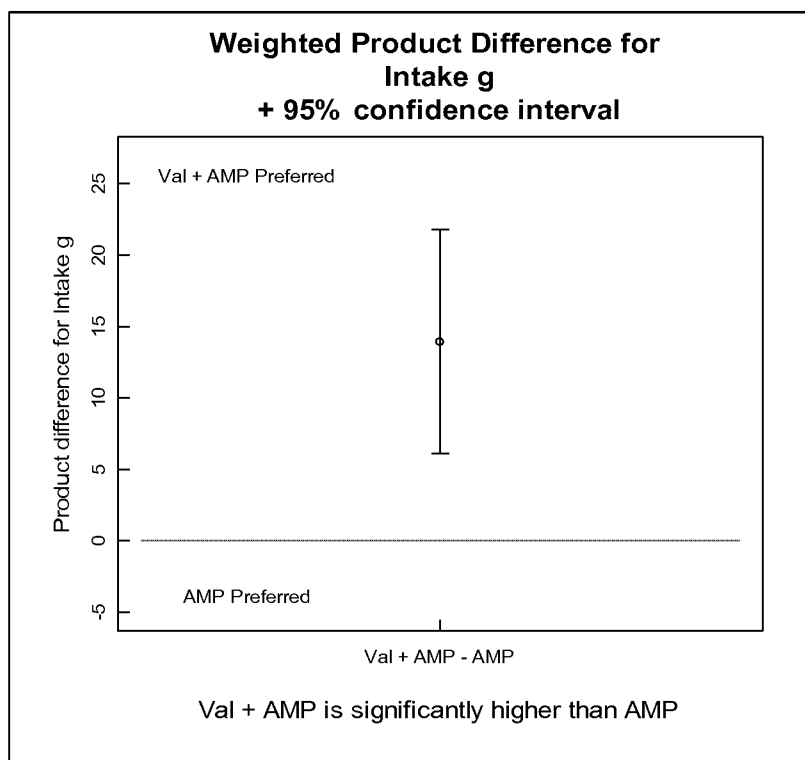


Figure 7

L-proline 25 mM + Ajitide 2.5 mM + furaneol 4 ppm vs. L-proline 25 mM + Ajitide 2.5 mM.

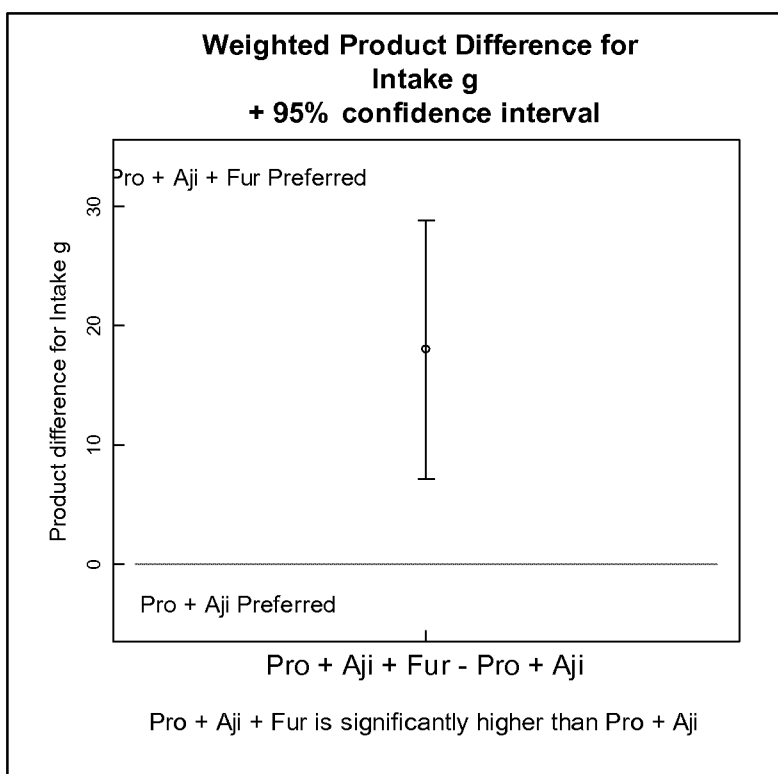


Figure 8

L-threonine 25 mM + Ajitide 2.5 mM + furaneol 4 ppm vs.
L-threonine 25 mM + Ajitide 2.5 mM.

