Case Study of Food Additive Safety and Efficacy; MSG the Most Researched Food Additive

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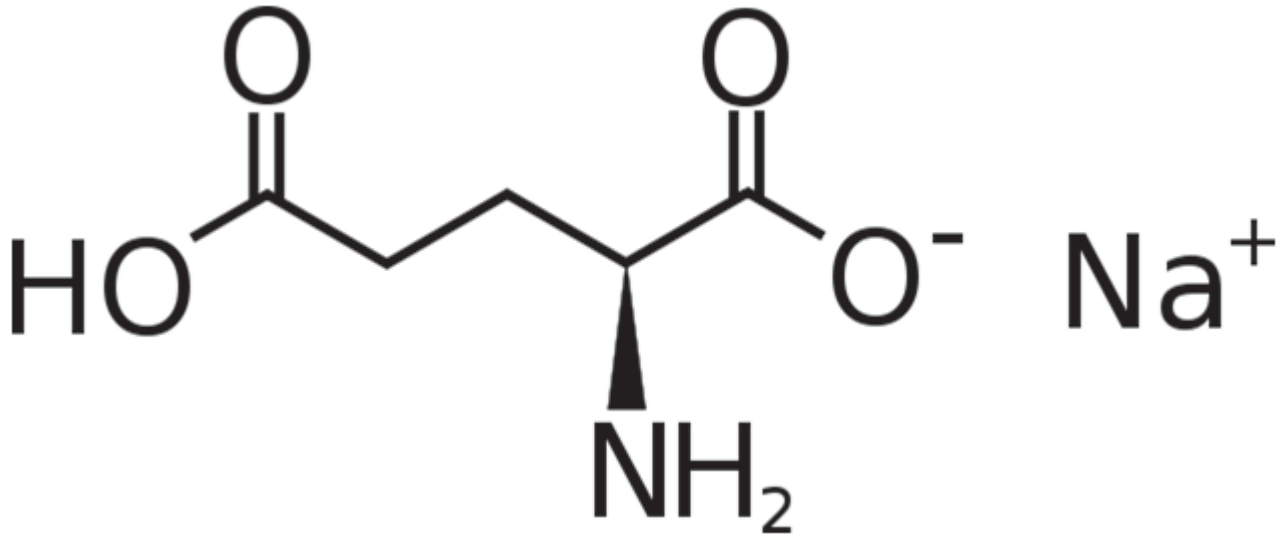
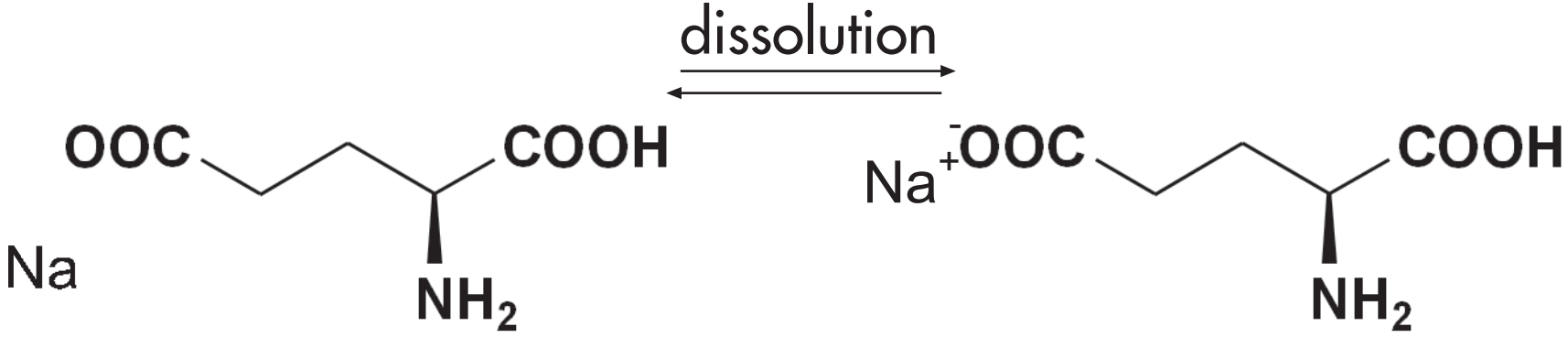
What is Monosodium Glutamate?

Monosodium Glutamate (MSG)
is the sodium salt of glutamic acid



MSG is sodium salt of glutamic acid



Monosodium Glutamate Crystal

Sodium ion Glutamate In water

MSG dissociates into sodium ion and glutamate when it is dissolved in food.

Our body can not distinguish added glutamate by MSG and natural existing glutamate.

Added glutamate from MSG and natural existing glutamate are completely the same.

What is Monosodium Glutamate?

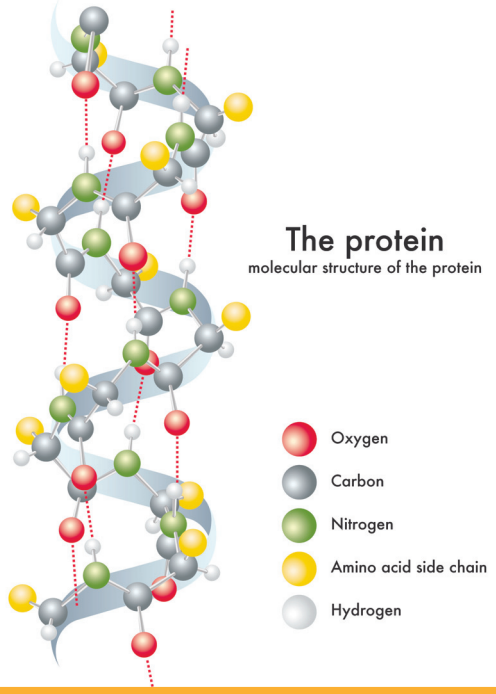
MSG

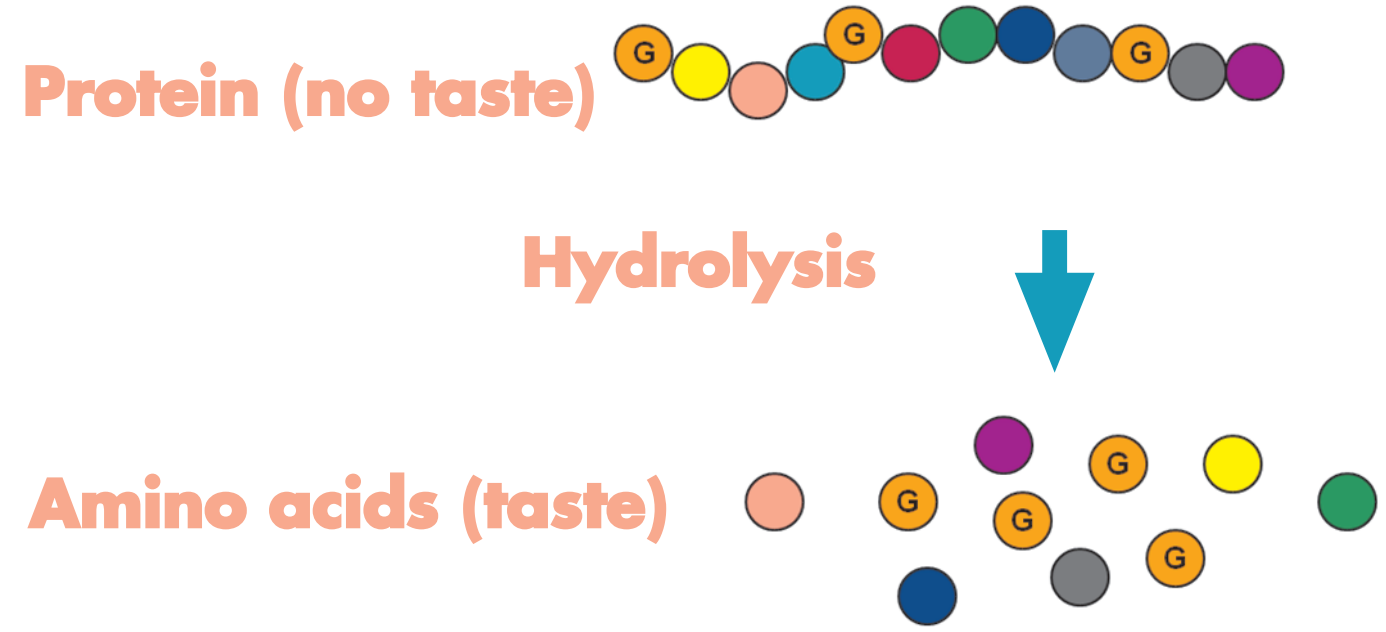
- Ionic form of glutamic acid
- One of the most abundant amino acids found in nature.
- Main component of protein.
- Present in most tissues.
- Produced in the body and play an essential role in our body as excitatory? neurotransmitter and intermediate of metabolism

Discovery of Glutamate

Isolated and Identified as a Substance

- Professor Ritthausen (1866), Germany
- Isolated from Hydrolyzed Wheat Gluten
- Named after Gluten



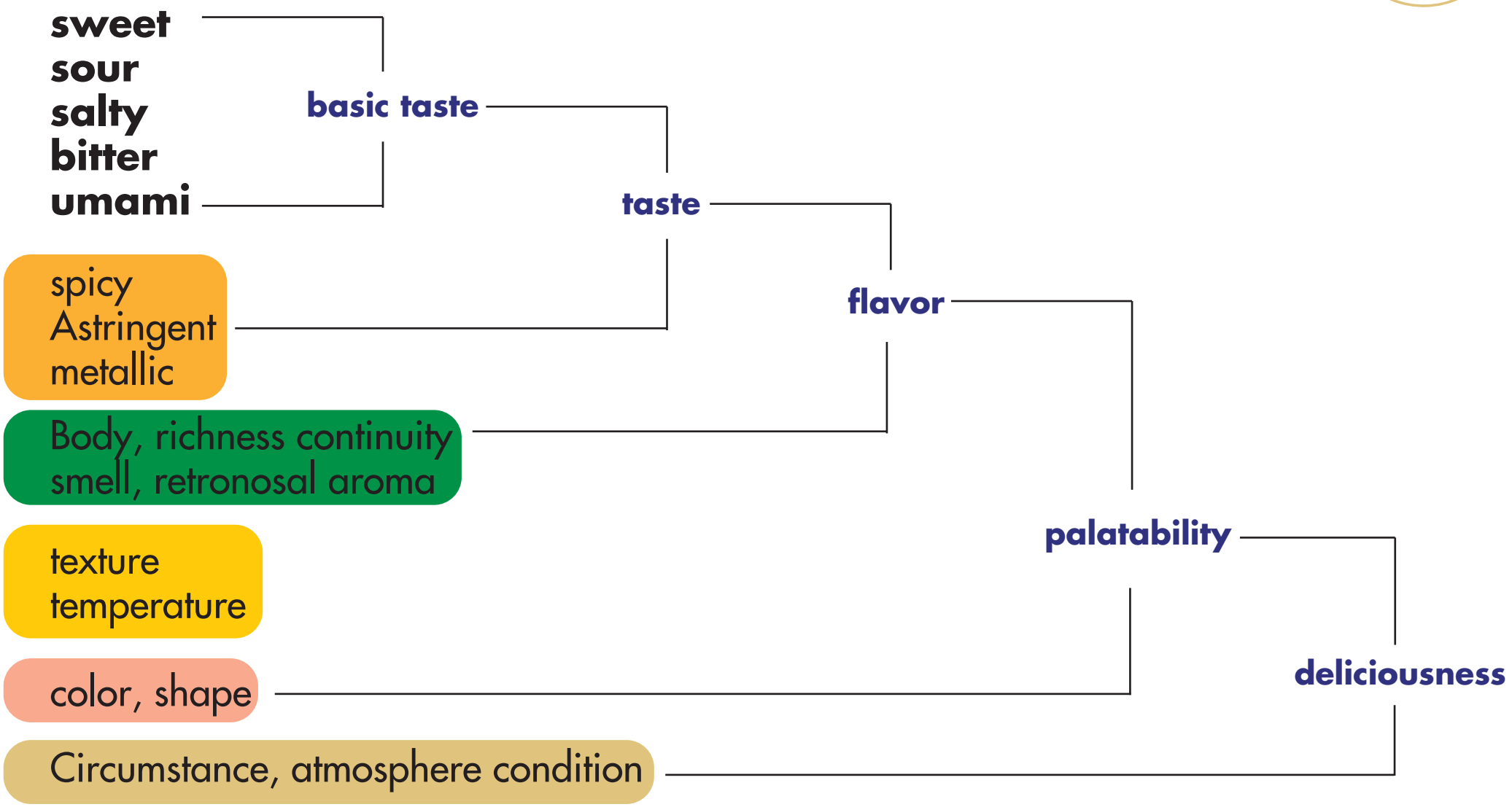


What is Umami?

What is Umami?

- Taste of glutamate which is an important taste element in natural foods.
- A basic taste along with sweet, sour, salty and bitter.
- It is usually described as savory, brothy meaty or mouthfullness.

What is Umami?

