

Module 8 - Flavour Enhancers for the food Industry

1. GENERAL INTRODUCTION

1.1 Definitions

A *flavour enhancer* is a substance that is added to a food to supplement or enhance its original taste or flavour. The term *flavour potentiator* has also been used with the same meaning. The most commonly used substances in this category are monosodium L-glutamate (MSG), disodium 5'-inosinate (IMP), and disodium 5'-guanylate (GMP). Salt, although not classed as a food additive, is the most widely used flavour enhancer.

The flavour enhancers are numbered between 620 and 640 in E numbering and/or INS numbering system as given in the following list.

620 E620	Glutamic acid	Natural amino acid (building block of protein). Commercially prepared from molasses by bacterial fermentation. Also prepared from vegetable protein, such as gluten, or soy protein. Glutamic acid and glutamates are present in all proteins. Free glutamates are present in high concentrations in ripened cheese, breast milk, tomatoes and sardines. Flavour enhancer, salt substitute used in sausages, and seasoning, savoury snacks - many savoury foods. Young children should avoid it. It could kill nerve cells, resulting in diseases such as Huntington's, Alzheimer's and Parkinson's.
621 E621	Monosodium L-glutamate (MSG)	Sodium salt from glutamic acid (E620), a natural amino acid (building block of protein). Commercially prepared from molasses by bacterial fermentation. Added to any savoury processed protein food. In cigarettes and animal food. Typical products are canned vegetables, canned tuna, dressings, many frozen foods. To be avoided. It could kill nerve cells, resulting in diseases such as Huntington's, Alzheimer's and Parkinson's. Pregnant women, children, hypoglycaemic, elderly and those with heart disease are at risk from reactions.
622 E622	Monopotassium L-glutamate	Potassium salt from glutamic acid (E620), a natural amino acid (building block of protein). Commercially prepared from same source as that for Glutamic acid. Less used and not as salty, low sodium salt substitute. Can cause nausea, vomiting, diarrhoea, abdominal cramps; typical products are low sodium salt substitutes. Not for babies under 12 months old or those people with impaired kidneys.
623 E623	Calcium di-L-glutamate	g block of protein. Commercially prepared from same source as that for Glutamic acid. Salt substitute, flavour enhancer. No known adverse effects. But Calcium glutamate may have possible problems for asthmatics and aspirin sensitive people.
624 E624	Monoammonium L-glutamate	
625 E625	Magnesium di-L-glutamate	
E626	Guanylic acid	Not listed for use in Australia. Guanylic acid is a natural acid, which is part of RNA, one of the genetic carrier molecules in the cell. Should be avoided by people suffering from gout.
627 E627	Disodium guanylate	Flavour enhancer. Isolated from sardines or yeast extract; not permitted in foods for infants and young children. Persons with gout, hyperactivity, asthmatics and aspirin sensitive's should avoid it. It is found in instant noodles, potato chips and snacks, savoury rice, tinned vegetables, cured meats, packet soup.