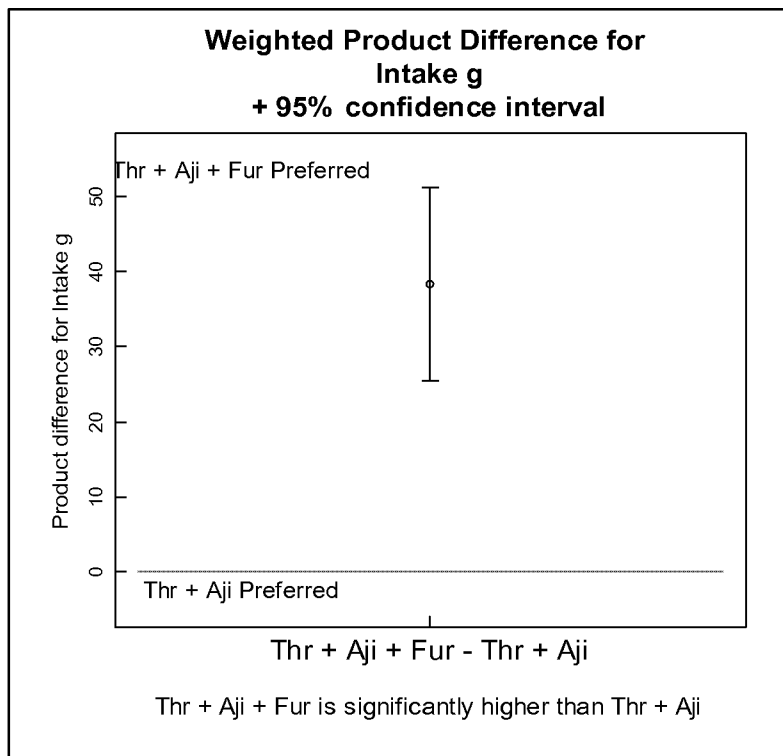


Figure 9

L-proline 25 mM + GMP 2.5 mM vs.
L-proline 25 mM + GMP 2.5 mM + furaneol 4 ppm.