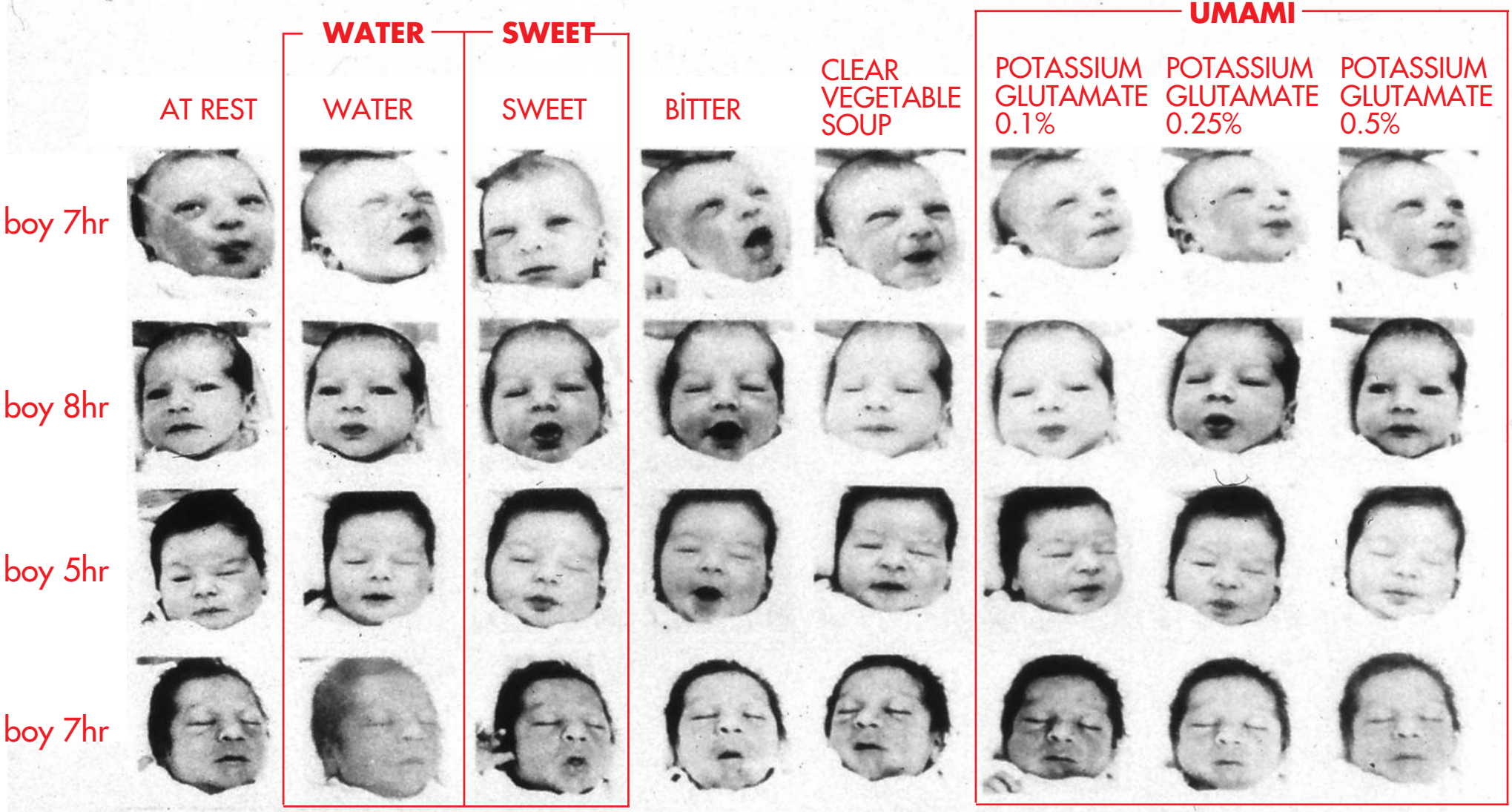


Umami is one of the basic taste

Basic taste	Typical taste substance	Example of food ingredient
Sweet	Sucrose	Sugar
Sour	Acetate	Vinegar
Salty	Sodium chloride	Salt
Bitter	Caffeine	Coffee
Umami	Glutamate	

What is Umami?

Facial expressions according to taste stimuli in newborn babies



(J. Steiner, et al., 1987)

Free Glutamate in Fish Sauce

	(mg/100ml)
Thailand	950
Vietnamese	1370
Chinese	828
Japanese	1383
Indonesian	727
Malaysian	948
Philippine	988

Fish sauce contains sodium and glutamate.
Glutamate contents are almost equivalent to 1% of MSG

Fish sauces in Ancient Greece and Rome

Ancient Greece: Garon

(mg/100ml)

Ancient Rome: Garum, Liquamen

- **Produced around the Mediterranean Coast and Black Sea**
- **Written evidence for fish sauce production 2,500 years ago**

Dr. Robert I. Curtis: U. Georgia, Professor of Classics

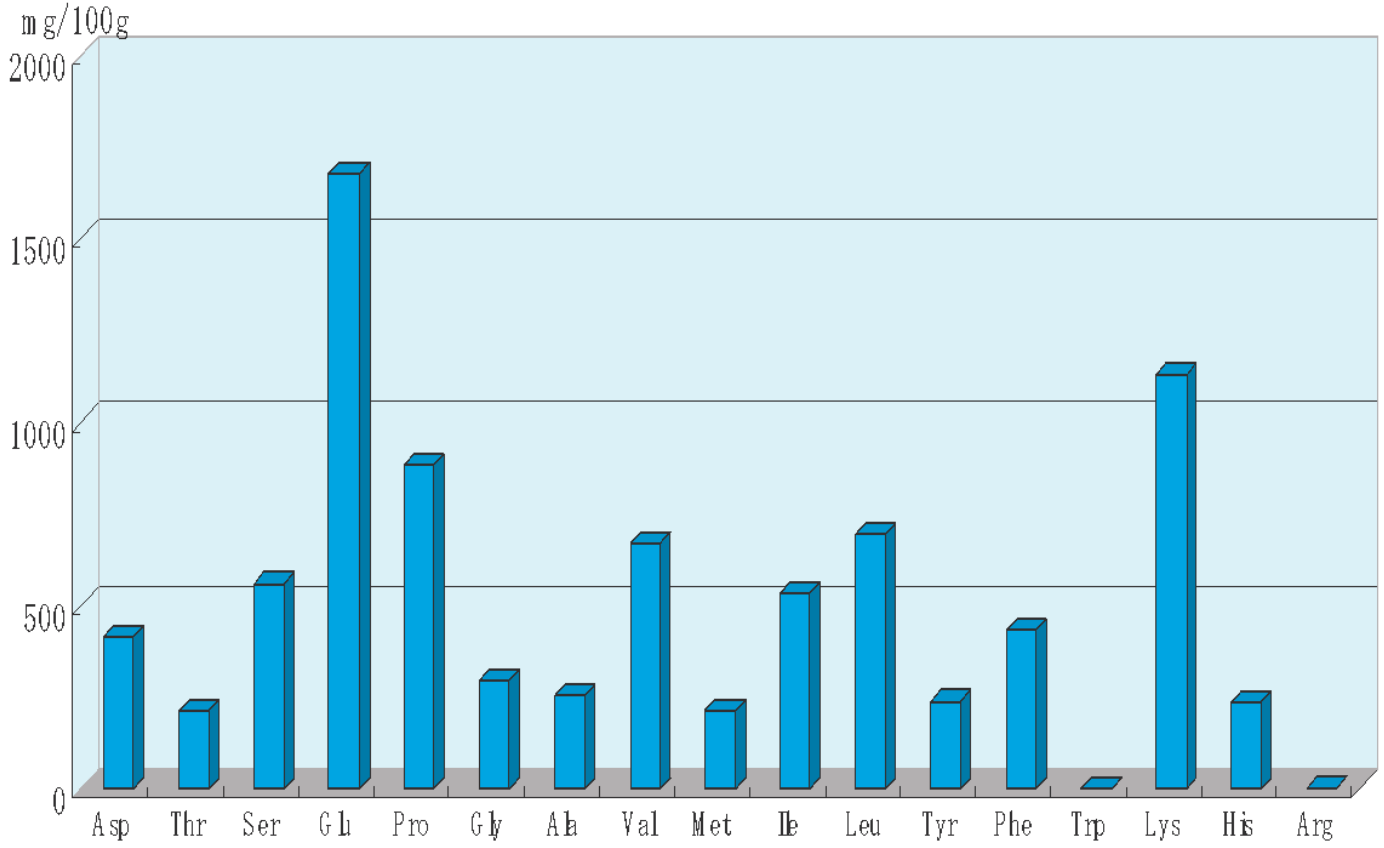
Garum and Salsamenta

Production and Commerce in Material Medica

Studies in Ancient Medicine, Pub: E. J. Brill 1991

Sites of Ancient Fish Sauce and Salted Fish Production

Free amino acids in Parmegiano Reggiano

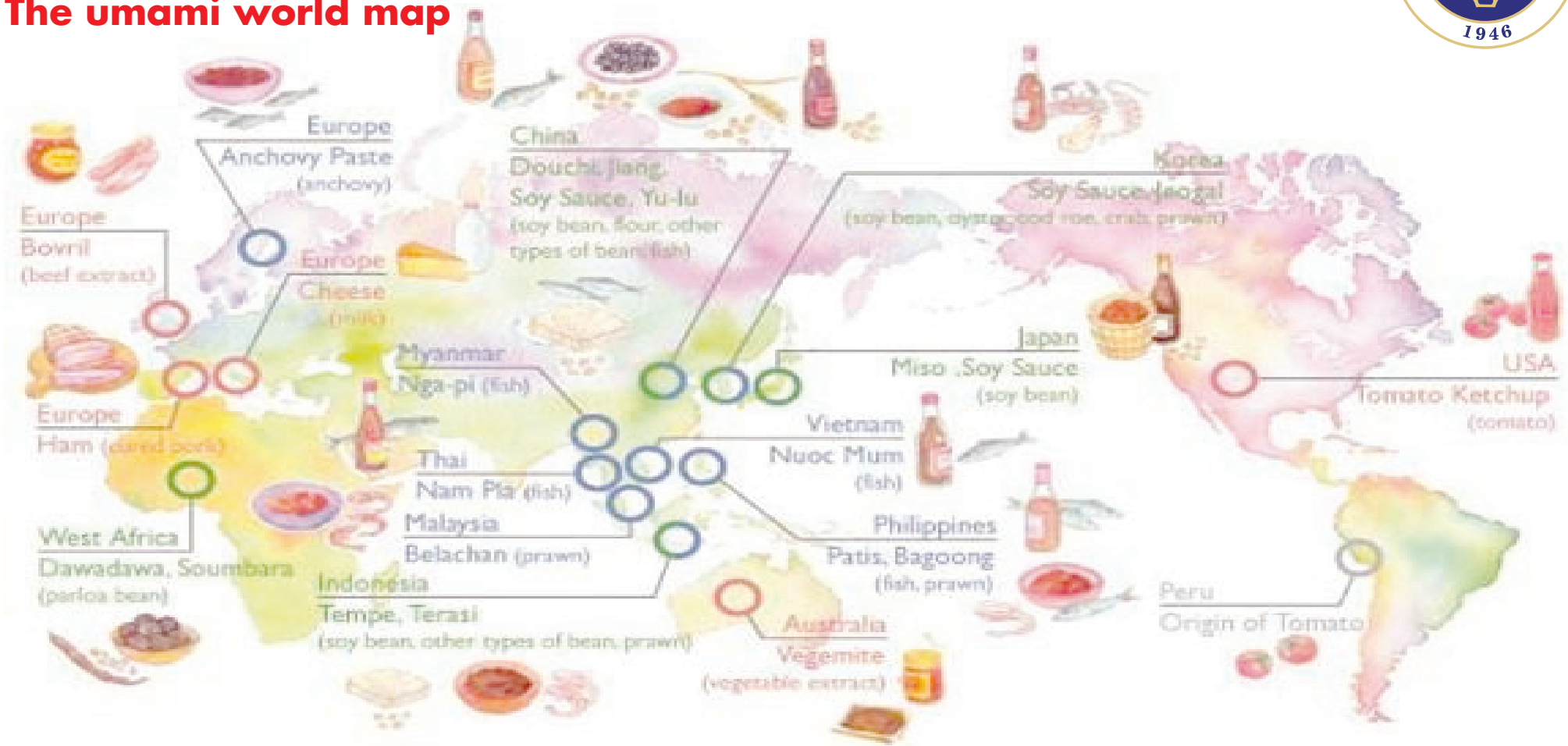


The history of the cheese in Italy goes back more than 1,000 years.

Glutamate content in Parmesan Cheese is equivalent to more than 1% of MSG

Umami Seasonings & Foods in the World

The umami world map



Umami food or seasoning made from fermented beans and/or grains. It is normally available in either paste or liquid form.

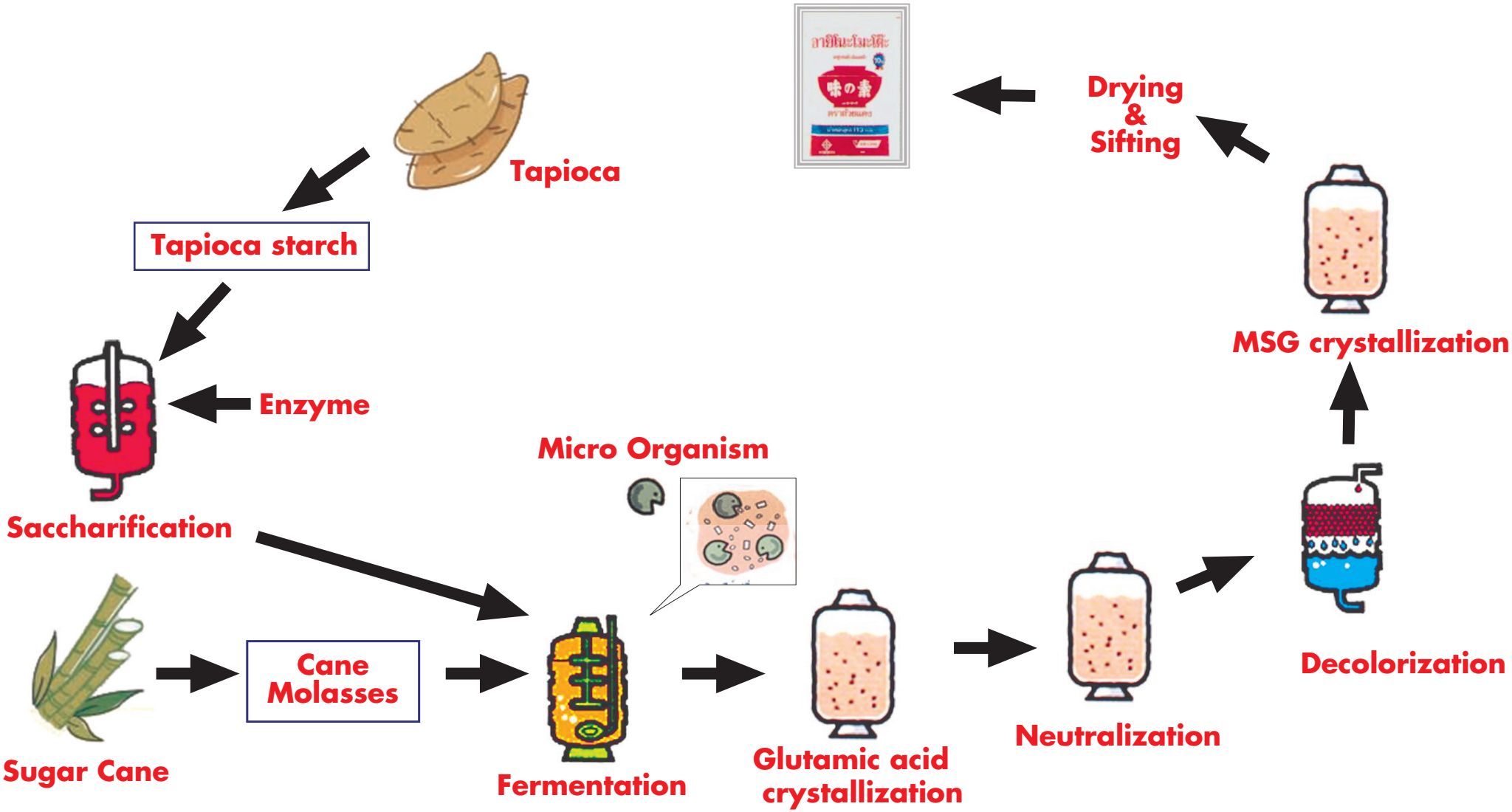
Umami seasoning made from fermented fish, prawns and / or other seafood. Available in either paste or liquid form.