E628	Dipotassium guanylate	Flavour enhancer. Guanylic acid and guanylates do not have the specific umami taste but strongly enhance many other flavours, thereby reducing the amounts of salt needed in a product. Guanylic acid and guanylates are generally produced from yeasts, but partly also from fish. They may thus not be suitable for vegans and vegetarians.
E629	Calcium guanylate	Calcium salt of guanylic acid (E626), a natural acid, which is part of RNA, one of the genetic carrier molecules in the cell. It is thus part of all cells in all living organisms. Commercially prepared from yeast extract or sardines. Flavour enhancer.
E630	Inosinic acid	A natural acid, that is mainly present in animals. Commercially prepared from meat or fish (sardines). May also be produced by bacterial fermentation of sugars. Used by athletes to supposedly increase the oxygen capacity of their blood.
631 E631	Disodium inosinate	May be prepared from meat or sardines; not permitted in foods for infants and young children. Gout sufferers avoid. It is found in instant noodles, potato chips and snacks, savoury rice, tinned vegetables, cured meats, packet soup.
E632	Dipotassium inosinate	Potassium and calcium salt of inosinic acid (E630), both natural acids that are mainly present in animals. Commercially prepared from meat or fish (sardines). May also be produced by bacterial fermentation of sugars. Flavour enhancer. Inosinic acid and inosinates do not have the specific umami taste but strongly enhance many other flavours, thereby reducing the amounts of salt or other flavour enhancers needed in a product. Used in many products. Mainly used in low sodium/salt products. Acceptable daily intake (ADI): None determined. Guanylates and inosinates may not be used in products intended for children under 12 weeks. People suffering from asthma and gout should avoid inosinates.
E633	Calcium inosinate	
E634	Calcium 5'-ribonucleotides	Mixture of calcium salts of guanylic (E626) and inosinic acid (E630). Flavour enhancer. Used in many products. Mainly used in low sodium/salt products. Guanylates and inosinates may not be used in products intended for children under 12 weeks. People suffering from asthma and gout should avoid guanylates and inosinates.
635 E635	Disodium 5'-ribonucleotide	Made from 627 and 631. May be associated with itchy skin rashes up to 30 hours after ingestion; typical foods include flavoured chips, instant noodles and party pies. Avoid it, especially gout sufferers, asthmatics and aspirin sensitive people.
E635	Sodium 5'-ribonucleotide	Mixture of sodium salts of guanylic (E626) and inosinic acid (E630). May be associated with itchy skin rashes up to 30 hours after ingestion; typical foods include flavoured chips, instant noodles and party pies. Avoid it, especially gout sufferers, asthmatics and aspirin sensitive people. Banned in Australia.
636 E636	Maltol	Derived from the bark of larch trees, pine needles, chicory wood, oils and roasted malt; it may be produced synthetically. Artificial sweetener, flavour enhancer used in baked goods to give a 'fresh baked' taste and smell in bread and cakes, chocolate substitute, soft and fizzy drinks, ice cream, jam. In large quantities it can cause Alzheimer's disease. Acceptable daily intake (ADI): Up to 2 mg/kg bodyweight. Some countries ban it for babies and young children.
637	Ethyl maltol	Derived from maltol chemically. Base for essences, synthetic artificial flavour and flavour enhancer. Some countries ban it for babies and young children. Acceptable daily intake (ADI): Up to 2 mg/kg bodyweight
640 E640	Glycine (and its sodium salts), glycol, amino acetic acid	Flavour modifier. Glycine is a natural amino acid, a building block of protein. Can be mildly toxic if ingested. Glycine is produced mainly from gelatin, which is derived from animal bones. It is therefore not suitable for vegans, vegetarians.

1.2 Historical Background

Dried seaweed for the preparation of soup has been recorded even in the oldest record on foods written on narrow strips of wood in the 8th century in Japan. The seaweed *kombu* (*Laminaria japonica*) has been an important item of trade from the northern islands to central Japan ever since. It became an offering for the divine service and a sacred gift at the formal engagement ceremony. Dried fermented bonito, *katsuobushi*, has also been used and was thought to be in the same category (*Kombu* connotes delight, and *katsuobushi* connotes victory).

Ancient Romans loved *Garme*, fermented fish sauce. In Japan soups were prepared with the unique raw materials mentioned. In 1908, Professor Kikunae Ikeda succeeded in isolating the essence of “tastiness” of soup, he isolated glutamic acid from kombu bouillon and named the unique glutamate taste “umami.” He suggested that this should be a basic taste independent of the four traditional basic tastes: sweet, sour, bitter, and salty. In China, the word *xianwei*, which represents the taste common in fish and meat, corresponds to umami. The same is true for *savory* in English, *osmazome* in old French, and *gulih* in Indonesian.

Glutamic acid was first isolated from gluten (wheat protein) and named after it by Ritthausen in 1866. Commercialization of glutamate began in 1909 with its isolation from wheat gluten. In 1913 the investigations of Ikeda’s protege Shintaro Kodama into dried bonito led to a second important realization: the discovery that inosinic acid was another typical umami substance.

Clarification of the full configuration of umami was not achieved until 1960, when Akira Kuninaka recognized the role of 5'-guanylate as another key component. The shiitake mushroom (*Lentinus edodus*) has been used as an invigorant. In 1960, guanylic acid was extracted from the broth of the common shiitake mushroom.

1.3 Food Occurrence

It is important to note that both compounds comprising umami, that is, glutamate (salts of glutamic acid) and nucleotides are key components of living organisms. Glutamate is naturally present in virtually all foods, including meat, fish, poultry, milk (human milk), and many vegetables. It occurs in bound form when linked with other amino acids to form protein, and also in free form when it is not protein bound or in peptides. Therefore, protein-rich foods such as human milk, cow’s milk, cheese, and meat contain large amounts of bound glutamate, while most vegetables contain little. Despite their low protein content, many vegetables, including mushrooms, tomatoes, and peas, have high levels of free glutamate. The glutamate content in foods is shown in Table 1.

