Propionic Acid

1 Nonproprietary Names

USPNF: Propionic acid

2 Synonyms

Carboxyethane; ethanecarboxylic acid; E280; ethylformic acid; metacetonic acid; methylacetic acid; propanoic acid; pseudoacetic acid.

3 Chemical Name and CAS Registry Number

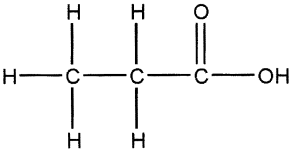
Propionic acid [79-09-4]

4 Empirical Formula and Molecular Weight

$C_3H_6O_2$

74.08

5 Structural Formula



6 Functional Category

Acidifying agent; antimicrobial preservative; antioxidant; esterifying agent.

7 Applications in Pharmaceutical Formulation or Technology

Propionic acid is primarily used as an antioxidant and antimicrobial preservative in foods, and in oral and topical pharmaceutical applications. It is also used as an esterifying agent.

8 Description

Propionic acid occurs as a corrosive, oily liquid having a slightly pungent, disagreeable, rancid odor. It is flammable.

9 Pharmacopeial Specifications

See Table I.

Table I: Pharmacopeial specifications for propionic acid.

Test	USPNF 20
Specific gravity	0.988–0.993
Distilling range	138.5–142.5 °C
Heavy metals	⩽0.001%
Limit of nonvolatile residue	⩽0.01%
Readily oxidizable substances	+
Limit of aldehydes	+
Organic volatile impurities	+
Assay	99.5–100.5%

10 Typical Properties

Antimicrobial activity: *see* Table II.

Table II: Typical minimum inhibitory concentrations (MICs) for propionic acid at pH 3.9.[n]

Microorganism	MIC (μg/mL)
Aspergillus niger	2000
Candida albicans	2000
Escherichia coli	2000
Klebsiella pneumoniae	1250
Penicillium notatum	2000
Pseudomonas aeruginosa	3000
Pseudomonas cepacia	3000
Pseudomonas fluorescens	1250
Staphylococcus aureus	2000

Autoignition temperature: 955 °C
Boiling point: 141.1 °C
Dissociation constant: $pK_a = 4.874$
Flash point: 52–58 °C (open cup)
Melting point: −21.5 °C
Partition coefficients: Octanol : water = 0.33.
Refractive index: $n_D^{25} = 1.3848$
Solubility: miscible with chloroform, ethanol (95%), ether, and water.
Specific gravity: 0.9934
Surface tension: 27.21 mN/m (27.21 dynes/cm) at 15 °C
Vapor density (relative): 2.56 (air = 1)
Vapor pressure: 320 Pa (2.4 mmHg) at 20 °C
Viscosity (dynamic): *see* Table III.

Table III: Dynamic viscosity of propionic acid.

Viscosity (dynamic)/mPa s	Temperature
1.175	15 °C
1.02	25 °C
0.956	30 °C
0.668	60 °C
0.495	90 °C

11 Stability and Storage Conditions

Although stable, propionic acid is flammable. It should be stored in an airtight container away from heat and flames.

12 Incompatibilities

Propionic acid is incompatible with alkalis, ammonia, amines, and halogens. It can be salted out of aqueous solutions by the addition of calcium chloride or other salts.

13 Method of Manufacture

Propionic acid can be obtained from wood pulp waste liquor by fermentation. It can also be prepared from ethylene, carbon monoxide and steam; from ethanol and carbon monoxide using boron trifluoride catalyst; from natural gas; or as a by-product in the pyrolysis of wood. Very pure propionic acid can be obtained from propionitrile. Propionic acid can be found in dairy products in small amounts.

14 Safety

Propionic acid is generally regarded as a nontoxic and non-irritant material when used as an excipient. Up to 1% may be used in food applications (up to 0.3% in flour and cheese products). *See also* Sodium Propionate.

LD_{50} (mouse, IV): 0.63 g/kg[2]
LD_{50} (rabbit, skin): 0.5 g/kg
LD_{50} (rat, oral): 2.6 g/kg

15 Handling Precautions

Propionic acid is corrosive and can cause eye and skin burns. It may be harmful if swallowed, inhaled or absorbed through the skin as a result of prolonged or widespread contact. Eye protection, PVC gloves, and suitable protective clothing should be worn. Propionic acid should be handled in a well-ventilated environment away from heat and flames. In the UK, the occupational exposure limits for propionic acid are 31 mg/m^3 (10 ppm) long-term (8-hour TWA) and 46 mg/m^3 (15 ppm) short-term.[3]

16 Regulatory Status

GRAS listed. Accepted for use in Europe as a food additive. In Japan, propionic acid is restricted to use as flavoring agent.

17 Related Substances

Sodium propionate.

18 Comments

The EINECS number for propionic acid is 201-176-3.

19 Specific References

1 Wallhäusser KH. Propionic acid. In: Kabara JJ, ed. *Cosmetic and Drug Preservation: Principles and Practice*. New York: Marcel Dekker, 1984: 665–666.
2 Lewis RJ, ed. *Sax's Dangerous Properties of Industrial Materials*, 10th edn. New York: Wiley, 2000: 3069–3070.
3 Health and Safety Executive. *EH40/2002: Occupational Exposure Limits 2002*. Sudbury: Health and Safety Executive, 2002.

20 General References

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21 Author

GE Amidon.

22 Date of Revision

26 June 2002