Umami food made from other ingredients.

Brackets indicate ingredient(s) which deliver Umami.

Current Production Process of MSG

MSG is Produced by Fermentation



Usefulness of MSG

Umami increase the palatability of foods.
What is meant by palatability?

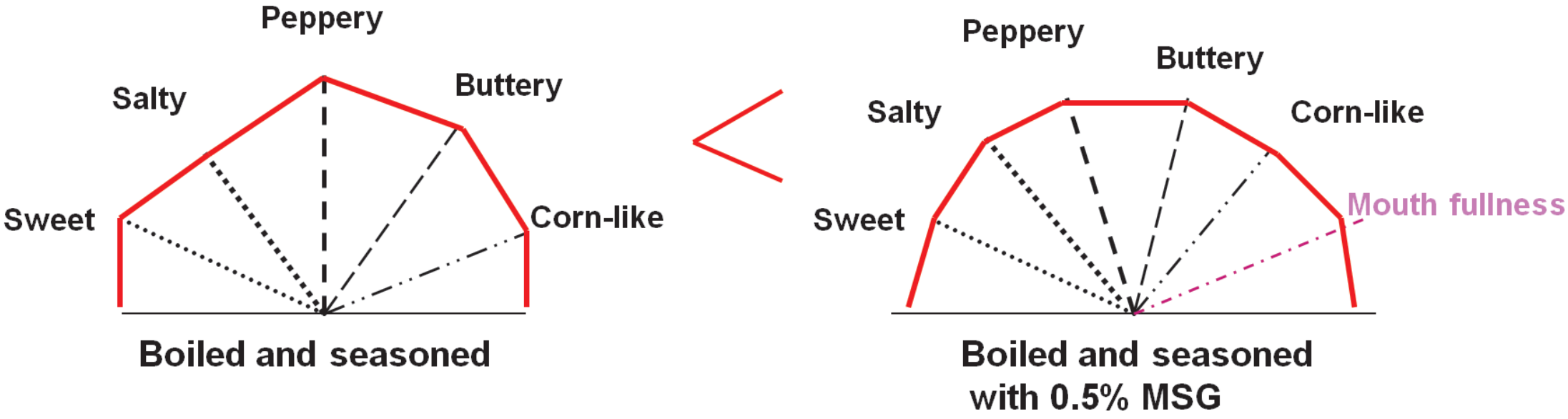
Key to flavor success is to produce a full-bodied blend of flavor sensations.

MSG promotes interest in food by

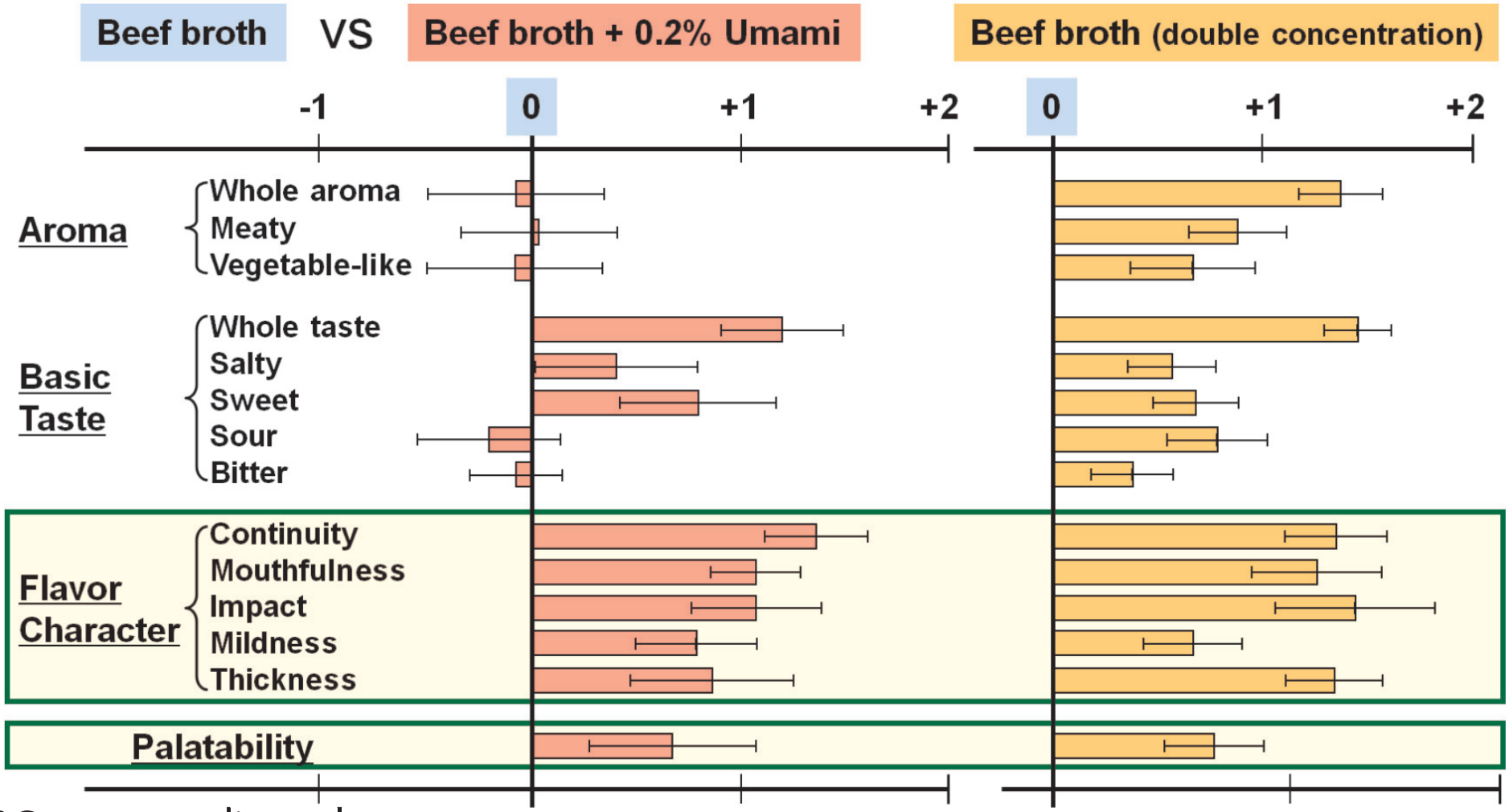
- blending flavor factor
- mouth satisfaction
- whetting the appetite

(S. E. Cairncross and L. B. Sjostrom, 1950; J. E. Caul, 1957)

Effect of MSG on flavor profile of boiled, seasoned summer squash



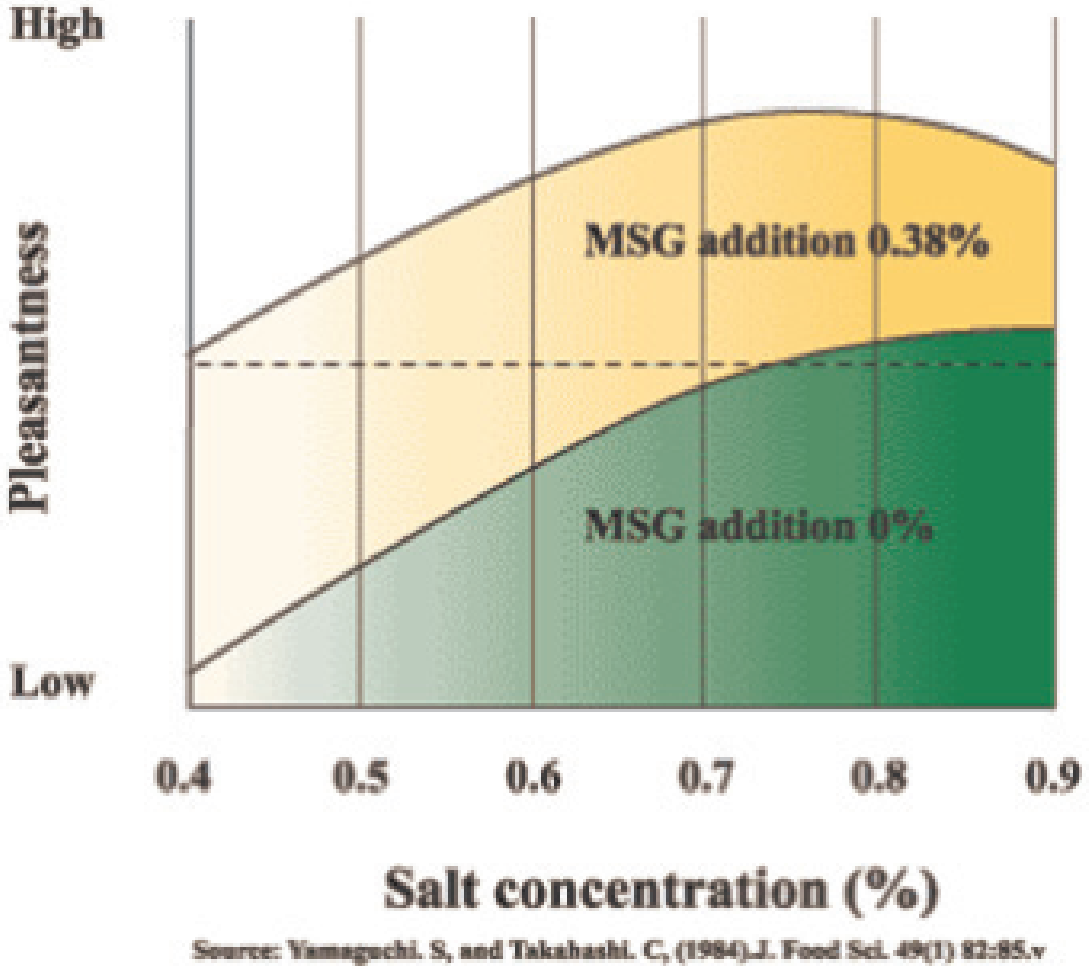
Flavor Enhance Effect on Foods



MSG: monosodium glutamate

Sodium Reduction by MSG

Relationship of MSG, Sodium and Pleasantness



Na in NaCL: 39.3%
Na in MSG: 12.3%
NaCL 0.75%:Na=0.30%
NaCL 0.40%:Na=0.16%
MSG 0.38%:Na=0.05%
Total Na=0.21%