It has been noted that glutamate is an important element in the natural and traditional ripening processes that allow the fullness of taste in food to be achieved. Perhaps this is why foods naturally high in glutamate, such as tomatoes, cheese, and mushrooms, have become important to the popular cuisines of the world. Distribution of nucleotides in foods are delineated in Table 2 and 3.

Table 1: Glutamate Content in Foods

Sr. No.	Food	Protein in Food (%)	Glutamate in protein	Protein bound glutamate	Free glutamate
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			(%)	(g/100g)	(mg/100g)
1	Cow's milk	2.9	19.3	0.560	1.9
2	Human milk	1.1	15.5	0.170	22
3	Camembert cheese	17.5	27.4	4.787	390
4	Parmesan cheese	36.0	27.4	9.847	1400
5	Cheddar cheese 1 month 8 months	-	-	5.092	21.8 182
6	Gruyere Appenzel Beaufort Comte	-	-	5.981	460 910 630
7	Blue cheese Roquefort	-	-	5.189	1230
8	Eggs	12.8	12.5	1.600	23
9	Chicken	22.9	16.1	3.700	44
10	Beef	18.4	13.5	2.500	33
11	Pork	20.3	15.7	3.200	23
12	Green peas	7.4	14.8	1.100	75
13	Sweet corn	3.3	15.1	0.500	100
14	Tomato Green Red	0.7	37.1	0.260	246 20.0 143.3
15	Canned tomato 0.343m 202n	-	-	0.343	202
16	Tomato juice	-	-	0.303	109
17	Tomato paste	-	-	1.510	556
18	Onion	-	-	0.190	102
19	Potato	-	-	0.347	180
20	Broccoli	-	-	0.375	115
21	Spinach	3.3	9.1	0.300	47

Table 2: Distribution of Nucleotides in Animal Foods

Sr. No.	Food	Nucleotides content (mg/100 g)		
		IMP	GMP	AMP
1	Beef	163	0	7.5
2	Pork	186	3.7	8.6
3	Chicken	115	2.2	13.1
4	Whale	326	5.3	2.4
5	Horse mackerel	323	0	7.2
6	Sweet fish	287	0	8.1
7	Common sea bass	188	0	9.5
8	Pilchard	287	0	0.8
9	Black sea bream	421	0	12.4
10	Pike mackerel	227	0	7.6
11	Mackerel	286	0	6.4
12	Keta salmon	235	0	7.8

13	Tuna	286	0	5.9
14	Globefish	287	0	6.3
15	Eel	165	0	20.1
16	Dried benito	630–1310	0	trace
17	Squid	0	0	184
18	Common octopus	0	0	26
19	Spiny lobster	0	0	82
20	Hairy crab	0	0	11
21	Squilla	26	0	37
22	Common abalone	0	0	81
23	Round clam	0	0	98
24	Round clam	0	0	98
25	Common scallop	0	0	116
26	Short-neck clam	0	0	12

IMP = Disodium 5' inosinate

GMP = Disodium 5' guanylate

AMP = Adenosine monophosphate

Table 3: Distribution of Nucleotides in Vegetable Foods

Sr. No.	Foods	Nucleotides content (mg/100 g)		
		IMP	GMP	AMP
1	Asparagus	0	trace	4
2	Welsh onion	0	0	1
3	Head lettuce	trace	trace	1
4	Tomato	0	0	12
5	Green peas	0	0	2
6	Cucumber	0	0	2
7	Japanese radish	trace	0	2
8	Onion	trace	0	1
9	Bamboo shoot	0	0	1
10	Mushroom, shiitake	0	103	175
11	Dried mushroom, shiitake	0	216	321
12	French mushroom	0	trace	13
13	Dried french mushroom	0	trace	190
14	Mushroom, enokidake	0	32	45
15	Mushroom, matsutake	0	95	112
16	Mushroom, syoro	0	9	16
17	Mushroom, hatsutake	0	85	58
18	Mushroom, benitengu dake	0	0	trace
19	Mushroom, naratake	0	0	trace

2. FUNCTION IN FOODS

2.1 Basic Qualities

2.1.1 Umami Taste

The theory of four basic tastes (sweet, sour, salty and bitter) was proposed by a German psychologist and was accepted for a long time without sufficient scientific data to support it. He explained that all tastes experienced could be made up from the mixture of the four basic tastes, located at the corners of a tetrahedron and located somewhere on the surface of the tetrahedron. Multidimensional scaling analyses of human sensory tests demonstrated that the umami taste is located outside the tetrahedron of the traditional four basic tastes, and the taste quality is distinctly different from those of the other basic tastes. The taste quality of umami is not produced by mixing any of the other four basic tastes. Electrophysiological studies suggest that the taste bud receptor site for glutamate is different from those for the traditional four basic tastes. These electrophysiological data are supported by the most recent molecular biological study on glutamate receptor sites in taste bud cells. Thus, Umami is definitely located outside the tetrahedron of the four basic tastes and is an independent basic taste (Fig. 2).