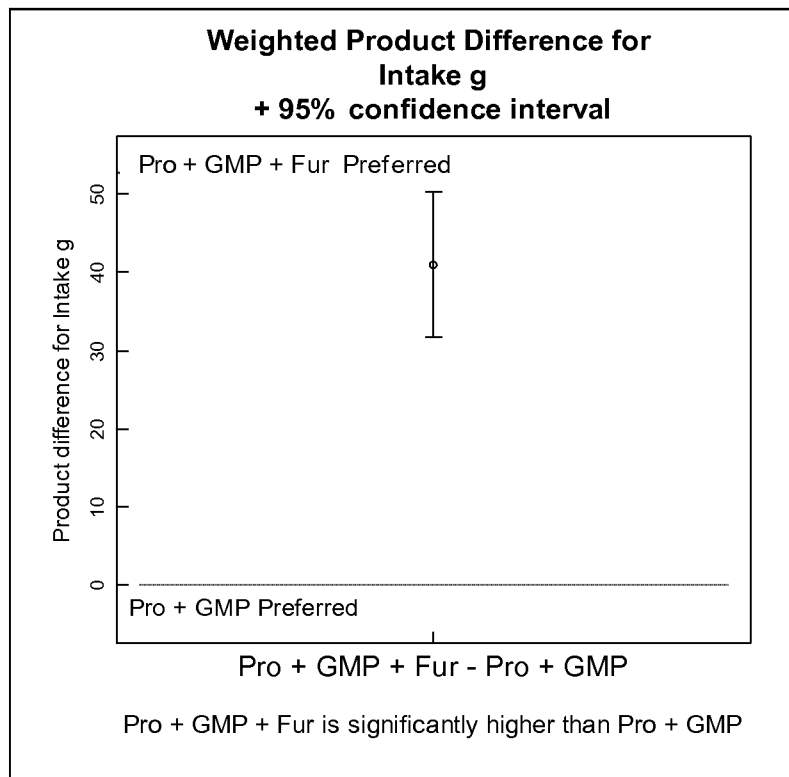
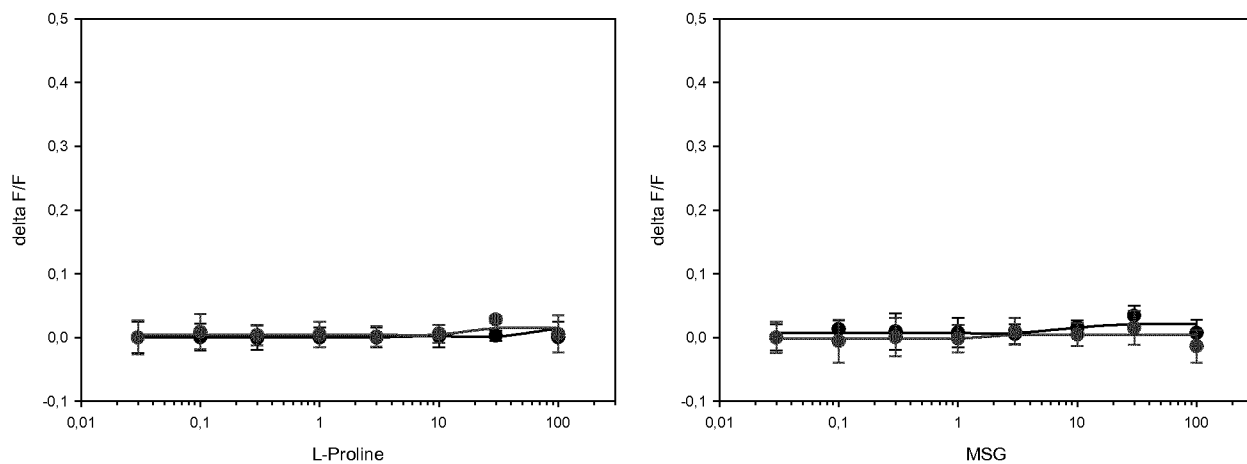
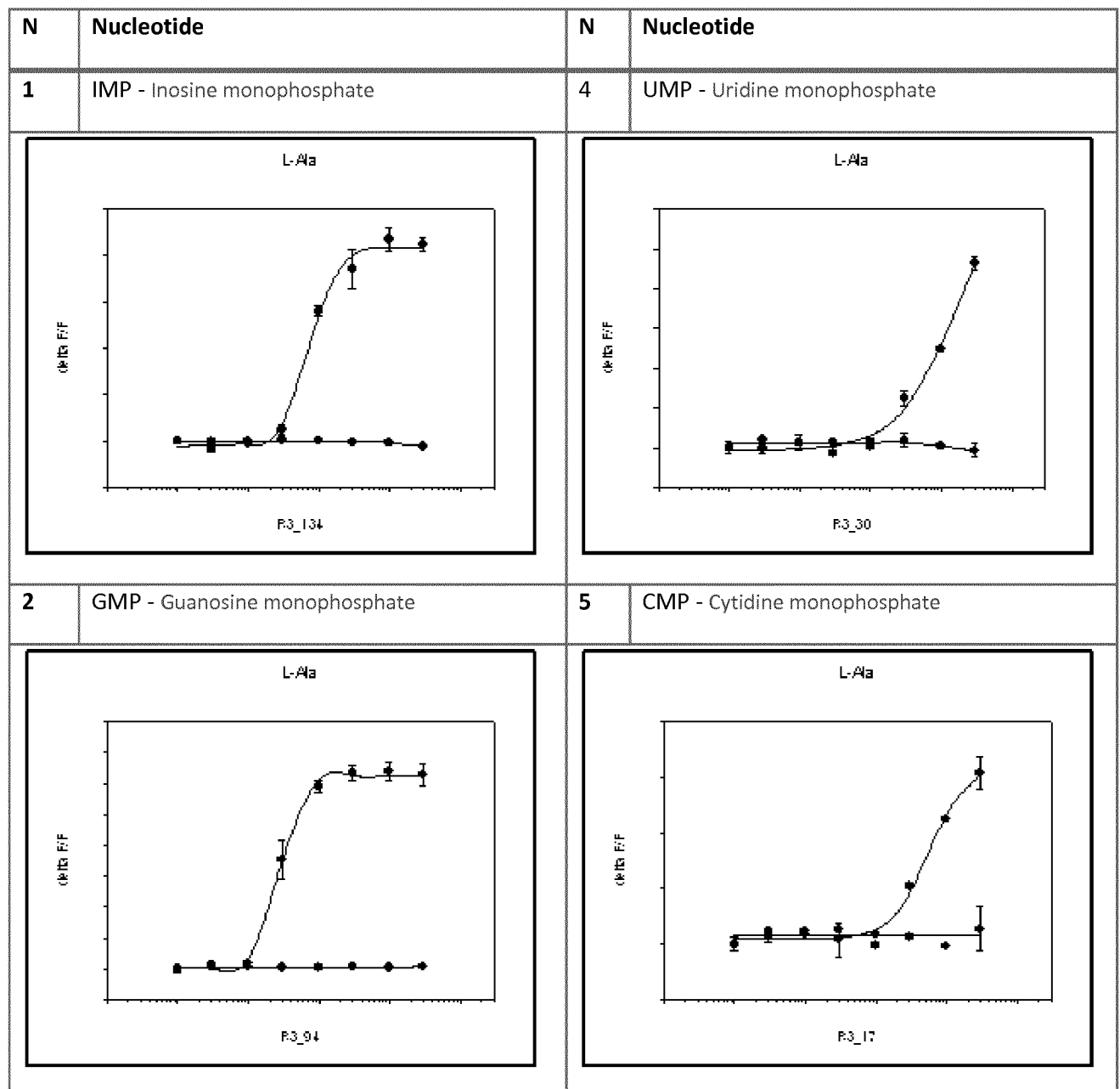