0.21/0.30=0.70 70%

30% reduction of Na

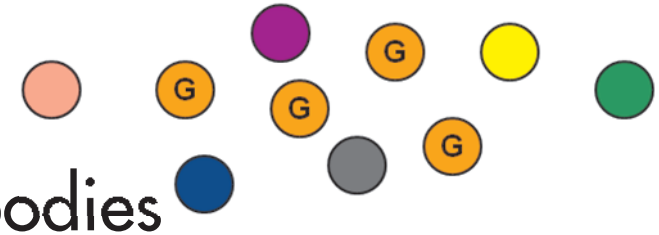
Bound glutamate

- Building block of protein

Around 10% of amino acids in protein

Free glutamate

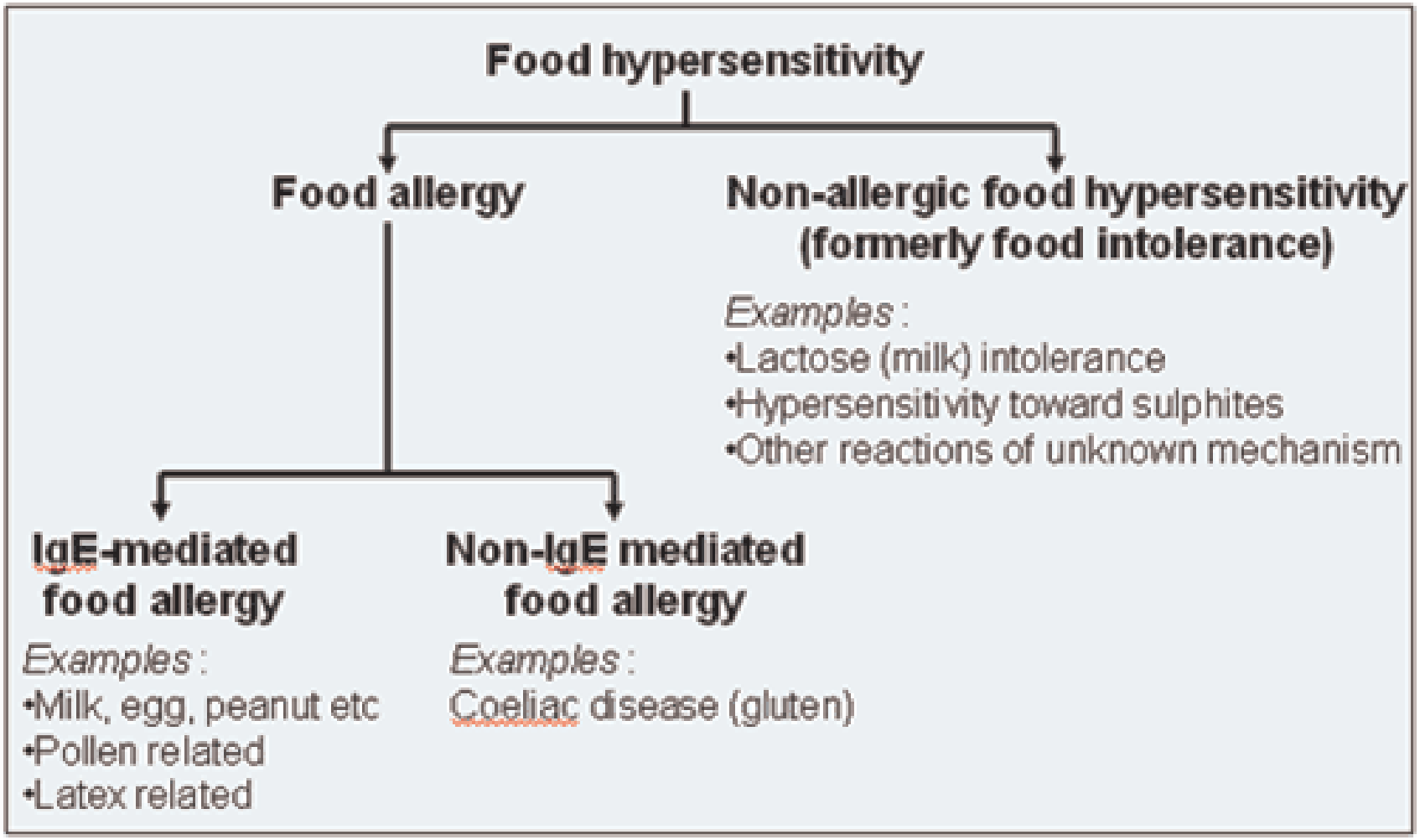
- Naturally exist in various tissues in living bodies
- Umami taste & enhance flavor of foods



Free glutamate in the organs of a normal adult

Muscles	6,000	mg
Brain	2,250	mg
Kidneys	680	mg
Liver	670	mg
Blood plasma	9,640	mg

Distinguish between Food Allergy and Food Intolerance



MSG is not food allergy

ALLERGEN

The following foods and ingredients are known to cause hypersensitivity and shall always be declared

Cereals containing gluten; i.e., wheat, rye, barley, oats, spelt or their hybridized strains and products of these;

Crustacea and products of these;

Eggs and egg products;

Fish and fish products;

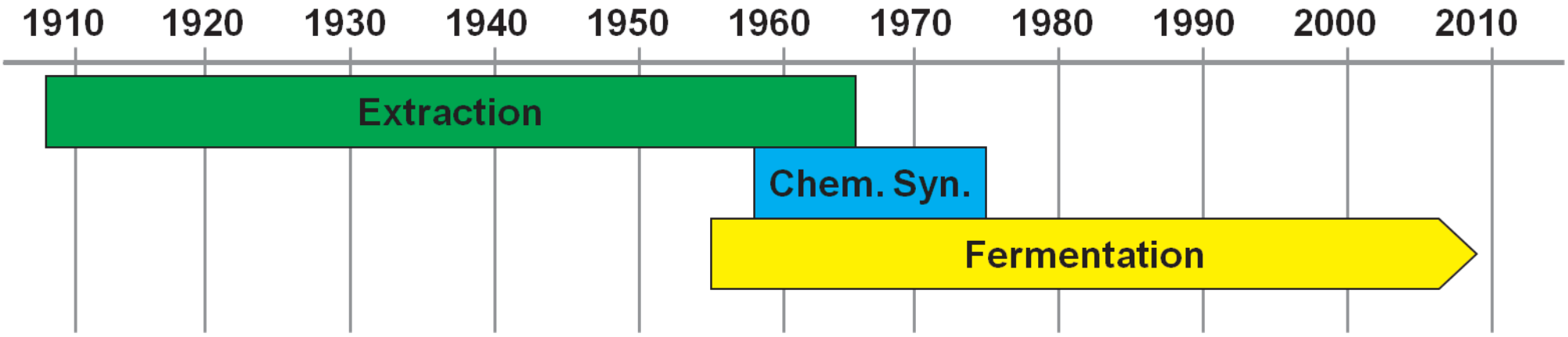
Peanuts, soybeans and products of these;

Milk and milk products (lactose included);

Tree nuts and nut products; and

Sulphite in concentrations of 10 mg/kg or more.

Evolution of MSG Production



Recent Estimated Demand of MSG in the World

Year	2005	2006	2007	2008	2009	2010	2011
Country/region	Estimated Demand (metric ton)						
Japan	102,000	101,000	100,000	99,000	100,000	98,000	98,000
Taiwan	30,000	30,000	30,000	30,000	30,000	30,000	32,000
Korea	62,000	45,000	45,000	35,000	35,000	35,000	48,000
Thailand	80,000	80,000	80,000	85,000	85,000	85,000	85,000
Malaysia	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Philippines	20,000	20,000	20,000	20,000	20,000	20,000	20,000
Indonesia	80,000	80,000	80,000	85,000	85,000	85,000	85,500
Vietnam	74,000	74,000	74,000	75,000	75,000	75,000	78,000
Other Asia	110,000	110,000	110,000	120,000	120,000	120,000	120,000
China	720,000	750,000	750,000	950,000	1,000,000	1,100,000	1,350,000
Whole Europe	90,000	90,000	90,000	80,000	80,000	80,000	80,000
North America/Canada	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Latin America	42,000	42,000	42,000	50,000	50,000	50,000	50,000
Africa	40,000	50,000	40,000	55,000	55,000	55,000	57,000
Others	50,000	50,000	50,000	86,000	96,000	97,000	97,000
Total	1,570,000	1,592,000	1,581,000	1,840,000	1,901,000	2,000,000	2,270,500

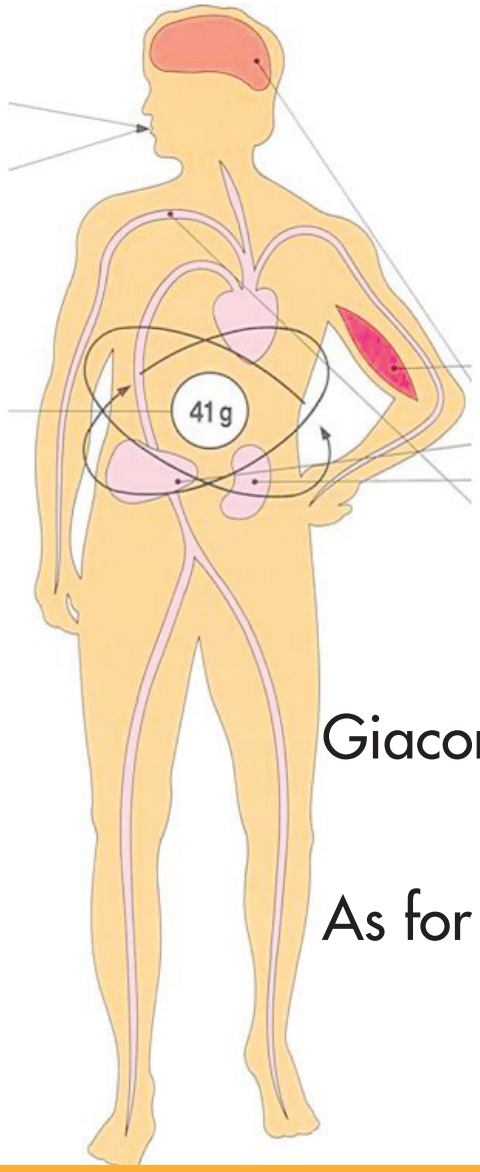
Shurui Shokuhinn Toukei Geppou (Alcoholic Beverage and Food Statistic Monthly Report) in Japan

GLUTAMATE IN HUMAN BODY

Food 17g

Turn Over

Food (bound + free)	17g
Food (free)	1g
MSG	0.5-3g
Total (bound + free) Glu in body	1400g
Free Glu in body	10g
Excretion	14g
Turn Over	41g



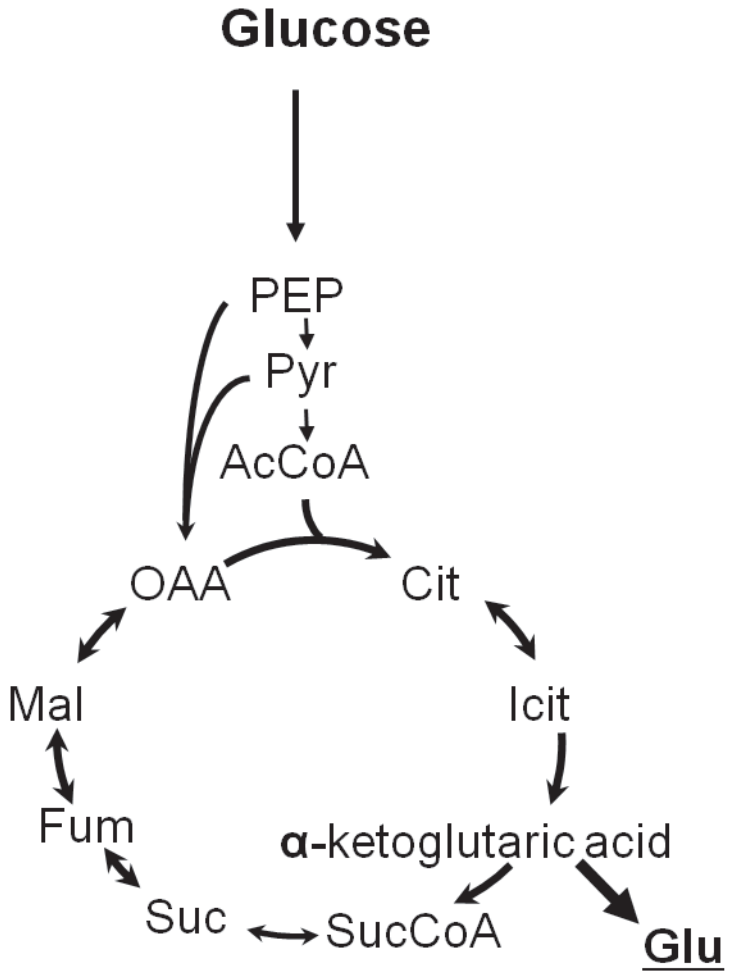
Free Glu	
Muscles	6.00g
Brain	2.25g
Liver	0.67g
Kidney	0.68g
Plasma	0.04g

Giacometti, Glutamic acid, 1979

As for 60kg body weight

Functions of glutamate

- Substrate for protein synthesis
- Precursor of glutamine
- N transport (muscle-glutamine; brain)
- Neurotransmitter (and g-aminobutyrate)
- Polyglutamate and cell signalling
- d-Carboxylation of glutamate
- Substrate for glutathione production
- Precursor of N-acetylglutamate
- Active sites of enzymes
- Inhibitor of glutaminase reaction
- Citric acid (TCA) cycle intermediate
- Energy source for some tissues (mucosa)



Dietary Glutamate is Extensively Metabolized by the Gut

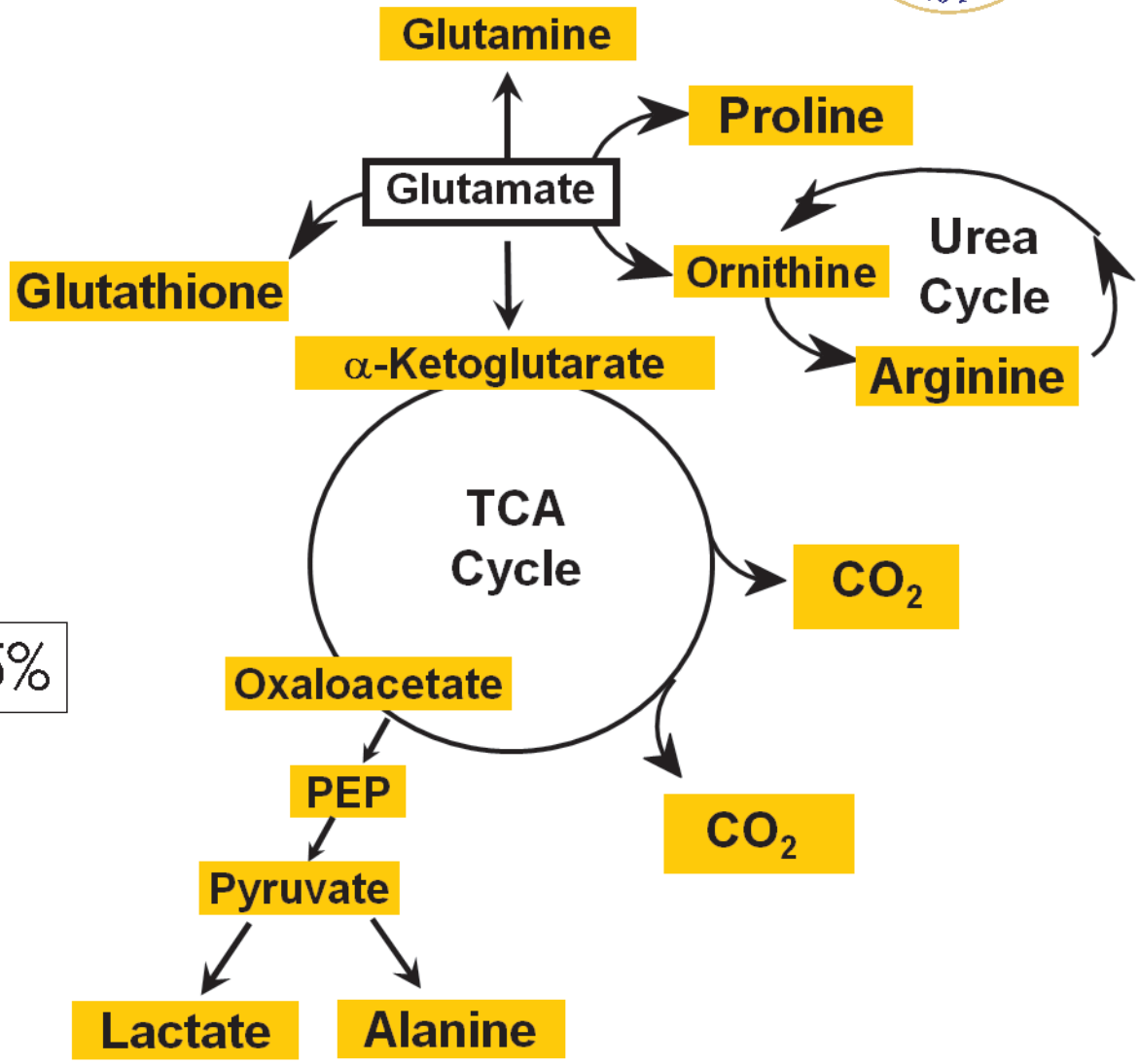
Absorption (Portal Vein) 4 %

Protein synthesis 10 %

Metabolism

Proline	5.6 %
Arginine	4.3 %
Glutathione	5.6 %
Alanine	5.2 %
Lactate	5.2 %
CO2	50.0 %