2.1.2 Taste Thresholds

a. Glutamate. The detection threshold for MSG was as low as 0.012 g/100 mL, or 6.25×10^{-4} M. It was higher than that of quinine sulfate or tartaric acid, lower than that of sucrose, and almost the same as that of sodium chloride at isomolar concentrations (Table 4).

b. Nucleotides. The threshold values of IMP and GMP are 0.025 and 0.0125 g/100 mL, respectively. The taste threshold for 50:50 blends of GMP and IMP has been reported to be 0.0063%. When they were used in combination with 0.8% MSG, however, the resulting threshold was lowered to 0.000031%, which represents a dramatic synergistic effect.

Table 4: Detection Thresholds for Five Taste Substances (in g/dL)

MSG	Sucrose	Sodium chloride	Tartaric acid	Quinine sulfate
0.012	0.086	0.0037	0.00094	0.000049

2.1.3 Taste Intensity

The relationship between MSG concentration and the taste intensity of MSG is found to follow a straight line. The slope for MSG is not as steep as for the four basic tastes. Moreover, the taste intensity of IMP increases hardly at all, even when its concentration is increased considerably.

2.2 Taste Synergism

2.2.1 The Synergistic Effects of Umami Substances

Figure 1 shows that taste intensity of mixtures (IMP and MSG) increases exponentially with their concentration and that the degree of synergism depends upon the ratio of IMP to MSG. Depending on concentration, the taste intensity of the mixture could be 16 times stronger than that of MSG alone.

The synergistic effect between MSG and IMP can be expressed by means of the following simple equation:

$$y = u + 1200uv \quad (1)$$

where u and v are the respective concentrations of MSG and IMP in the mixture, and y is the equi-umami concentration of MSG alone.

The synergistic effect can be demonstrated between any combination of various Umami substances and intensity of Umami taste can also be expressed using equation 1.

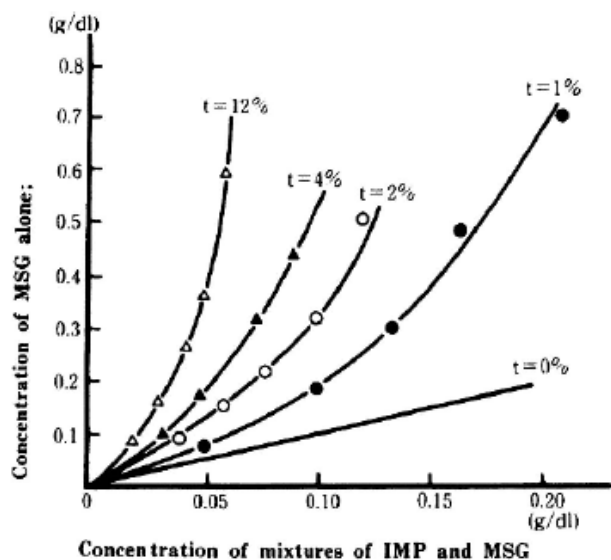


Figure 1: Taste equivalency of mixture of IMP and MSG to MSG alone. t represents IMP content (percent) in mixtures.

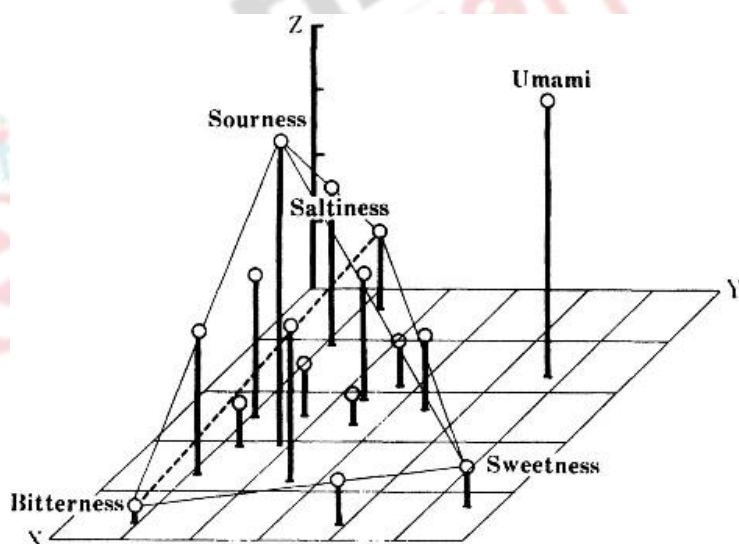


Figure 2: Three-dimensional configuration for five taste stimuli.