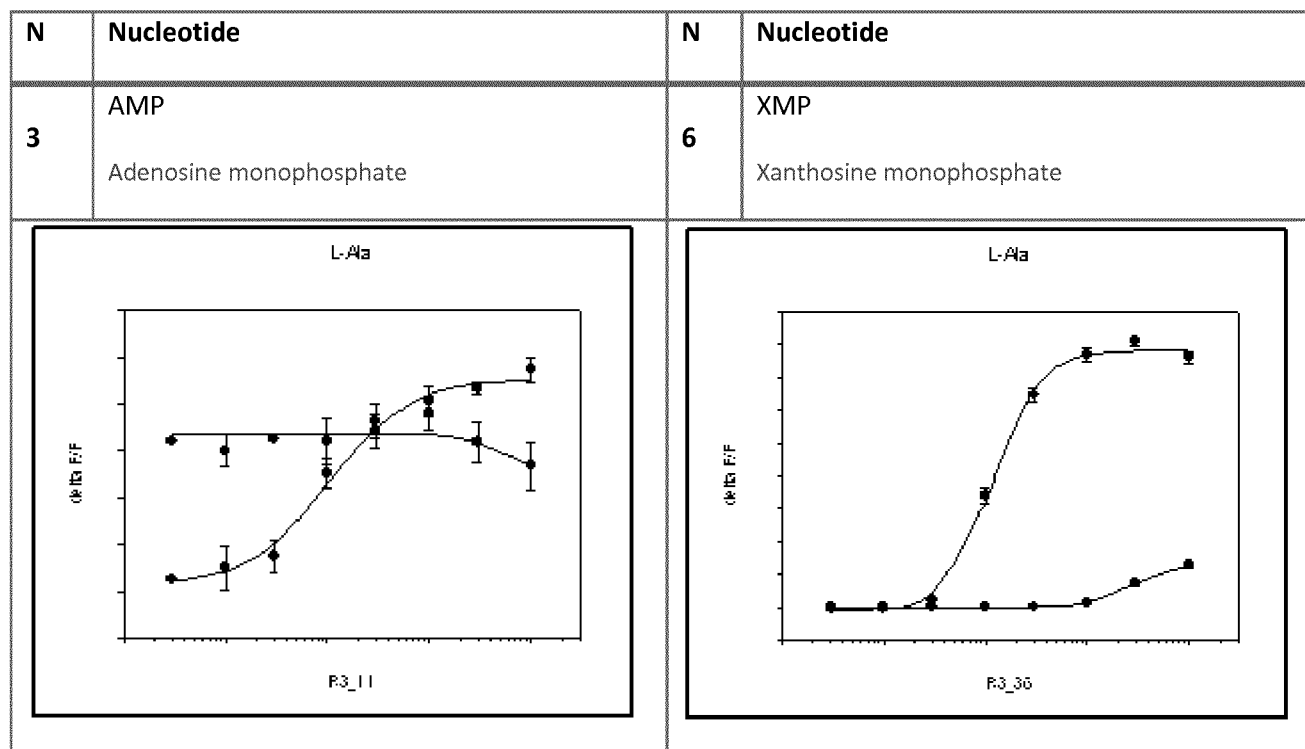
Figure 10



EC50 – Response in the presence of 0.2 mM IMP		
Amino acids binding to binding site B	L-Proline	-
	Hydroxy-L-proline	-
	L-Glutamic acid	-
	MSG	-
	L-Aspartic acid	-
	L-Arginine	-
	L-Cystine	-
	L-Glutamine	-
	L-Isoleucine	-
	L-Lysine	-
	L-Threonine	-
	L-Valine	-
	L-Ornithine (HCl)	-

Figure 11





EC50 – Response in the presence of 20 mM L-Alanine		
Nucleotides binding to umami receptor T1R1-T1R3	Adenosine 5'-monophosphate disodium salt (AMP)	0.011 ± 0.002
	Guanosine 5'-monophosphate (GMP)	0.03 ± 0.001
	Inosine 5'-monophosphate (IMP)	0.07 ± 0.01 mM
	Xanthosine 5'-Monophosphate Disodium Salt (XMP)	0.1 ± 0.01 mM
	Cytidine 5'-monophosphate (CMP)	5.7 ± 1.3 mM
	Uridine 5'-monophosphate disodium salt (UMP)	>30 mM