~75%



Stoll et al. Am J Physiol, 1999

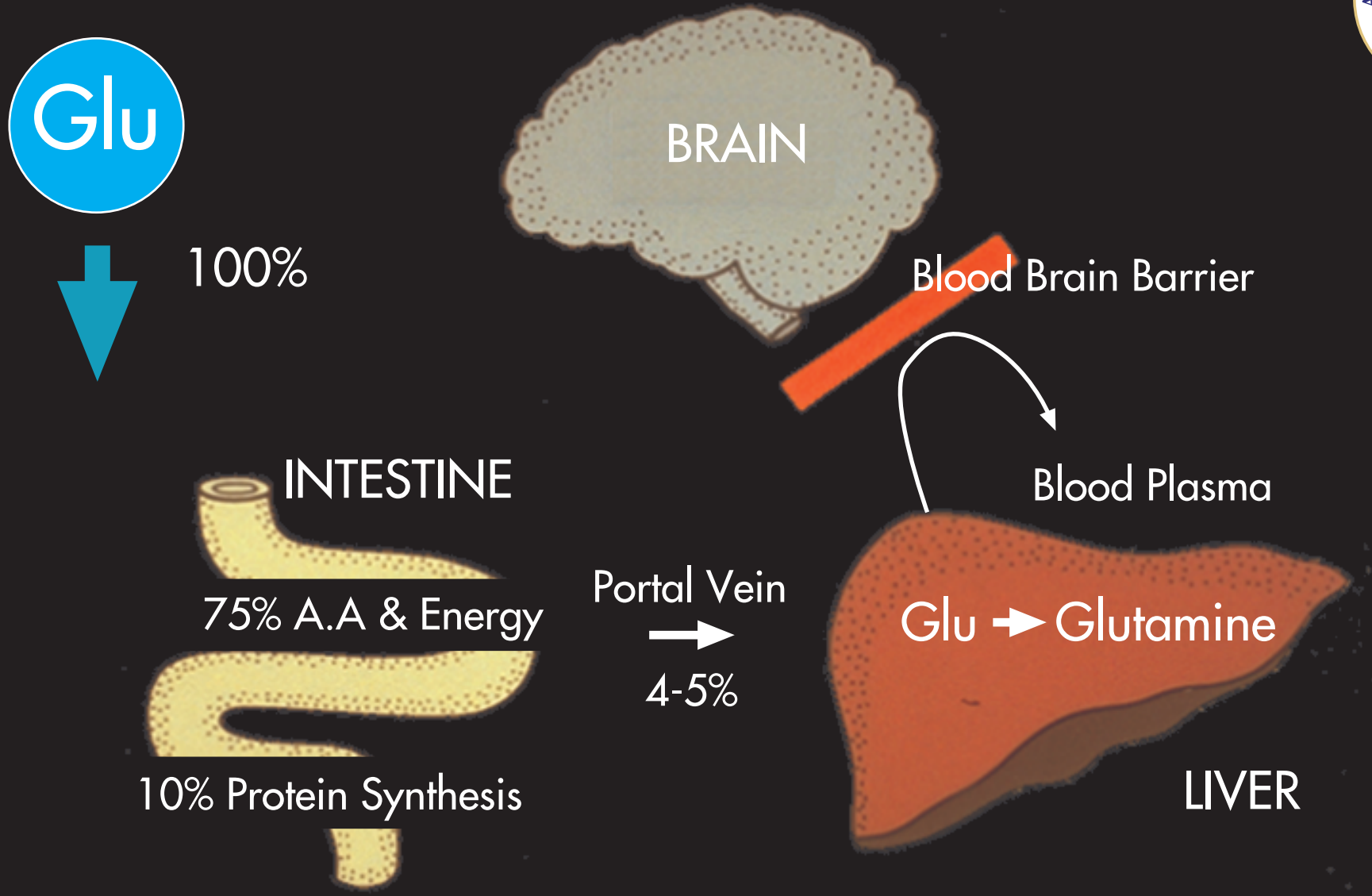
Role of dietary glutamate

- major energy source for the intestines, accounting for 50% of the energy consumed during digestion.
- specific precursor for the biosynthesis of glutathione, arginine and proline by small intestinal mucosa.
- about 95% of dietary glutamate presented to the mucosa was metabolized in fast pass.

Dietary glutamate has an important functional role in the gut.

(Reeds PJ. et al, J Nutri 2000;130:978S-982S)

Dietary Glutamate Regulation in Our Body



Prof. Dr. Nevzat Artık

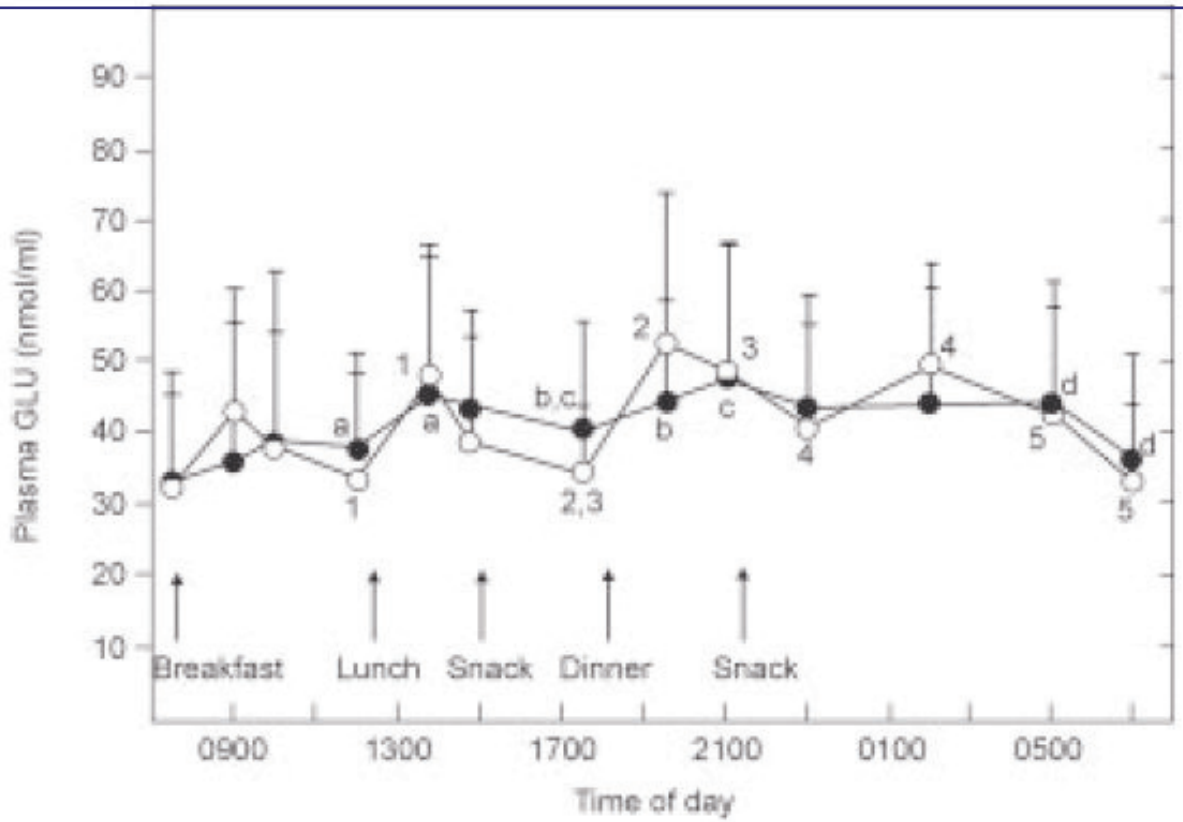
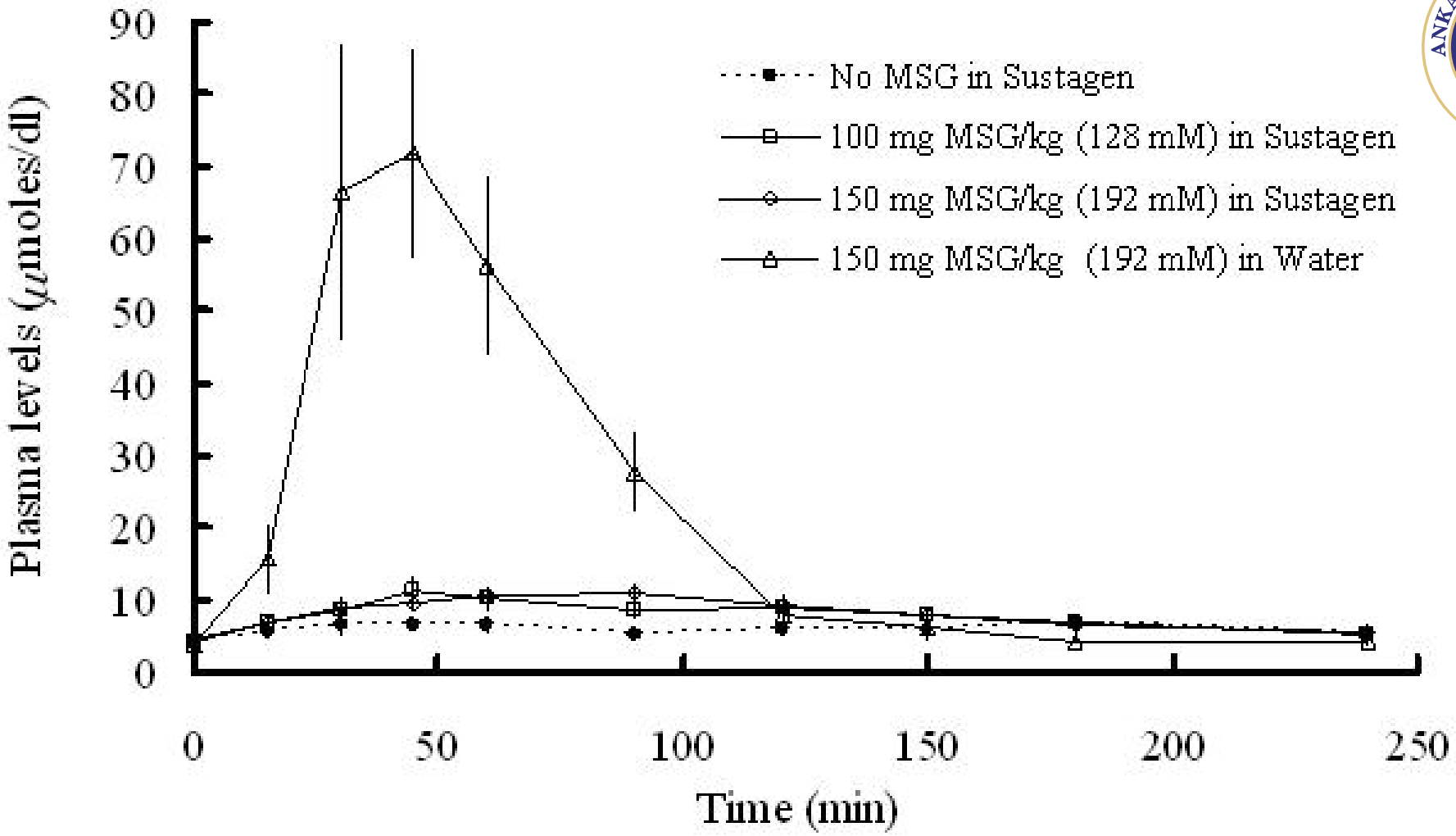


Fig. 3.1 Plasma glutamate concentrations over the 24-hr period in adult male subjects who have consumed a normal diet either containing or lacking added MSG. Data are means ± 1 std deviation ($n = 10$); the concentrations at different time points with different letters (no MSG added day, closed circles) or numbers (MSG added day, open circles) are significantly different ($P < 0.05$). Adapted from ref. 74.

2000 TSAI and HUANG. J Nutr 130 1002S-1004S.
Circadian variations in plasma and erythrocyte glutamate concentrations in adult men consuming a diet with and without added monosodium glutamate.



Comparison of plasma glutamate levels (mean ± SEM) in normal adult subjects ingesting MSG either dissolved in water or as part of a Sustagen meal.

Safety evaluation of Monosodium Glutamate (MSG) by the World Authorities

Prof. Dr. Nevzat Artık

1968 Kwok. New Eng J Med, Letter to Editor, Apr 4

Allegedly experienced symptoms after eating Chinese food.