2.2.2 The Synergistic Action of Umami in Foods

Multidimensional analysis has shown umami to be present in the taste of natural foods. The broths made from animal and fish stocks fall outside the area of the four basic tastes and lie nearer to umami (Fig. 3). This demonstrates that umami is a vitally important element in broth taste composition. In contrast, broth made from vegetables also contains umami, but some of the taste factors are sweetness or sourness. Thus these broths are distributed widely over the five taste areas (Fig. 4). However, if a small amount of IMP is added, the tastes of all the broths move in the direction of umami (Fig. 5). This shows the synergistic effect of umami that is brought into existence between the glutamate contained in the vegetables and the added inosinate.

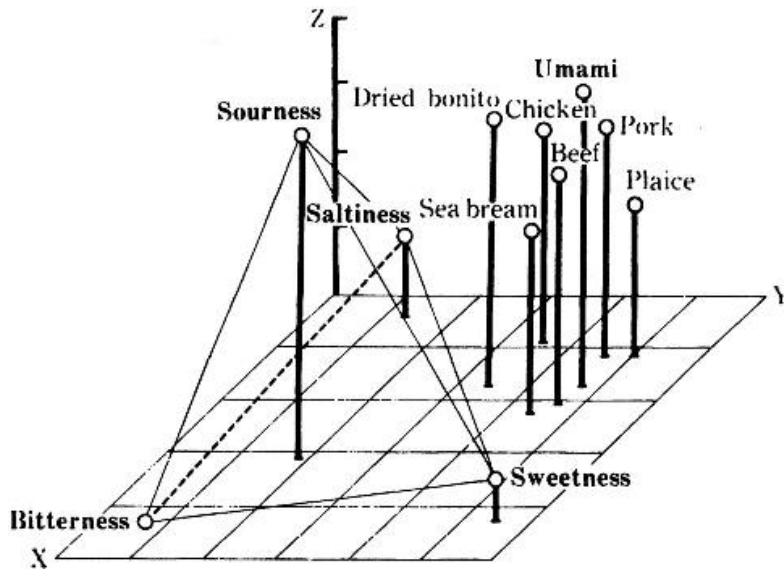


Figure 3: Three-dimensional configuration for meat and fish and the five taste stimuli.

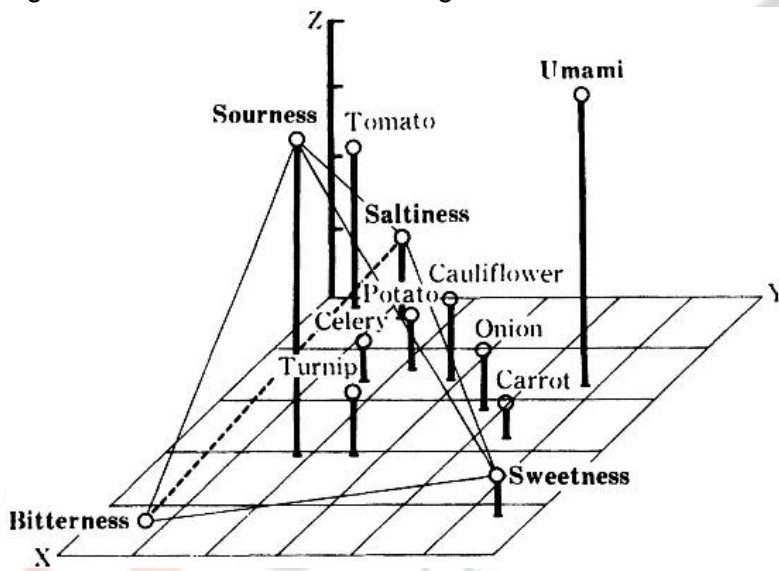


Figure 4: Three-dimensional configuration for vegetable stocks and the five taste stimuli.

