

# Sodium Propionate

## 1 Nonproprietary Names

USPNF: Sodium propionate

## 2 Synonyms

E281; ethylformic acid, sodium salt, hydrate; methylacetic acid, sodium salt, hydrate; sodium propanoate hydrate; sodium propionate hydrate.

## 3 Chemical Name and CAS Registry Number

Propionic acid, sodium salt, hydrate [6700-17-0]

Propionic acid, sodium salt, anhydrous [137-40-6]

## 4 Empirical Formula Molecular Weight

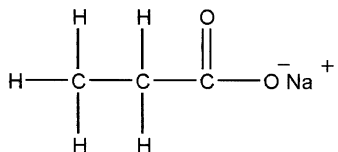
$C_3H_5NaO_2 \cdot xH_2O$

114.06 (for monohydrate)

$C_3H_5NaO_2$

96.06 (for anhydrous)

## 5 Structural Formula



## 6 Functional Category

Antimicrobial preservative.

## 7 Applications in Pharmaceutical Formulation or Technology

As an excipient, sodium propionate is used in oral pharmaceutical formulations as an antimicrobial preservative. Like propionic acid, sodium propionate and other propionic acid salts are fungistatic and bacteriostatic against a number of Gram-positive cocci. Propionates are more active against molds than is sodium benzoate, but have essentially no activity against yeasts; see Section 10.

Therapeutically, sodium propionate has been used topically in concentrations up to 10% w/w alone or in combination with other propionates, caprylates, or other antifungal agents, in the form of ointments or solutions for the treatment of dermatophyte infections. Eye drops containing 5% w/v sodium propionate have also been used. See Section 18.

In food processes, particularly baking, sodium propionate is used as an antifungal agent; it may also be used as a flavoring agent in food products. In veterinary medicine, sodium propionate is used therapeutically as a glucogenic substance in ruminants.<sup>(1)</sup>

## 8 Description

Sodium propionate occurs as colorless transparent crystals or as a granular, free-flowing, crystalline powder. It is odorless, or with a slight characteristic odor, and is deliquescent in moist air. Sodium propionate has a characteristic, slightly cheeselike taste, although by itself it is unpalatable.

## 9 Pharmacopeial Specifications

See Table I.

Table I: Pharmacopeial specifications for sodium propionate.

Test	USPNF 20
Identification	+
Alkalinity	+
Water	≤ 1.0%
Heavy metals	≤ 0.001%
Organic volatile impurities	+
Assay (dried basis)	99.0–100.5%

## 10 Typical Properties

**Antimicrobial activity:** sodium propionate, propionic acid, and other propionates possess mainly antifungal activity and are used as preservatives primarily against molds; they exhibit essentially no activity against yeasts. Although, in general, propionates exhibit little activity against bacteria, sodium propionate is effective against *Bacillus mesenterium*, the organism that causes ‘rope’ in bread. Antimicrobial activity is largely dependent upon the presence of the free acid and hence propionates exhibit optimum activity at acid pH, notably at less than pH 5. Synergistic effects occur between propionates and carbon dioxide or sorbic acid. See also Propionic acid.

**Solubility:** soluble 1 in 24 of ethanol (95%), 1 in 1 of water, and 1 in 0.65 of boiling water; practically insoluble in chloroform and ether.

## 11 Stability and Storage Conditions

Sodium propionate is deliquescent and should therefore be stored in an airtight container in a cool, dry place.

## 12 Incompatibilities

Incompatibilities for sodium propionate are similar to those of other weak organic acids.

## 13 Method of Manufacture

Sodium propionate is prepared by the reaction of propionic acid with sodium carbonate or sodium hydroxide.

## 14 Safety

Sodium propionate and other propionates are used in oral pharmaceutical formulations, food products, and cosmetics. The free acid, propionic acid, occurs naturally at levels up to 1% w/w in certain cheeses.

Following oral consumption, propionate is metabolized in mammals in a manner similar to that of fatty acids. Toxicity studies in animals have shown sodium propionate and other propionates to be relatively nontoxic materials.<sup>(2,3)</sup> In veterinary medicine, sodium propionate is used as a therapeutic agent for cattle and sheep.<sup>(1)</sup>

In humans, 6 g of sodium propionate has been administered daily without harm.<sup>(2)</sup> However, allergic reactions to propionates can occur.

LD<sub>50</sub> (mouse, oral): 6.33 g/kg<sup>(4)</sup>

LD<sub>50</sub> (mouse, SC): 2.1 g/kg

LD<sub>50</sub> (rabbit, skin): 1.64 g/kg

## 15 Handling Precautions

Observe normal precautions appropriate to the circumstances and quantity of material handled. Sodium propionate may be irritant to the eyes and skin. Gloves, eye protection, and a dust-mask are recommended. When heated to decomposition, sodium propionate emits toxic fumes of sodium monoxide, Na<sub>2</sub>O.