Symptoms: burning, numbness, tight sensation

Candidate: cooking wine, MSG, High content of salt.

Called Chinese Restaurant Syndrome (CRS)

1968 H.H. Schaumburg & R. Byck, New Eng J Med, Letter to Editor, July 11,
"The Cause is MSG"

1969 H.H. Schaumberg et al. Science 163, 826.

Monosodium L-Glutamate: In Pharmacology and Role in the Chinese Restaurant Syndrome.

Open and double blind challenge but not consider taste.

"The Cause is MSG"

1970 Morselli and Garattini, Nature, 227, 611.

Monosodium L-glutamate and Chinese Restaurant Syndrome

Double-blind crossover challenge.

There is no evidence that CRS follows ingestion of MSG in a beef broth.

1972 Kenney and Tidball, Am. J. Clin. Nutr. 25 140-146.

Human susceptibility to oral monosodium L-glutamate

Placebo controlled study in 77 subjects.

Adverse reactions occurred after MSG ingestion but no classical CRS triad.

There was no correlation between the appearance of symptoms and blood glutamate concentrations.

1979 Kerr et al., J Am Dietetic Association 75, 29-33.

Survey of 3,222 people

43 % unpleasant symptoms after eating (not only MSG)

1.8 % "possible CRS"

0.19% symptoms associated with Chinese food

1980 Kenney, Lancet Feb 9. Letter to editor.

Symptoms were reported in response to coffee, spiced tomato juice and MSG. Since MSG was not unique in producing CRS like symptoms, it was proposed that "CRS" may be manifestation of esophageal irritation

1983 Vichai et al, Nutrition Reports Int'l. 28, 783-792.

Postprandial responses to Thai Food with and without added MSG

Addition of 3g MSG to an Thai food is not related to the CRS.

MSG and Chinese Restaurant Syndrome

1986 Kenney, Fd Chem Toxic 24, 351-354.

The Chinese Restaurant Syndrome, Anecdote Revisited

Double blind placebo controlled (DBPC) test by drink vehicle with a novel taste (taste mask)

4/6: Not react to either substance

2/6: Reacted to both 6 g MSG and placebo

1989 Chin et al., Fd Chem Toxic, 27, 283-287.

The Histamine content of oriental foods

Histamine in some foods may cause symptoms

1993 Tarasoff and Kelly, Fd Chem Toxic, 31, 1019-1035.

MSG: A double blind study and review.

Review of previous studies and 1.5, 3.0, 3.5 g DBPC cross over test by 71 subjects controlled MSG after taste.

Sensation did not occur at a significantly higher rate than did those elicited by placebo.

1993 Tarasoff and Kelly (cont.)

Table 1. Summary of literature on human responses to monosodium glutamate

Authors	No. of subjects	Dose (g)	Criticisms of protocol†
Ambos *et al.*, 1968	35	2–4 teaspoons	1,3,4,6,7?,8
Bazzano *et al.*, 1970	14	25–147/day	2,4,5,6,7?,8
Folkers *et al.*, 1984	27	4–6	1,3?,4?,6,7
Ghadimi *et al.*, 1971	14	0.025-0.25 g/kg body weight	1,3,4,5,6,7
Gore and Salmon, 1980	55	1.5–6.0	1,3,4,6,7,8
Hsu and Huang, 1986	15	0.1 g/kg body weight	1,2,4,5,6,7?
Kenney, 1974	13/77*	5	3,4,6,7,8,9
Kenney, 1979			
experiment A	11/47*	1–6	1,3,4,6,7,8,9
experiment B	16/57*	6	1,3?,4?,6,8,9
Kenney, 1980	60	4	1,2,4,6,7?,8
Kenney, 1986	6	6.0	1,3?,4?,5,6,7,8
Kenney and Tidball, 1972	22/77*	1–5	1,3,4,6,7,8,9
Morselli and Garattini, 1970	26	3	3,4,6,7,8
Rosenblum *et al.*, 1971	99	5–12	1,3,4,6,7,8
Schaumburg *et al.*, 1969	56	1.5–20	1,2,4,6,7?,8
Tanphaichitr *et al.*, 1983	50	3.0	3,4,6,7
Tanphaichitr *et al.*, 1985	12	2.8/day	3,4,5,6,7
Tarasoff and Kelly, 1990	41	0.1 g/kg body weight	1
Wilkin and Richmond, 1986	24	3.0–18.5	1,2,4,6,7
Zanda *et al.*, 1973	73	3	3,4,6,7

*The authors screened a group of subjects (denominator) and proceeded with sensitive subjects (numerator).

†1 = Solid food not used; 2 = no placebo used; 3 = inadequate placebo used; 3? = adequacy of placebo unclear; 4 = not double-blind; 4? = double-blind integrity unclear; 5 = insufficient sample size; 6 = adequate or inappropriate statistical analysis of subjective symptoms; 7 = symptom suggestion overwhelmed experimental design; 7? = symptom suggestion unclear; 8 = detail needed to calculate dose of monosodium glutamate per kg body weight not supplied; 9 = subjects 'trained' with repeated monosodium glutamate treatments.

Review identified the strong taste of MSG as the factor invalidating most "blind" and "double-blind" claims of previous researchers.

CRS is an anecdote applied to a variety of postprandial illnesses; rigorous and realistic scientific evidence linking the syndrome to MSG could not be found.

1999 Yang et al., J Allergy Clin Immunol 99 757-762.

1.25, 2.5, 5 g DBPC. 61 self-identified MSG sensitive subjects.

No significant difference in reaction rate between placebo and 5 g MSG.

Headache, muscle tightness, numbness/tingling,

general weakness and flushing more frequently occurred MSG than placebo.

2000 Prawirohardjono et al., J. Nutri 130, 1074S-1076S.

Indonesian subjects reporting no sensitivity to MSG.

Double-blind, randomized, crossover and placebo-controlled trial.

1.5g and 3.0g MSG and placebo.

No significant differences in adverse events between placebo and MSG.

2000 Geha et al. J Allergy Clin Immunol. 106 973-980.

Multicenter, Double-blind placebo-controlled multiple-challenge evaluation of reported reaction to MSG.

Method:

In 3 of 4 protocols (A, B, and C), MSG was administered without food.

A positive response was scored if the subject reported 2 or more symptoms from a list of 10 symptoms reported to occur after ingestion of MSG-containing foods within 2 hours.

In protocol A 130 self-selected reportedly MSG-reactive volunteers were challenged with 5 g of MSG and with placebo on separate days (days 1 and 2).

Of the 86 subjects who reacted to MSG, placebo, or both in protocol A, 69 completed protocol B to determine whether the response was consistent and dose dependent.

To further examine the consistency and reproducibility of reactions to MSG, 12 of the 19 subjects who responded to 5 g of MSG but not to placebo in both protocols A and B were given, in protocol C, 2 challenges, each consisting of 5 g of MSG versus placebo.

MSG and Chinese Restaurant Syndrome

Results:

1. Of 130 subjects in protocol A, 50 (38.5%) responded to MSG only, 17 (13.1%) responded to placebo only ($P < .05$), and 19 (14.6%) responded to both.
2. Challenge with increasing doses of MSG in protocol B was associated with increased response rates.
3. Only half ($n = 19$) of 37 subjects who reacted to 5 g of MSG but not placebo in protocol A reacted similarly in protocol B, suggesting inconsistency in the response.
4. Two of the 19 subjects responded in both challenges to MSG but not placebo in protocol C; however, their symptoms were not reproducible in protocols A through C.
5. These 2 subjects were challenged in protocol D 3 times with placebo and 3 times with 5 g of MSG in the presence of food. Both responded to only one of the MSG challenges in protocol D.

MSG and Chinese Restaurant Syndrome

Conclusion:

1. "The results suggest that large doses of MSG given without food may elicit more symptoms than a placebo in individuals who believe that they react adversely to MSG.
2. However, neither persistent nor serious effects from MSG ingestion are observed, and the responses were not consistent on retesting.
3. The responses were not observed when MSG was given with food "

No causative link between MSG and CRS was found.

The study results showed that although a minor sub-group of otherwise healthy individuals may react to exceedingly high doses (>3.0g) of MSG applied in capsules on empty stomach.

Those effects were inconsistent, not serious and not occurred when MSG was ingested with food.

At the present level of knowledge, food-added MSG does not represent a significant risk factor in food intolerances

MSG and Asthma

1981 Allen and Baker, N Engl J Med. Letter to editor, Nov. 4 1154-1155.

Monosodium L-Glutamate – Chinese Restaurant Asthma

Asthma attacks could be provoked by ingesting 2.5 g MSG

1987 Allen et al. J Allergy Clin Immunol. 80, 530–537.

Monosodium L-glutamate-induced asthma 32 subjects, including two subjects who were the subject of the original case report.

Of the 32 subjects, 14 have a history of asthmatic attacks after consuming a Chinese meal, 18 have unstable asthma and a reported sensitivity to other chemicals.

Single blind oral challenges with MSG (0.5, 1.5, and 2.5g in capsules) followed by peak expiratory flow (PEF) measurements for 12 hours after each challenge.

13 subjects were concluded to have experienced an MSG-induced asthma attack.

Above studies have been criticised for a variety of reasons as follows;

Single blind, rather than a double blind protocol.

MSG and Asthma

Inadequate procedures for establishing baseline and control data.
Use of effort-dependent PEF which can be influenced by subject bias.
Cessation of anti-inflammatory and bronchodilator medications just prior to the challenge sequence making it hard to judge whether an asthmatic attack is due to the challenge substance rather than simply a result of the withdrawal of therapy.
No measurements of immunologic inflammatory markers or changes in airway responsiveness were taken.

1998 Woods et al. J Allergy Clin Immunol. 101 762-71

The effects of monosodium glutamate in adults with asthma who perceive themselves to be monosodium glutamate-intolerant
A DBPC crossover study (n=12), 1 and 5g MSG; No significant effect of MSG on lung function at either dose, relative to placebo.

1999 Woessner et al. J Allergy Clin Immunol. 104 305-310.
Monosodium glutamate sensitivity in asthma
Subjects who reported sensitivity to GLU showed no difference in response to placebo and MSG.

2009 Williams and Woessner Clin Experimental Allergy, 39 640-646.
Monosodium glutamate 'allergy': menace or myth?
This review prevents a critical review of the available literature related to the possible role of MSG in the so-called 'Chinese restaurant syndrome' and in eliciting asthmatic bronchospasm, urticaria, angio-oedema, and rhinitis.
Despite concerns raised by early reports, decades of research have failed to demonstrate a clear and consistent relationship between MSG ingestion and the development of these conditions.

MSG and Brain Damage

1969 Olney, Science, 164 719-721.

Brain lesions, obesity, and other disturbances in mice treated with monosodium glutamate.
High doses of MSG may adversely affect brain function.
MSG-induced brain lesions/force-feeding or injection in neonatal mice

MSG dosage 0.5 – 4.0 g / kg of body weight
(Corresponds to 30 - 240 g/60 kg)

1978 Takasaki et al. Toxicology. 9 307-318.

Studies on brain lesions after administration of monosodium L-glutamate to mice. II. Absence of brain damage following administration of monosodium L-glutamate in the diet.

1979 Takasaki et al. Glutamic acid. pp. 255-275, Raven Press, New York.

Toxicological studies of monosodium L-glutamate in rodents:
Relationship between routes of administration and neurotoxicity.
MSG in the diet does not cause any acute or long-range adverse effect on the brain.

MSG and Brain Damage

1979 Pardridge, Glutamic acid, pp. 125-137.
Dietary glutamate does not enter the brain blood-brain barrier.

1994 Fernstrom, J. Am. Diet. Assoc. 94 71-77.
Dietary amino acids and brain function
Dietary glutamate does not present a risk to normal brain function.

2000 Smith, J. Nutri 130 1016S-1022S
Transport of Glutamate and Other Amino Acids at the Blood-Brain Barrier
Brain glutamate is independently kept constant from the circulatory system.

2000 Walker and Lupien J. Nutri 130 1049S-1052S
The Safety Evaluation of Monosodium Glutamate
The mouse appeared to be the most sensitive species, and there were significant differences with age and maturity, the neonate was particularly sensitive.
Notably, most of the studies in primates were negative.

1979 Baker et al, Glutamic acid. pp. 111-124.

Factors influencing dicarboxylic amino acid content of human milk

Human milk contains large amounts of glutamate.

The total glutamate content (free and protein-bound) in human milk is up to 230.0 mg/dL. The free glutamate intake per day of a breast fed infant is about 36 mg/kg body weight (equivalent to 46 mg/kg body weight of MSG) while the intake of protein bound glutamate is approximately 357 mg/kg body weight. Human infants ingest more glutamate than human adults on a per body weight.

1980 Tung and Tung, Nutrition Reports International, 22, 431-443.

Serum free amino acid levels after oral glutamate intake in infant and adult humans.