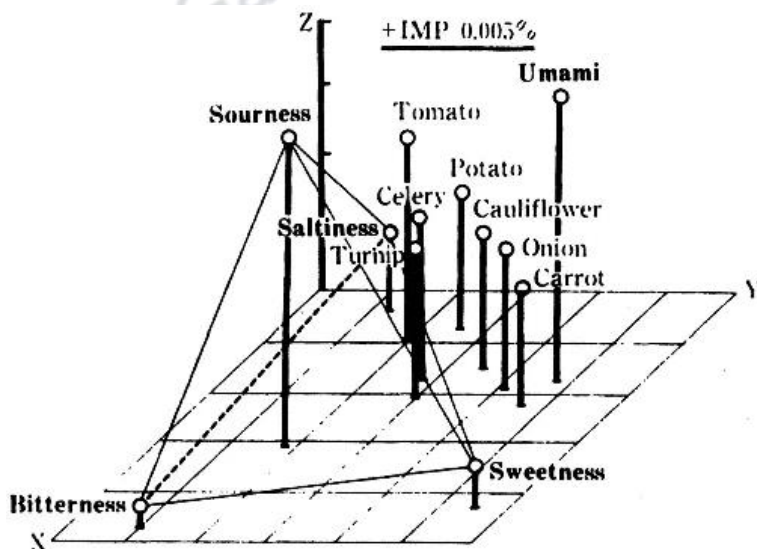


Figure 5: Three-dimensional configuration for vegetable stocks with 0.005% disodium inosinate (IMP) added and the five taste stimuli.

2.3 Hedonic Functions and Self-Limiting Properties

Psychometric studies on aqueous solutions of the four basic tastes revealed that three (salty, bitter, and sour) are rated as unpalatable over a wide concentration range in that they received unpleasantness ratings. Only sweetness was given a pleasantness rating. In a similar fashion to salty, sour, or bitter stimuli, umami (MSG in aqueous solution) also had an unpleasantness rating or was rated neutral in acceptability at all concentrations studied. Of additional importance is the fact that there is an optimal concentration for MSG added to food. Beyond this most palatable concentration, the palatability of food decreases. Thus the use of MSG is self-limiting in that overuse decreases palatability (Fig. 6)

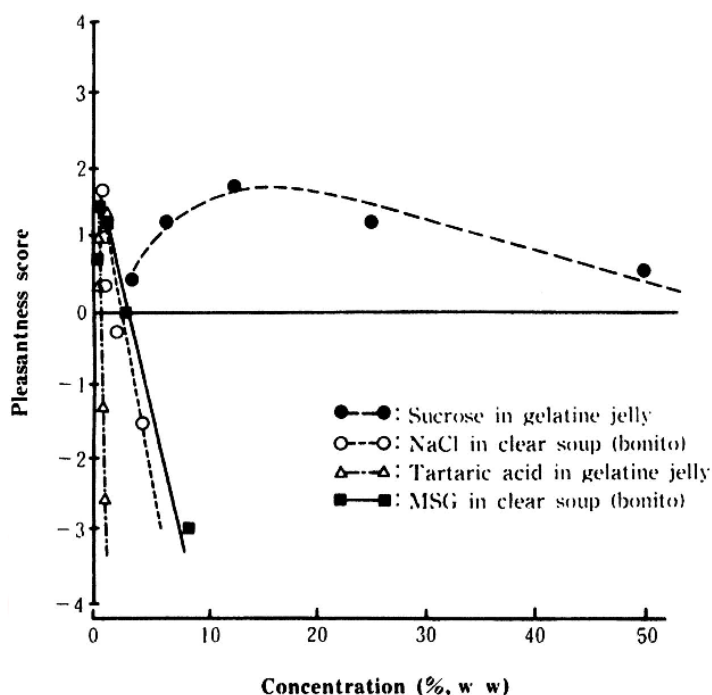


Figure 6: Typical hedonic patterns for four taste substances, showing the self-limiting effect of the amount of MSG (and also NaCl and tartaric acid) to be added to foods. No self-limiting effect is seen with sucrose.

3. STABILITY

3.1 Glutamate

Glutamate is not hygroscopic and does not change in appearance or quality during storage. The characteristic taste of glutamate, umami, is a function of its stereochemical molecular structure. The D-isomer of glutamate does not possess a characteristic taste or enhance flavours. Glutamate is not decomposed during normal food processing or in cooking. In acidic (pH 2.2–4.4) conditions with high temperatures, a portion of glutamate is dehydrated and converted into 5-pyrrolidone-2-carboxylate. At very high temperature glutamate racemizes to DL-glutamate in strong acid or alkaline conditions and especially in latter. Maillard (or browning) reactions occur when glutamate is treated at high temperatures with reducing sugars, as is the case with other amino acids.