Figure 12

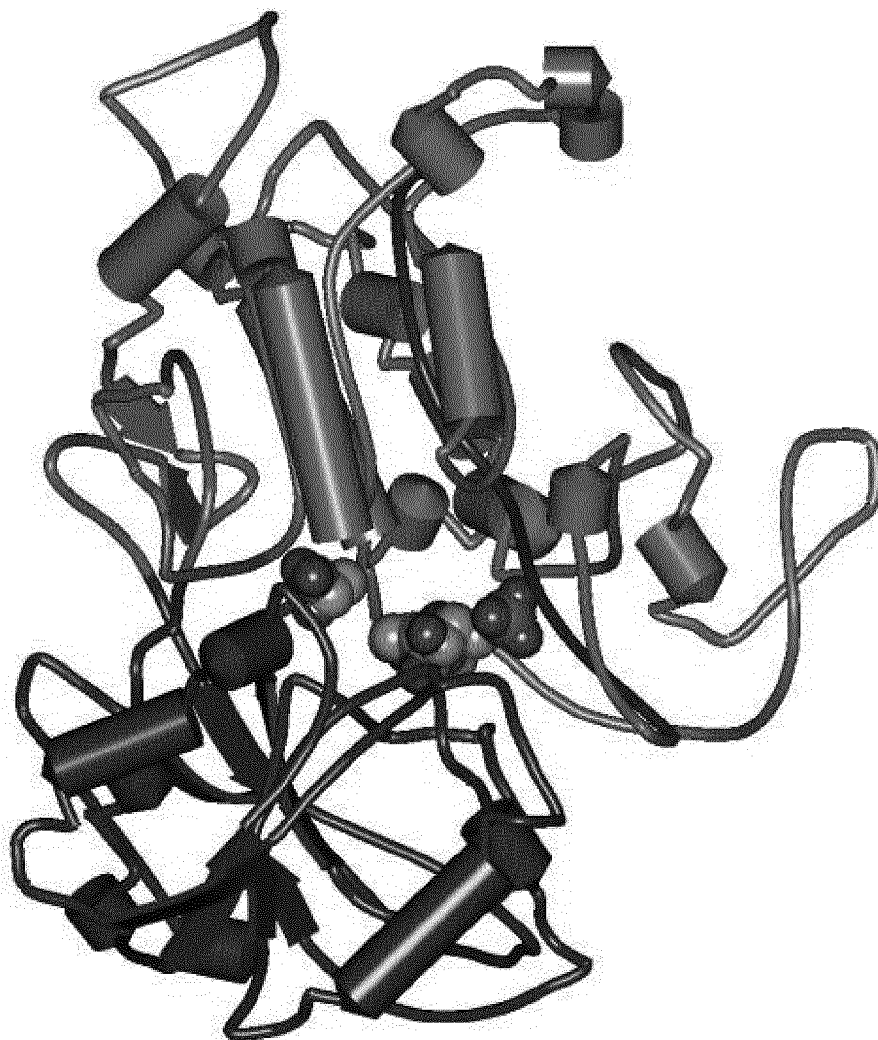


Figure 13

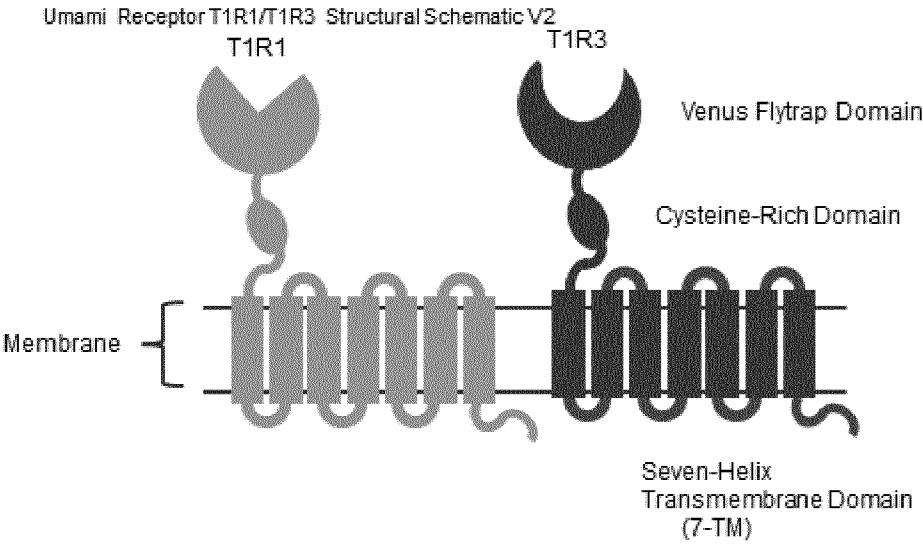


Figure 14

T1R1	Mouse	MLFWAAHLLLSLQLAVAYCWAFCQRTLESSPGFSLPGDFLLAGLFLSHAD
T1R1	Rat	MLFWAAHLLLSLQLV--YCWAFSCQRTLESSPGFSLPGDFLLAGLFLSHGD
T1R1	Human	MLLCTARLV-GLQLLISCCWAFACHSTESSPDFTLPGDYLLAGLFLPHSG
T1R1	Dog	MSLLAAHLV-SLQLSLSCCWALSCHNTLESSPDFSLPGDYLLAGLFLPHSD
T1R1	Cat	MSLPAAHLV-GLQLSLSCCWALSCHSTETSADFSLPGDYLLAGLFLPHSD