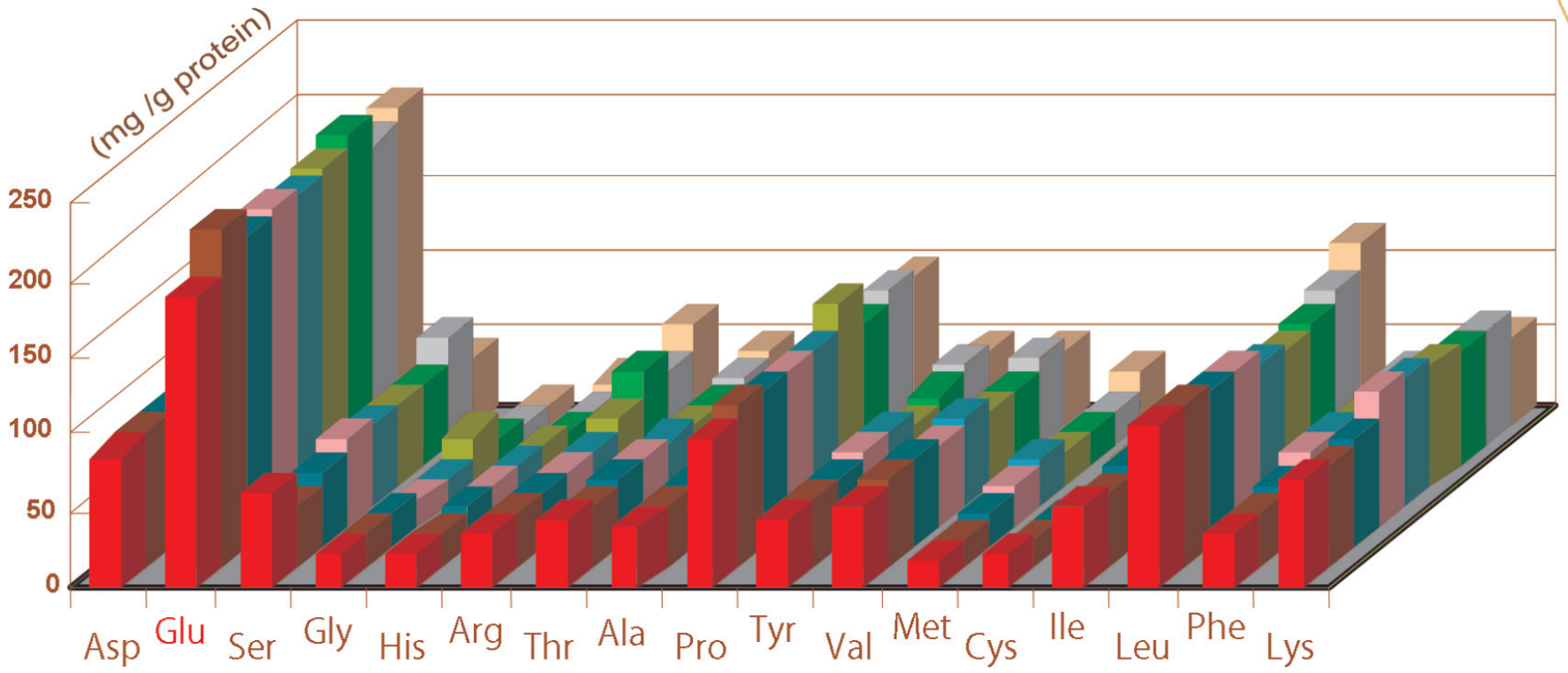
Human infants, including the premature, clearly had the ability to metabolize large amounts of glutamate added to infant formula.

1986 Stegink et al, Pediatr. Res., 20 (1), 53-58.
Plasma glutamate concentration in 1 year old infants and adults ingesting monosodium L-glutamate in consomme.
The elevation of plasma glutamate levels did not differ between infants and adults when MSG was administered orally in a consomme containing very little carbohydrate.

1987 JECFA arrived at the conclusion of "ADI not specified" and noted that "In view of the finding that infants metabolize MSG in a similar way to adults, no additional hazard to infants was indicated".

MSG is a safe food additive in adults as well as in infants.

Total Amino Acids in Mother's Milk

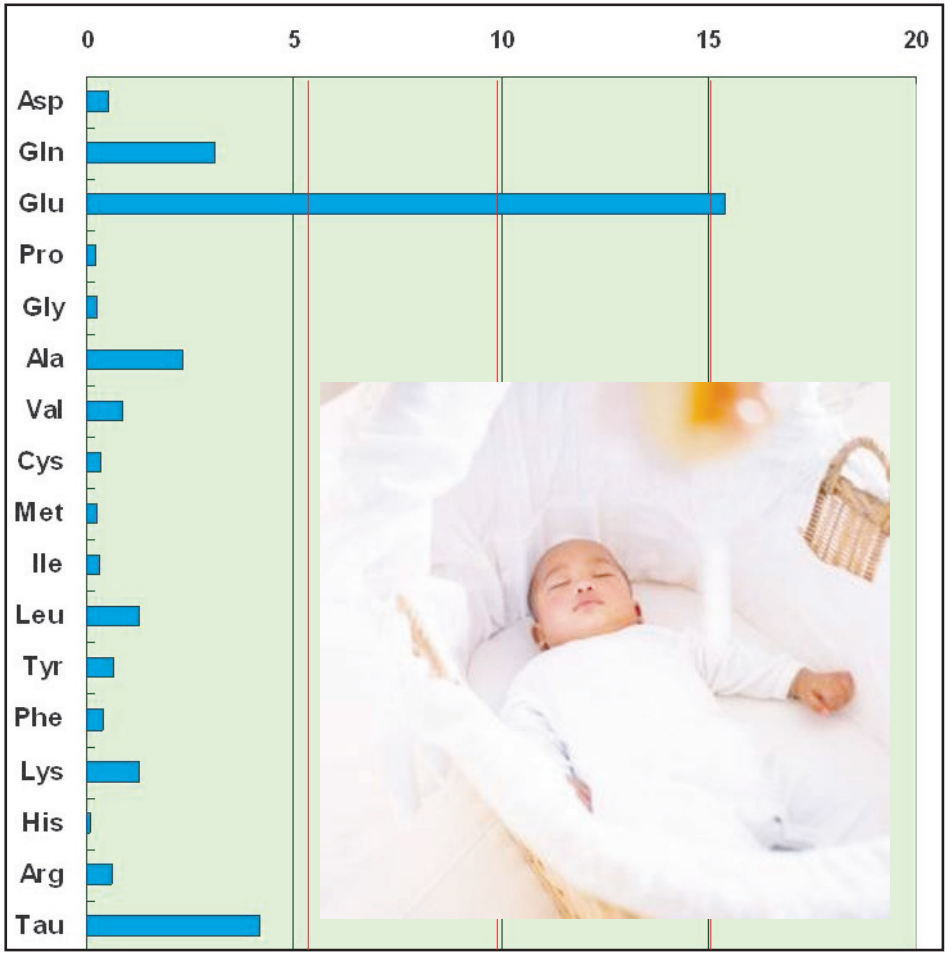


Human
Chimpanzee
Gorrila
Cow
Sheep
Pig
Horse
Elephant
Cat

Davis *et al*, *J. Nutr*. 124: 1126-1132, 1994

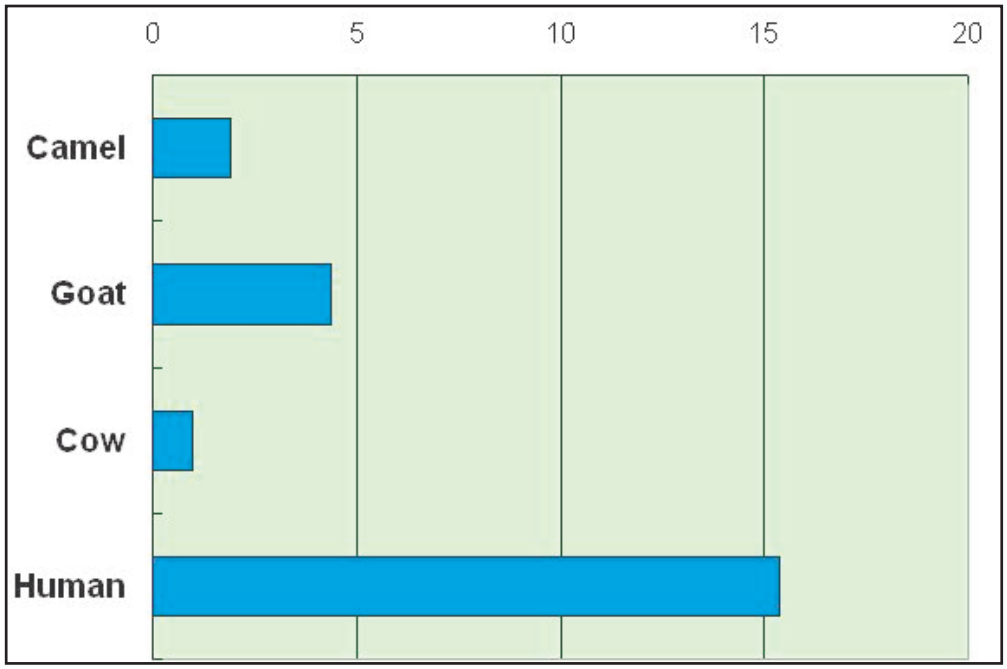
Glutamate Contents in Breast Milk

Free amino acids in human breast milk



(M. A. Mehaia et al., 1992)

Glutamate in breast milk



(M. A. Mehaia et al., 1992)

Free Glutamate in Milk and Formula

Free Glutamate	mg/100 mL	Reference
Human Milk	14.5 – 31.7	Sarwar et al., 1998 Harzer et al., 1984
Chimpanzee Milk	37.2	Sarwar et al., 1998
Rhesus monkey Milk	6.2	Sarwar et al., 1998
Bovine Milk	5.1	Mehaia and Al-Kanhal, 1992
Milk-Based Formulas	1.3	IFT, 1987
Hydrolysate Formulas	440	Hernell and Lonnerdal, 2003

MSG and Fetus

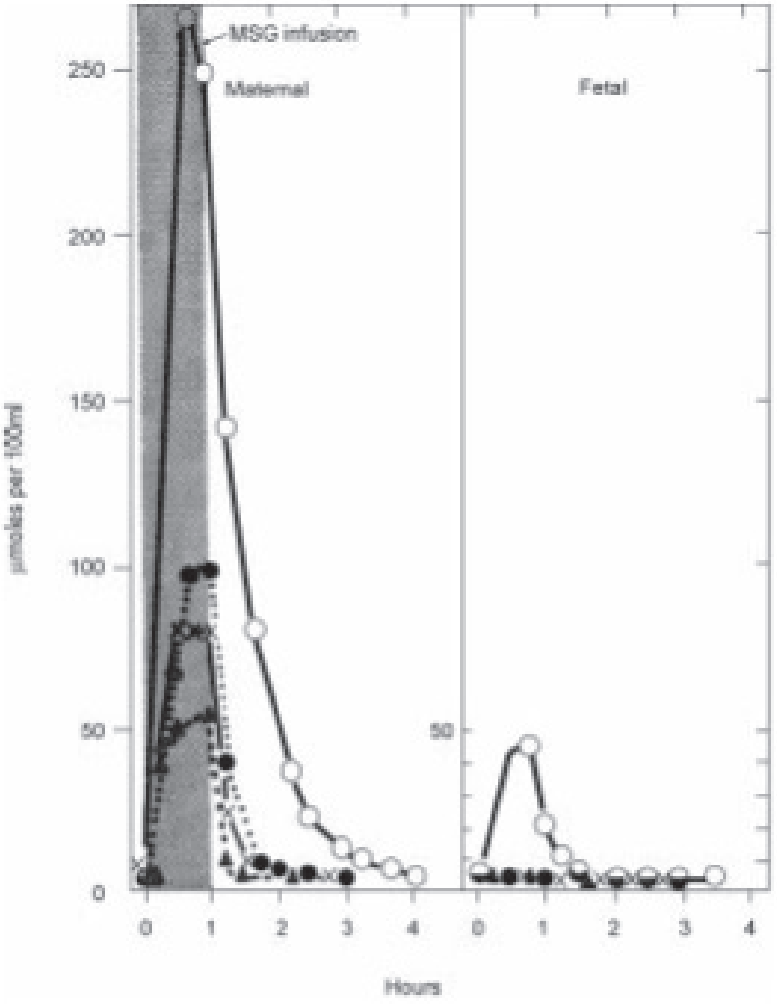


Fig. 3.4 Fetal plasma glutamate response to the intravenous infusion of glutamate into the maternal circulation. The glutamate doses were: ▲, 150 mg/kg; X, 170–190 mg/kg (mean of two animals); ●, 220 mg/kg; ○, 400 mg/kg. Figure reproduced from the *American Journal of Obstetrics and Gynecology*, 122 (1): 70–78, Stegink LD, 1975 with permission from Elsevier.

1975 Stegink et al., Am J Obstet Gynecol, 122 70-78. Placental transfer of glutamate and its metabolites in the primate.

The primate placenta is virtually impermeable to glutamate unless extreme elevation of plasma glutamate are induced

MSG and Fetus

2000 FC. Battaglia, J Nutr, 130 974S-977S.

Glutamine and Glutamate Exchange between the Fetal Liver and the Placenta.

Placenta utilizes glutamate as an important source of energy. The placenta is said to account for up to 60% of the fetal glutamate disposal rate. The fetal liver has been identified as the key provider of glutmate, although the placenta is fully capable of utilizing maternal-derived glutamate as well.