3.2 5'-Nucleotides

IMP and GMP are not hygroscopic. IMP and GMP are stable in aqueous solution, but in acidic solution at high temperature, decomposition of the nucleotides occurs. The ribose linkage of 5'-nucleotides is more labile than the phosphomonoester linkage, and the purine base is completely liberated by heating at 100°C in 1 N HCl. Enzymatic activity can also have a significant influence on flavour enhancer breakdown and buildup. The phosphomonoester linkage of 5'-nucleotides is easily split by phosphomonoesterases, which are readily found in plant and animal products. From a practical standpoint, these enzymes should be inactivated before the addition of 5'-nucleotide flavour enhancers to foods. Heating or storage below 0°C is usually sufficient to cause inactivation.

4. Manufacturing Process

Glutamate and 5'-nucleotides were originally isolated from natural sources. Even today certain flavour enhancers can be economically isolated from various natural products, but certainly not in the quantities required by the food industry. Presently the vast majority of commercial MSG is produced through a fermentation process: Most L-glutamic acid producing bacteria are gram-positive, non-spore forming, and nonmotile and require biotin for growth. Among these strains, bacteria belonging to the genera *Corynebacterium* and *Brevibacterium* are in widespread use along with an oleic acid requiring auxotrophic mutant, which was derived from biotin-requiring *Brevibacterium thiogenitalis*. These bacteria can utilize various carbon sources, such as glucose, fructose, sucrose, maltose, ribose, or xylose, as the substrate for cell growth and L-glutamic acid biosynthesis. For industrial production, starch (tapioca, sago, etc.), cane molasses, beet molasses, or sugar is generally employed as the carbon source.

An ample supply of a suitable nitrogen source is essential for L-glutamic acid fermentation, since the molecule contains 9.5% nitrogen. Ammonium salts such as ammonium chloride or ammonium sulfate and urea are assimilable. The ammonium ion is detrimental to both cell growth and product formation, and its concentration in the medium must be maintained at a low level. The pH of the culture medium is very apt to become acidic as ammonium ions are assimilated and L-glutamic acid is excreted. Gaseous ammonia has a great advantage over aqueous bases in maintaining the pH at 7.0–8.0, the optimum for L-glutamic acid accumulation. It serves as a pH-controlling agent and as a nitrogen source, and solves various technological problems. Moreover, recent technological innovations, such as genetic recombination, cell fusion, and bioreactor development, are now being applied for further improvement of L-glutamic acid fermentation. Genetic recombination and cell fusion techniques might be useful for the genetic construction of microorganisms with higher production yields or with the capability to assimilate less expensive raw materials such as C1 compounds and cellulosic materials. Bioreactors packed with L-glutamic acid producing microorganisms are being investigated in an attempt to improve productivity (Hirose et al., 1985).

IMP and GMP are commercially produced by two procedures: (1) degradation of RNA with 5'-phosphodiesterase to form 5'-nucleotides, and (2) fermentation, resulting in the production of nucleosides, which in turn can be phosphorylated into 5'-nucleotides. MSG, IMP, and GMP occur as colorless or white crystals or as white crystalline powders. They are odorless and dissolve in water readily.

5. Assay Techniques/Analysis for Flavour Enhancers in Food

5.1 Glutamate

Paper and thin-layer chromatography, amino acid analyzer procedures, gas chromatographic measurement of the trimethylsilyl ether derivative of glutamic acid, and potentiometric titration methods are generally used for analyzing glutamic acid content in various foods. Enzymatic analysis has also been conducted utilizing L-glutamate decarboxylase from pumpkin rind or *Escherichia coli* and L-glutamate dehydrogenase, which catalyzes the conversion of L-glutamate to α -ketoglutarate. In general, glutamate is extracted from the food, preferably under acidic conditions, as free glutamic acid and is subjected to quantitative analysis using liquid column chromatography.

5.2 5'-Nucleotides

In the case of 5'-nucleotides, there are numerous procedures that utilize paper and thin layer chromatography and high-performance liquid chromatography. Enzymatic assays specific for 5'-nucleotides are also available.

Thus it can be appreciated that a large number of techniques are available to measure flavor enhancer levels. Perhaps the most important limiting factor associated with all, or at least most, of these techniques is that they are not effective for a wide variety of foods, mainly because of incomplete extractions associated with certain foods or interference due to extraneous compounds. Thus, before a specific technique is chosen for a food, its potential limitations must be evaluated.