T1R1	Mouse	CLQVRHRPLVTSCDRSDSFNGHGYHLFQAMRFTVEEINNSTALLPNITLG
T1R1	Rat	CLQVRHRPLVTSCDRPDSFNGHGYHLFQAMRFTVEEINNSTALLPNITLG
T1R1	Human	CLQVRHRPEVTLCDRSCSFNEHGYHLFQAMRLGVVEINNSTALLPNITLG
T1R1	Dog	CPGVRRRPMVTLCDRPNSFNGHGYHLFQAMRFGIEEINNSTALLPNITLG
T1R1	Cat	CPGVRHRPTVTLCDXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

T1R1	Mouse	YELYDVCSESSNVYATLRVLAQQGTGHLEMQRDLRNHSSKVVALIGPDNT
T1R1	Rat	YELYDVCSESANVYATLRVLALQGPRHIEIQKDLRNHSSKVVAFIGPDNT
T1R1	Human	YQLYDVCSDSANVYATLRVLSLPGQHHEIQGDLLHYSPTVLAVIGPDST
T1R1	Dog	YQLYDVCSESANVYATLNVLSLTLGTHHIEIQADPSHYSAPALAVIGPDST
T1R1	Cat	XX

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T1R1	Mouse	DHAVTTAALLSPFLMPLVSY E ASSVILSGKRKFPSFLRTIPSDKYQVEVI
T1R1	Rat	DHAVTTAALLGPFLMPLVSY E ASSVLSAKRKFPSFLRTVPSDRHQVEVM
T1R1	Human	NRAATTAALLSPFLVPMISY A ASSETLSVKRQYPSFLRTIPNDKYQVETM
T1R1	Dog	NHAATAAALLSPFLVPVISY E ASSVMLGVKRYPSFLRTIPSDKYQVEIM
T1R1	Cat	XXXXXXXXXXXXXXXXXXISY E ASSVTLGVKRHYPSFLRTIPSDKHQVEAM

T1R1	Mouse	VRLQLSFGWVWISLVGSYGDYQQLGVQALEELATPRGICVAFKDVVPLSA
T1R1	Rat	VQLQLSFGWVWISLVGSYGDYQQLGVQALEELAVPRGICVAFKDIPFSA
T1R1	Human	VLLQLKFGWVWISLVGSDDYQQLGVQALENQATQGICIAFKDIMPFSA
T1R1	Dog	VLLQLRFGWVWISLVGSDGYQQLGVQALEEQATQQGICIAFKDIIPFSA
T1R1	Cat	VLLQLSFGWVWISLVGSDGYQQLGVQALEEQATQQGICVAFKDIIPFSA

T1R1	Mouse	QAGDPRMQRMMLRLARARTTVVVVFSNRHLAGVFFRSVVLANLTGKVVIA
T1R1	Rat	RVGDPRMQSMMQHLLAQARTTVVVVFSNRHLARVFFRSVVLANLTGKVWVA
T1R1	Human	QVGDERMQCLMRHLAQAGATVVVVFSRQLARVFFESVVLNLTGKVWVA
T1R1	Dog	QPGNERMQSMYHLDRARTTVVVVFSRQLARVFFESVVLAKLTAKVWIA
T1R1	Cat	RPGDERMQGIMHHLARARTTVVVVFSRQLARVFFESVVLNLTAKVWIA

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T1R1	Mouse	SE D WAISTYITNVPGIQIGIGITVLGVAIQQRQVPGLKEFEESYVQAVMGAP
T1R1	Rat	SE D WAISTYITSVTGIQIGIGITVLGVAVQQRQVPGLKEFEESYVRAVTAAP
T1R1	Human	SE A WALS RHITGVPGIQRIGMVLGVAIQKRAVPGLKAFEEAYARADKKAP
T1R1	Dog	SE D WAISRHISSLPRIWGIGITVLGVAIQQLVPGLKEFEESYVRAKKAH
T1R1	Cat	SE D WAISRHISNVPGIQIGIGITVLGVAIQQLVPGLKEFEESYVQADKGAP

T1R1	Mouse	RTCPEGSWCSTNQLCRECHAFTTWNMPELGAFSMAAYNVYEAVYAVAHG
T1R1	Rat	SACPEGSWCSTNQLCRECHFTTTRNMP TLGAFSMAAYRVYEAVYAVAHG
T1R1	Human	RPCHKGSWCSSNQLCRECQAFMAHTMPKLFASMSAYNAYRAVYAVAHG
T1R1	Dog	RPCSRDSWCSSNQLCRECQAFVQMP TLGAFSMAAYNAYRAVYAAAHG
T1R1	Cat	GPCSRTSECSNQLCRECRAFTAEQMP TLGAFSMAAYNAYRAVYAVAHG