In the UK, the occupational exposure limits for propionic acid are 31 mg/m<sup>3</sup> (10 ppm) long-term (8-hour TWA) and 46 mg/m<sup>3</sup> (15 ppm) short-term.<sup>(5)</sup>

## 16 Regulatory Status

GRAS listed. Accepted for use as a food additive in Europe. In cheese products, propionates are limited to 0.3% w/w concentration; a limit of 0.32% w/w is applied in flour and white bread rolls, while a limit of 0.38% w/w is applied in whole wheat products.

Included in the FDA Inactive Ingredients Guide (oral capsules, powder, suspensions, and syrups). Included in non-parenteral medicines licensed in the UK.

## 17 Related Substances

Anhydrous sodium propionate; calcium propionate; potassium propionate; propionic acid; zinc propionate.

### Anhydrous sodium propionate

Empirical formula: C<sub>3</sub>H<sub>5</sub>O<sub>2</sub>Na

Molecular weight: 96.06

CAS number: [137-40-6]

Synonyms: E281; propanoic acid, sodium salt, anhydrous.

Safety:

LD<sub>50</sub> (mouse, oral): 2.35 g/kg<sup>(4)</sup>

LD<sub>50</sub> (rat, oral): 3.92 g/kg

### Calcium propionate

Empirical formula: C<sub>6</sub>H<sub>10</sub>O<sub>4</sub>Ca

Molecular weight: 186.22

CAS number: [4075-81-4]

Synonyms: calcium dipropionate; E282; propanoic acid, calcium salt; propionic acid, calcium salt.

Appearance: white crystalline powder.

Solubility: soluble in water; slightly soluble in ethanol and methanol; practically insoluble in acetone and benzene.

**Method of manufacture:** prepared by the reaction of propionic acid and calcium hydroxide.

**Comments:** occurs as the monohydrate or trihydrate.

### Potassium propionate

Empirical formula: C<sub>3</sub>H<sub>5</sub>O<sub>2</sub>K

Molecular weight: 112.17

CAS number: [327-62-8]

Synonyms: E283; propanoic acid, potassium salt; propionic acid, potassium salt.

Appearance: white crystalline powder.

Comments: occurs as the anhydrous form and the monohydrate. Decomposes in moist air to give off propionic acid.

### Zinc propionate

Empirical formula: C<sub>6</sub>H<sub>10</sub>O<sub>4</sub>Zn

Molecular weight: 211.52

CAS number: [557-28-8]

Synonyms: propanoic acid, zinc salt; propionic acid, zinc salt.

Appearance: white platelets or needlelike crystals (for the monohydrate).

Solubility: the anhydrous form is soluble 1 in 36 of ethanol (95%) at 15°C, 1 in 6 of boiling ethanol (95%), and 1 in 3 of water at 15°C.

Method of manufacture: prepared by dissolving zinc oxide in dilute propionic acid solution.

Comments: occurs as the anhydrous form and the monohydrate. Decomposes in moist air to give off propionic acid.

## 18 Comments

Propionates are used as antimicrobial preservatives in preference to propionic acid since they are less corrosive.

The therapeutic use of sodium propionate in topical antifungal preparations has largely been superseded by a new generation of antifungal drugs. The EINECS number for sodium propionate is 205-290-4.

## 19 Specific References

- 1 Bishop Y, ed. *The Veterinary Formulary*, 5th edn. London: Pharmaceutical Press, 2001: 552.
- 2 Heseltine WW. A note on sodium propionate. *J Pharm Pharmacol* 1952; 4: 120-122.
- 3 Graham WD, Teed H, Grice HC. Chronic toxicity of bread additives to rats. *J Pharm Pharmacol* 1954; 6: 534-545.
- 4 Lewis RJ, ed. *Sax's Dangerous Properties of Industrial Materials*, 10th edn. New York: Wiley, 2000: 3276.
- 5 Health and Safety Executive. *EH40/2002: Occupational Exposure Limits 2002*. Sudbury: Health and Safety Executive, 2002.

## 20 General References

- Doores S. Organic acids. In: Branen AL, Davidson PM, eds. *Antimicrobials in Foods*. New York: Marcel Dekker, 1983: 85-87.
- Furia TE, ed. *CRC Handbook of Food Additives*. Cleveland, OH: CRC Press, 1972: 137-141.

## 21 Authors

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## 22 Date of Revision

23 October 2002.