"Neither the fetus nor the suckling infants are at risk from maternal ingestion of glutamate" (JECFA 1973)

MSG and Cancer

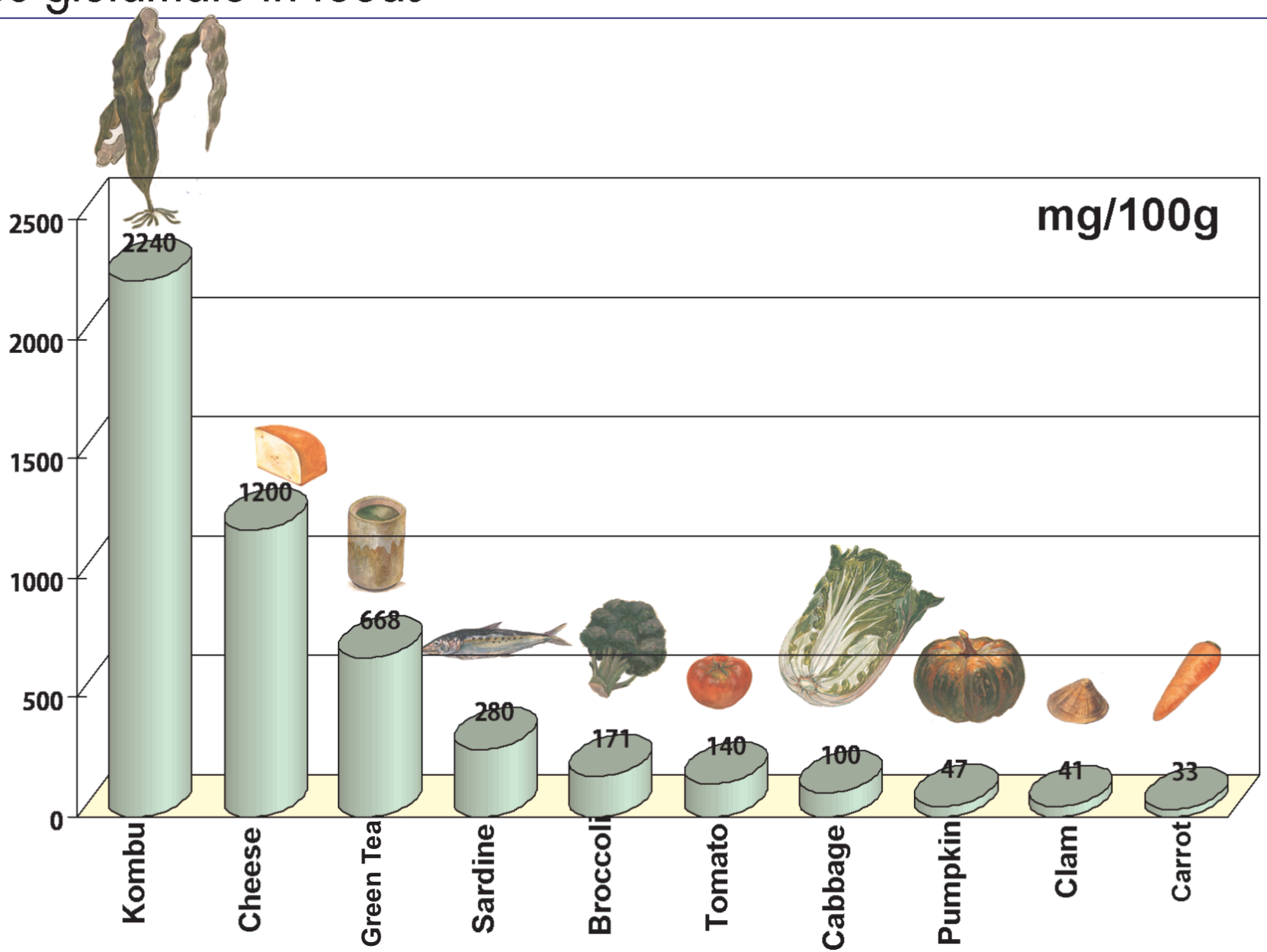
MSG is sodium salt of glutamic acid and glutamic acid is one of the most abundant amino acids found in nature. Glutamic acid is produced in our body and play an essential role.

Numerous studies confirmed that MSG had no significant carcinogenic effect on any organ and tissue.

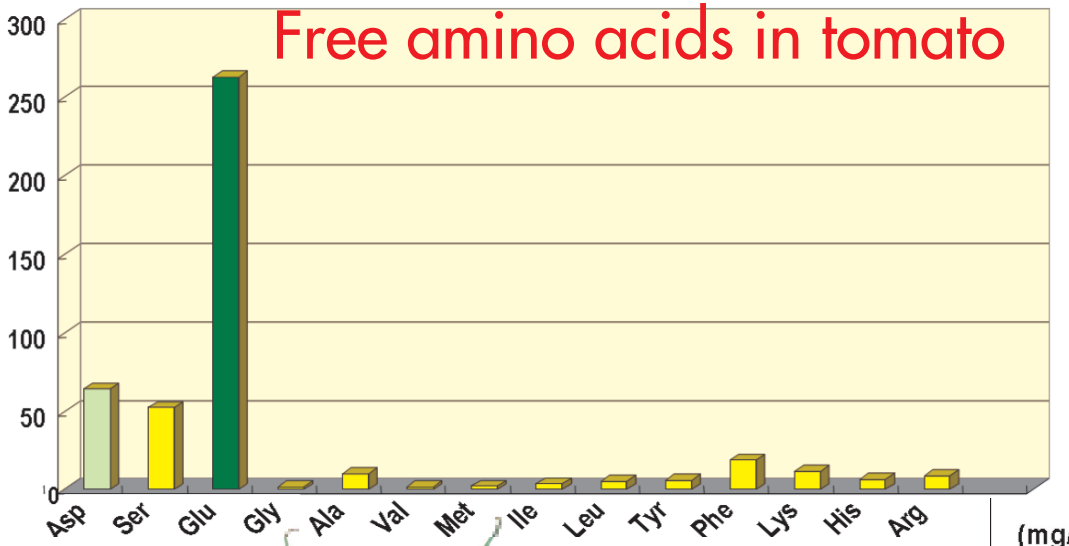
1995 Shibata et al, Food Chem Toxic 33 383-391.
Lack of carcinogenicity of MSG in Fischer 344 Rats.

MSG dose not cause cancer

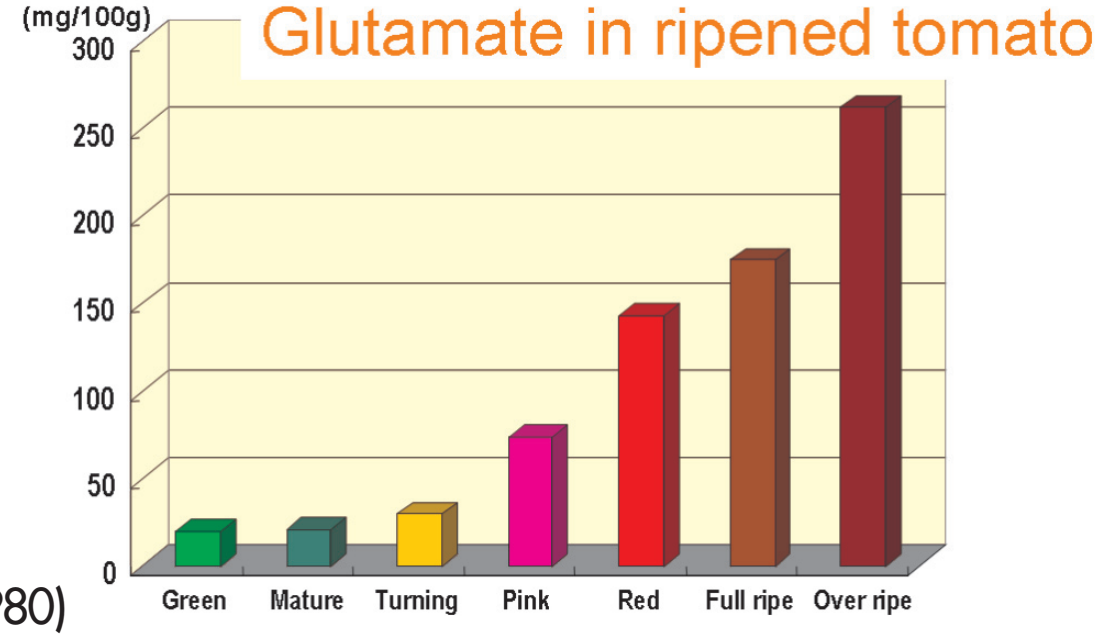
Free glutamate in foods



Free Glutamate in Tomato



(A. Inaba et al., 1980)



Free Glutamate in Tomato Products (mg/100g)

Tomato paste (commercial canned)	758[a]
Tomato	140[b]
Fresh tomato juice	260[b]
Processed tomato juice	230[b]
Whole tomato	246[c]
Dried tomato	648[c]
Tomato sauce	134[d]

aUnpublished data, bGiacometti Glutamic Acid 1979, cNinomiya Food Reviews Intl 1998, dKhairunnisak Food Addit Contam 2009.

A commercial canned tomato paste contains 0.76% (w/w) of glutamate corresponding to 0.97% (w/w) of MSG.

Discovery of Umami

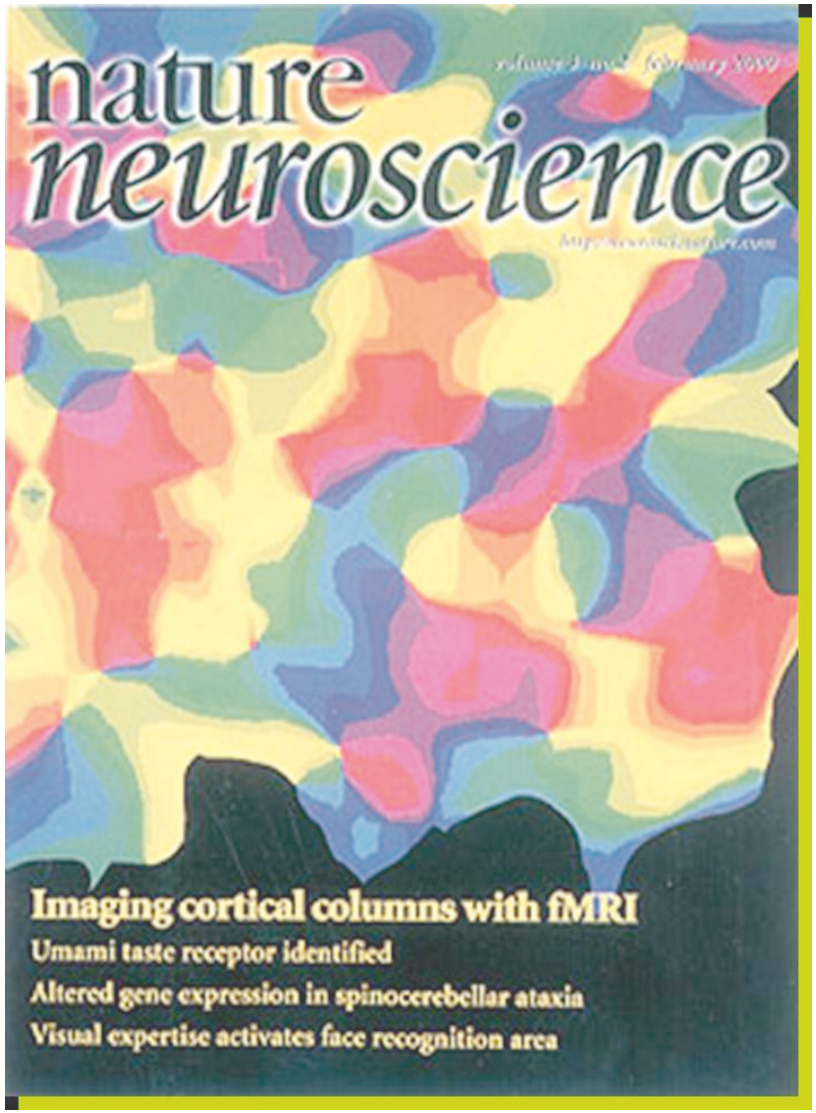
Dr. Kikunae Ikeda, assistant professor of Tokyo Imperial University in Japan studied in Germany from 1899 for two years.

- Interested in taste of western foods.
- Impressed at the physique of westerners.
- Felt necessity for the improvement of nutritional status of Japanese

At that time, scientists believed there were only four basic tastes. However Dr. Ikeda felt that there might be a unique taste different from the other four basic tastes.

In 1908, Prof. Dr. Ikeda discovered **glutamate** is the key component to the taste of traditional Japanese soup stock made from seaweed (Konbu).He named taste of **glutamate "umami"**

Discovery of Umami Receptors



2000 t-mGluR4

2000 T1R1/T1R3

2006 mGluR1

Discovery of umami receptors on taste buds is final proof that umami is really a physiological basic taste

Good taste promotes digestion.

"Food and digestion" by Dr. Hiizu Miyake

Ikeda was inspired by Dr. Miyake's essay to make

a new seasoning which enable people to eat food tasty.

He found MSG is the ideal substance for a seasoning

He got patent right of the production method of MSG by the extraction from Hydrolyzed Vegetable Protein

1908 Discovery of umami

Daily Intake of Monosodium Glutamate

Country	Intake of MSG (Mean, g)	Remarks	Reference
USA	0.55	< 1.3g (99th percentile)	Committee on GRAS List Survey, 1979
Netherlands	0.66	Max. 0.99g	Van Dokkum, 1982
Thailand	1.5		Pothisiri, 1983
Japan	2.41	1.9g (as glutamic acid)	Ministry of Health, Labour and Welfare, 2000
Indonesia	0.6	1.0g (for adults) 0.2g (for children)	Muhilal, 1986
Korea	1.57	< 4.57g (96.6%)	Lee, 1986
Malaysia	0.37	< 3.0g (99.2%)	Survey Research Malaysia Sdn Bhd., 1986
UK	0.55	< 2.33g (97.5%)	Rhodes et al., 1991

Safety evaluation of Monosodium Glutamate (MSG) by the World Authorities

Prof. Dr. Nevzat Artık

Safety Evaluation by the World Authorities

Safety Evaluation by JECFA
JECFA evaluated the safety of glutamate in 1970, 1973 and 1987.
Conclusion made by JECFA in 1987:

ADI not specified

JECFA: Joint FAO/WHO Expert Committee on Food Additives

Acceptable Daily Intake (ADI) not specified

(The safest category of food additive)

Total dietary intake of glutamate arising from their use at levels necessary to achieve the desired technological effect and from their acceptable background in food do not represent a hazard to health.

Safety Evaluation by the World Authorities

Safety Evaluation by JECFA
In 1991, EC/SCF independently reviewed the scientific data of MSG
Conclusion: ADI not specified

EC/SCF: European Community's Scientific Committee for Food

Safety Evaluation by FASEB

In 1995, FASEB reviewed scientific database of MSG sponsored by FDA

US FDA affirmed safety of MSG

FASEB: Federation of American Societies for Experimental Biology

Safety Evaluation by the World Authorities

In the USA, MSG has been the Generally Recognized As Safe (GRAS) substance since 1958 together with salt, pepper, vinegar, and baking powder.

Safety Evaluation by FSANZ

In 2003, FSANZ reviewed scientific data of MSG

Safety of MSG was reconfirmed

FSANZ :Food Standards Australia New Zealand

MSG is one of the most extensively investigated ingredients in the past 40 years.

Thank you for your kind attention

Prof. Dr. Nevzat Artık
Ankara University, Engineering Faculty, Food Engineering Department_ANKARA
Ankara University, Food Safety Institute-ANKARA