T1R1	Mouse	LHQLLGCTSGTCARGPVYPWQLLQIYKVNFLHKKTVAFDDKGDPLGY
T1R1	Rat	LHQLLGCTSEICSRGPVYPWQLLQIYKVNFLHENTVAFDDNGDPLGY
T1R1	Human	LHQLLGCASGACSRGRVYPWQLLEQIHKVHFLHKTVAFNDNRDPLSS
T1R1	Dog	LHQLLGCASGACSRDRVYPWQLLEQIRKVNFLHEDTVIFNDNGDPLSG
T1R1	Cat	LHQLLGCASGACSRDRVYPWQLLEQIRKVNFLHKTVRFNDNGDPLSG

T1R1	Mouse	DIIAWDWNWPEWTFEIVIGSASLSPVHLDINKTKIQWHGKNNQVPVSVCTR
T1R1	Rat	DIIAWDWNWPEWTFEIIIGSASLSPVHLDINKTKIQWHGKNNQVPVSVCTT
T1R1	Human	NIIAWDWNWPKWTFITVLGSSTWSPVQLNINETKIQWHGKDNQVPKSVCSS
T1R1	Dog	DIIAWDWSGPKWTFTRVIGSSTWPPVQLDINKTKIRWHGEDNQVPESVCS
T1R1	Cat	DIIAWDWSGPKWNFRVIGSSMWPPVQLDINKTKIRWHGKDNQVPKSVCS

T1R1	Mouse	DCLEGHRLVMGSHHCCFECMPCEAGTFLNTSELHTCQPCGTEEWAPEGS
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T1R1	Rat	DCLAGHHRVVVGS SHCCFECVPC EAGTFLNMSELHICQPCGTEEWAPKES
T1R1	Human	DCLEGHQRVVVTGFHHCCFECVPCGAGTFLNKSDLYRCQPCGKEEWAPEGS
T1R1	Dog	NCLEGHQRVVVGFYHCCFECVPC EAGTFLNKSDLHSCQPCGKEEWAPEGS
T1R1	Cat	DCLEGHQRVISGIFYHCCFECVPC EAGSFLNKSDLHSCQPCGKEEWAPAGS
T1R1	Mouse	SACFSRTVEFLGWHEPISLVLLAANTLLLLLLIGTAGLFAWRLHTPVVRS
T1R1	Rat	TTCFPRTVEFLAWHEPISLVLLAANTLLLLLLVGTAGLFAWHFHTPVVRS
T1R1	Human	QTCFPRTVVFLALREHTSWVLLAANTLLLLLLVGTAGLFAWHLDTPVVRS
T1R1	Dog	ESCFLRTVVFLTWHEPISWVLLAANTLLLLLVAGTAGLFAWHLDTPVVRS
T1R1	Cat	ETCFPRTVVFLTWHEPISWVLLAANTLLLLLVGTAGLFAWHLDTPVVKS
T1R1	Mouse	AGGRLCFLMLGSLVAGSCSLYSFFGKPTVPACLLRQPLFSLGFAIFLSCL
T1R1	Rat	AGGRLCFLMLGSLVAGSCSFYSFFGEPTVPACLLRQPLFSLGFAIFLSCL
T1R1	Human	AGGRLCFLMLGSLAAGSGSLYGFFGEPTRPACLLRQALFALGFTIFLSCL
T1R1	Dog	AGGRLCFFMLGSLAGGSCGLYGFFGEPTLATCLLRQGLFALGFAIFLSCL
T1R1	Cat	AGGRLCFFMLGSLAGGSCGLYGFFGEPTLPTCLLRQSLALGFAIFLSCL
T1R1	Mouse	TIRSFQLVLIIFKFSTKVPTFYHTWAQNHGAGIFVIVSSTVHLFLCLTWLA
T1R1	Rat	TIRSFQLVLIIFKFSTKVPTFYRTWAQNHGAGLFVIVSSTVHLLICLTLWL
T1R1	Human	TVRSFQLIIIFKFSTKVPTFYHAWVQNHGAGLFVMISSAAQLLICLTLWL
T1R1	Dog	TIRSFQLVFIIFKFSAKVPTFYQAWVQNHGPRLFVVISSMAQLLICLTLWL
T1R1	Cat	TIRSFQLVFIIFKFSAKVPTFYRAWVQNHGPRLFVVISSMAQLLICLTLWL
T1R1	Mouse	MWTPRPRTREYQRFPPLVILECTEVNSVGFLVAFAHNILLSISTFVCSYLG
T1R1	Rat	MWTPRPRTREYQRFPPLVILECTEVNSVGFLAFTHNILLSISTFVCSYLG
T1R1	Human	VWTPPLPAREYQRFPPLVMLECTETNSLGFILAFLYNGLLSISAFACSYLG
T1R1	Dog	VWTPPLPRTREYQRFPQLVVLDCTEANSPGFMVAFAYNGLLSVSFAFACSYLG
T1R1	Cat	VWTPPLPRTREYQRFPQLVVL-----
T1R1	Mouse	KELPENYNEAKCVTFSLLLHFVSWIAFFTMSSIQGSYLPVNVLAGLAT
T1R1	Rat	KELPENYNEAKCVTFSLLLNFVSWIAFFTMASIQGSYLPVNVLAGLTT
T1R1	Human	KDLPENYNEAKCVTFSLLLNFVSWIAFFTTASVYDGKYLPAANMMAGLSS
T1R1	Dog	KDLPENYNEAKCVTFSLLLNFVSWIGFFTTASVYQGYLPVNVLAALSS
T1R1	Cat	-----
T1R1	Mouse	LSGGFSGYFLPKCYVILCRPELNNTTEHFQASIQDYTRRCGTT
T1R1	Rat	LSGGFSGYFLPKCYVILCRPELNNTTEHFQASIQDYTRRCGTT
T1R1	Human	LSSGFGGYFLPKCYVILCRPDLNSTEHFQASIQDYTRRCGST
T1R1	Dog	LSSGFSGYFLPKCYVILCRPDLNSTEHFQASIQDYTRRCGST
T1R1	Cat	-----

