Monosodium Glutamate

1 Nonproprietary Names

USPNF: Monosodium glutamate

2 Synonyms

Chinese seasoning; E621; glutamic acid monosodium salt; glutamic acid, sodium salt; MSG; monosodium L-glutamate monohydrate; natrii glutamas; sodium L-glutamate; sodium glutamate monohydrate; sodium hydrogen L-(+)-2-amino-glutarate monohydrate.

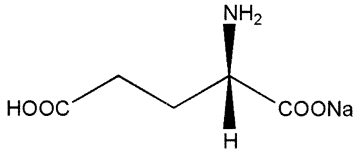
3 Chemical Name and CAS Registry Number

Glutamic acid monosodium salt monohydrate [142-47-2]

4 Empirical Formula and Molecular Weight

Empirical Formula	Molecular Weight
$C_5H_8NO_4Na$	169.13 (anhydrous)
$C_5H_8NO_4Na \cdot H_2O$	187.13 (monohydrate)

5 Structural Formula



6 Functional Category

Buffering agent; flavor enhancer.

7 Applications in Pharmaceutical Formulation or Technology

Monosodium glutamate is used in oral pharmaceutical formulations as a buffer and a flavor enhancer. For example, it is used with sugar to improve the palatability of bitter-tasting drugs and can reduce the metallic taste of iron-containing liquids. However, the most widespread use of monosodium glutamate is as a flavor enhancer in food products. Typically, 0.2–0.9% is used in normally salted foods, although products such as soy protein can contain 10–30%. The use of monosodium glutamate in food products has been controversial owing to the relatively high number of adverse reactions attributed to the substance, which gives rise to the so-called 'Chinese Restaurant Syndrome' (*see* Section 18.)

8 Description

Monosodium glutamate occurs as white free-flowing crystals or a crystalline powder. It is practically odorless and has a meatlike taste.

9 Pharmacopeial Specifications

See Table I.

Table I: Pharmacopeial specifications for monosodium glutamate.

Test	USPNF 20
Identification	+
Clarity and color of solution	+
Specific rotation	+24.8° to +25.3°
pH (5% solution)	6.7–7.2
Loss on drying	≤0.5%
Chloride	+
Lead	10 ppm
Heavy metals	≤0.002%
Organic volatile impurities	+
Assay	99.0–100.5%

10 Typical Properties

Acidity/alkalinity: pH = 7.0 (0.2% w/v aqueous solution)
Melting point: 232 °C
Solubility: soluble in water; sparingly soluble in ethanol (95%).
Specific rotation $[\alpha]_D^{25}$ +24.2° to +25.5° at 25 °C (8.0% w/v in 1.0 N HCl)

11 Stability and Storage Conditions

Aqueous solutions of monosodium glutamate may be sterilized by autoclaving. Monosodium glutamate should be stored in a tight container in a cool, dry place.

12 Incompatibilities

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13 Method of Manufacture

Monosodium glutamate is the monosodium salt of the naturally occurring L-form of glutamic acid. It is commonly manufactured by fermentation of carbohydrate sources such as sugar beet molasses. In general, sugar beet products are used in Europe and the USA. Other carbohydrate sources such as sugar cane and tapioca are used in Asia.

14 Safety

Monosodium glutamate is widely used in foods and oral pharmaceutical formulations. It is generally regarded as moderately toxic on ingestion or intravenous administration. Adverse effects include somnolence, hallucinations and distorted perceptions, headache, dyspnea, nausea or vomiting, and dermatitis. The lowest lethal oral dose in humans is reported to be 43 mg/kg.[1] *See also* Section 18.

LD_{50} (cat, SC): 8.0 g/kg[1]
LD_{50} (guinea pig, IP): 15 g/kg
LD_{50} (mouse, IP): 3.8 g/kg

LD_{50} (mouse, IV): 30 g/kg
LD_{50} (mouse, oral): 11.4 g/kg
LD_{50} (mouse, SC): 8.2 g/kg
LD_{50} (rat, IP): 4.3 g/kg
LD_{50} (rat, IV): 3.3 g/kg
LD_{50} (rat, oral): 16.6 g/kg
LD_{50} (rat, SC): 5.6 g/kg

15 Handling Precautions

Observe normal precautions appropriate to the circumstances and quantity of material handled. When heated to decomposition, monosodium glutamate emits toxic fumes of NO_x and Na_2O.

16 Regulatory Status

GRAS listed. Accepted in Europe for use as a food additive in certain applications. Included in the FDA Inactive Ingredients Guide (oral syrup). Included in nonparenteral medicines licensed in the UK.

17 Related Substances

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18 Comments

Monosodium glutamate has been associated with reports of adverse reactions termed 'Chinese Restaurant Syndrome' after it was first self-reported by a physician who regularly experienced numbness and palpitations after consuming Chinese food.[2]

Subsequent to this first report, numerous other anecdotal reports of adverse reactions to monosodium glutamate were made, with symptoms occurring at doses of 1.5–12 g. Reactions include paresthesias or a skin burning sensation, facial pressure or tightness sensation, and substernal chest pressure. Severity of reaction corresponded with increased dose. Reports of 'Chinese Restaurant Syndrome' in children are rare. A variety of other adverse reactions to monosodium glutamate have also been reported including flushing, asthma,[3] headache, behavioral abnormalities, and ventricular tachycardia.[4]

Placebo-controlled, blinded, trials of monosodium glutamate consumption have, however, largely failed to reproduce the full effects of 'Chinese Restaurant Syndrome' as it was originally described and symptoms may be simply due to dyspepsia. Some dose-dependent adverse reactions may be attributed to monosodium glutamate, with doses of 5 g producing reactions in 30% of individuals tested.[5] In the USA, the FDA has stated that monosodium glutamate and related substances are safe food ingredients for most people when used at 'customary' levels.[6]

Monosodium glutamate monohydrate 32 g is approximately equivalent to anhydrous monosodium glutamate 29 g or glutamic acid 25 g. Each gram of monosodium glutamate monohydrate represents 5.3 mmol (5.3 mEq) of sodium.

The EINECS number for monosodium glutamate is 205-538-1.

19 Specific References

1 Lewis RJ, ed. *Sax's Dangerous Properties of Industrial Materials*, 10th edn. New York: Wiley, 2000: 2575.
2 Kwok HM. Chinese restaurant syndrome. *N Engl J Med* 1968; **278**: 796.
3 Allen DH, Baker GH. Chinese restaurant asthma. *N Engl J Med* 1981; **305**: 1154–1155.
4 Smolinske SC. *Handbook of Food, Drug and Cosmetic Excipients*. Boca Raton, FL: CRC Press, 1992: 235–241.
5 Kenney RA. The Chinese restaurant syndrome: an anecdote revisited. *Food Chem Toxicol* 1986; **24**: 351–354.
6 Anonymous. Monosodium glutamate safe for most people, says FDA. *Pharm J* 1996; **256**: 83.

20 General References

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Japan Pharmaceutical Excipients Council. *Japanese Pharmaceutical Excipients Directory 1996*. Tokyo: Yakuji Nippo, 1996: 335.
Walker R. The significance of excursions above the ADI. Case study: monosodium glutamate. *Reg Toxicol Pharmacol* 1999; **30**: S119–S121.

21 Authors

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22 Date of Revision

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