6. USE OF GLUTAMATE IN FOODS AND REGULATIONS

6.1 Food Applications: Glutamate and 5'-Nucleotides

The major use of MSG in cooking around the world is as a flavour enhancer in soups and broths, sauces and gravies, and flavourings and spice blends. MSG is also included in a wide variety of canned and frozen meats, poultry, vegetables, and combination dishes. Results of taste panel studies indicate that a level of 0.1–0.8% by weight in food gives the best enhancement of the food's natural flavour. In home or restaurant cooking, this amounts to about 1–2 teaspoonfuls per kilogram of meat or per 8–12 servings of vegetables, casseroles, soups, etc.

Generally, the nucleotides are useful in enhancing the flavour of many products containing soups, certain canned meats, fish, vegetables, and vegetable juice. The application levels of Glutamate and 5'-nucleotide in various foods are presented in Table 5.

Table 5: Processed Foods to Which Flavour Enhancers Are Added and Their Usage Levels

Sr. No.	Food	Usage Levels	
		MSG (%)	5'-Nucleotide (50:50 IMP and GMP) (%)
1	Canned soups	0.12–0.18	0.002–0.003
2	Canned asparagus	0.08–0.16	0.003–0.004
3	Canned crab	0.07–0.10	0.001–0.002
4	Canned fish	0.10–0.30	0.003–0.006
5	Canned poultry, sausage, ham	0.10–0.20	0.006–0.010
6	Dressings	0.30–0.40	0.010–0.150
7	Ketchup	0.15–0.30	0.010–0.020
8	Mayonnaise	0.40–0.60	0.012–0.018
9	Sausage	0.30–0.50	0.002–0.014
10	Snacks	0.10–0.50	0.003–0.007
11	Soy sauce	0.30–0.60	0.030–0.050

12	Vegetable juice	0.10–0.15	0.005–0.010
13	Processed cheese	0.40–0.50	0.005–0.010
14	Dehydrated soups	5–8	0.10–0.20
15	Soup powder for instant noodles	10–17	0.30–0.60
16	Sauces	1.0–1.2	0.010–0.030

6.2 Regulations

The use of monosodium glutamate in foods, like that of hundreds of other flavors, spices, and food additives, is subject to a variety of standards and regulations on a worldwide basis. In 1987, the Joint Expert Committee on Food Additives (JECFA) of the Food and Agricultural Organization of the United Nations and the World Health Organization (FAO/WHO) reviewed and endorsed the safety of glutamate, allocating an acceptable daily intake (ADI) for MSG as “not specified.” Along with JECFA specifications, various national bodies have also established standards of purity for glutamates. For example, monographs of identity for purity are listed in the U.S. Food Chemicals Codex and the Japanese Standard of Food Additives. In the United States, MSG is included in the GRAS (generally recognized as safe) list of food ingredients by the U.S. Food and Drug Administration, along with salt, pepper, sugar, and vinegar. The Scientific Committee for Foods of the European Community evaluated MSG and gave number E621 as a safe food additive (EL/SCF, 1991). The regulation was published as a Council Directive in 1995 (European Parliament, 1995). In Japan, MSG is a permitted food additive with no limitation. For calcium and disodium salts of guanylic and inosinic acid, the committee has stated “ADI not specified.”

In India, addition of flavour enhancers in various food products is as per the directives given by Food Safety Standards Act (FSSA). According to FSSA, Monosodium Glutamate may be added to foods as per the provisions contained in Appendix A of FSSA act, subject to Good Manufacturing Practices (GMP) level and under proper label declaration. It shall not be added to any food for use by infant below twelve months and has provided list of foods where MSG is not allowed to be added.

7. Conclusion

The benefits of Monosodium Glutamate (MSG) are to make stale or cheap ingredients taste irresistible. However, since its introduction in the year 1948, the usage of Monosodium Glutamate (MSG) is surrounded with many controversies. It is known to cause Chinese Syndrome Disease (symptoms include burning, numbness, facial pressures, headaches and chest pain) and many other complications at various levels in different people. However, studies have failed to demonstrate that MSG is the causal agent in provoking the full range of symptoms of Chinese restaurant syndrome and other diseases. Also there are no full proof reports of other Flavour enhancers causing specific health complications including toxicity. As a result MSG and other flavour enhancers are still used in most of the countries in various food products to improve their acceptability level. Due to some of their known health effects, nowadays food products are labeled as not containing MSG but these products may again contain other flavour enhancers that are labeled on package with E-numbers. Also there is recent trend for usage of natural flavour enhancers like soy proteins, milk proteins, etc.