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/072790

A. CLASSIFICATION OF SUBJECT MATTER
INV. A23L1/22 A23K1/16 A23K1/18
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A23L A23K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, BIOSIS, FSTA, WPI Data, EMBASE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 267 195 A (BOUDREAU JAMES C ET AL) 12 May 1981 (1981-05-12)	10,11
Y	column 2, line 62 - column 3, line 13 claims 1,10	1-9, 12-19

X	DATABASE WPI Week 201214 Thomson Scientific, London, GB; AN 2012-B65042 XP002697403, & CN 102 318 784 A (TIANJIN CHENHUI FEED CO LTD) 18 January 2012 (2012-01-18)	10,11
Y	abstract	1-9, 12-19

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Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

24 January 2014

Date of mailing of the international search report

06/02/2014

Name and mailing address of the ISA/

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Fax: (+31-70) 340-3016

Authorized officer

Vermeulen, Stéphane

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/072790

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DATABASE WPI Week 200950 Thomson Scientific, London, GB; AN 2009-L85515 XP002697404, & CN 101 480 229 A (UNIV GUANGDONG OCEAN) 15 July 2009 (2009-07-15)	10,11
Y	abstract	1-9, 12-19
X	----- US 2003/232407 A1 (ZOLLER MARK [US] ET AL) 18 December 2003 (2003-12-18)	10,11
Y	paragraph [0028] paragraph [0076] - paragraph [0077] paragraph [0306] - paragraph [0311] figures 14,15	1-9, 12-19
X	----- YOSHII K ET AL: "Synergistic effects of 5'-nucleotides on rat taste responses to various amino acids", BRAIN RESEARCH, ELSEVIER, AMSTERDAM, NL, vol. 367, no. 1-2, 5 March 1986 (1986-03-05), pages 45-51, XP024279385, ISSN: 0006-8993, DOI: 10.1016/0006-8993(86)91577-5 [retrieved on 1986-03-05]	10,11
Y	figures 1,2,4; tables I,II,V	1-9, 12-19
X	----- US 3 524 747 A (O'HARA MASAMI ET AL) 18 August 1970 (1970-08-18)	10,11
Y	column 2, line 6 - line 49 column 3, line 54 - line 61 examples 1-8	1-9, 12-19
X	----- WO 2005/053421 A2 (HILLS PET NUTRITION INC [US]; IMAFIDON GILBERT I [US]; SHU CHI-KUEN [U] 16 June 2005 (2005-06-16)	10,11
Y	paragraph [0007] - paragraph [0008]; compounds II,III paragraphs [0018], [0019], [0021], [0022] paragraph [0054]; examples 1-7	1-9, 12-19

INTERNATIONAL SEARCH REPORT

International application No.

PCT/EP2013/072790

Box No. I Nucleotide and/or amino acid sequence(s) (Continuation of item 1.c of the first sheet)

1. With regard to any nucleotide and/or amino acid sequence disclosed in the international application and necessary to the claimed invention, the international search was carried out on the basis of:
- a. (means)
- ☐ on paper
- ☒ in electronic form
- b. (time)
- ☒ in the international application as filed
- ☐ together with the international application in electronic form
- ☐ subsequently to this Authority for the purpose of search
2. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
3. Additional comments:

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2013/072790

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