

# Lactic Acid

## 1 Nonproprietary Names

BP: Lactic Acid  
JP: Lactic Acid  
PhEur: Lactic Acid  
USP–NF: Lactic Acid

## 2 Synonyms

Acidum lacticum; E270; *Eco-Lac*; 2-hydroxypropanoic acid;  $\alpha$ -hydroxypropionic acid; DL-lactic acid; L-lactic acid; *Lexalt L*; milk acid; *Patlac LA*; *Purac 88 PH*; *Purac PF 90*; racemic lactic acid.

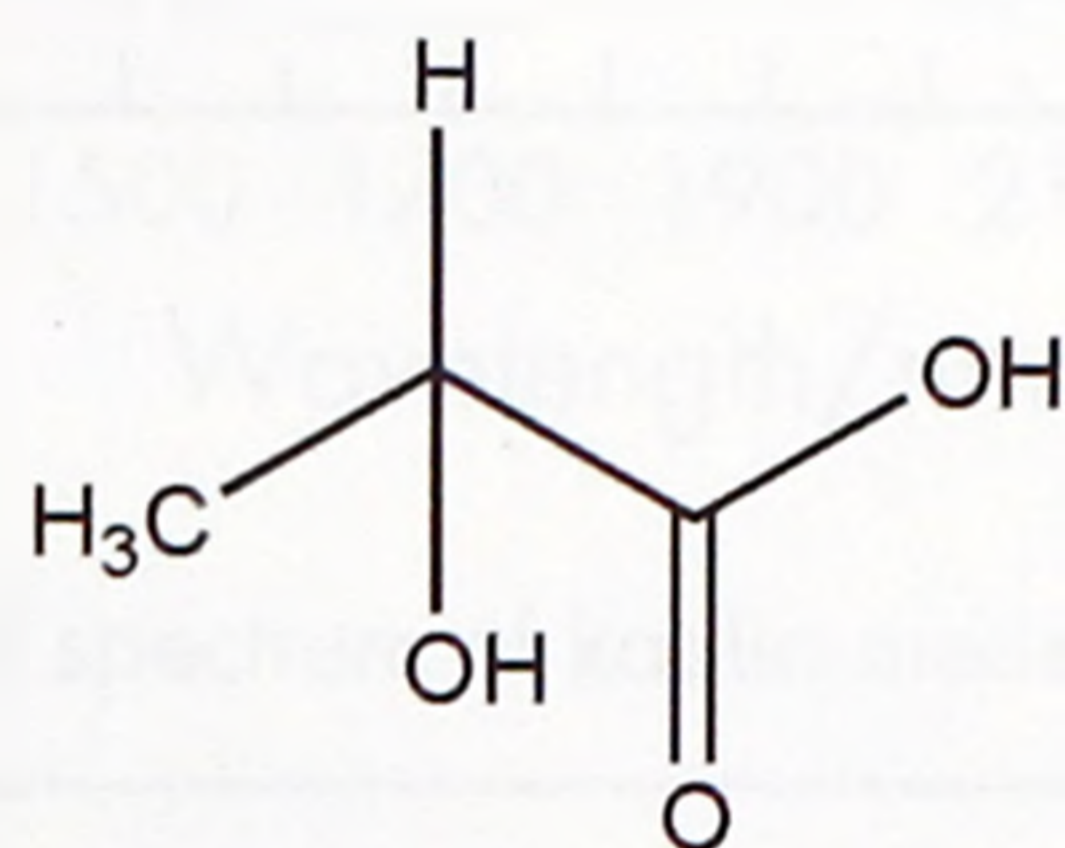
## 3 Chemical Name and CAS Registry Number

2-Hydroxypropionic acid [50-21-5]  
(R)-(-)-2-Hydroxypropionic acid [10326-41-7]  
(S)-(+)-2-Hydroxypropionic acid [79-33-44]  
(RS)-( $\pm$ )-2-Hydroxypropionic acid [598-82-3]  
See also Section 8.

## 4 Empirical Formula and Molecular Weight

$C_3H_6O_3$  90.08

## 5 Structural Formula



## 6 Functional Category

Acidulant.

## 7 Applications in Pharmaceutical Formulation or Technology

Lactic acid is used in beverages, foods, cosmetics, and pharmaceuticals (see Table I) as an acidulant.

In topical formulations, particularly cosmetics, it is used for its softening and conditioning effect on the skin. Lactic acid may also be used in the production of biodegradable polymers and microspheres, such as poly(D-lactic acid), used in drug delivery systems.<sup>(1,2)</sup> See also Aliphatic Polyesters.

Lactic acid is also used as a food preservative.

**Table I:** Uses of lactic acid.

Use	Concentration (%)
Injections	0.012–1.16
Topical preparations	0.015–6.6

## 8 Description

Lactic acid consists of a mixture of 2-hydroxypropionic acid, its condensation products, such as lactoyllactic acid and other polylactic acids, and water. It is usually in the form of the racemate,

(RS)-lactic acid, but in some cases the (S)-(+)-isomer is predominant.

Lactic acid is a practically odorless, colorless or slightly yellow-colored, viscous, hygroscopic, nonvolatile liquid.

## 9 Pharmacopeial Specifications

See Table II.

## 10 Typical Properties

**Boiling point** 122°C at 2 kPa (15 mmHg)  
**Dissociation constant**  $pK_a = 4.14$  at 22.5°C  
**Flash point** >110°C  
**Heat of combustion** 15.13 kJ/kg (3615 cal/kg)  
**Melting point** 17°C  
**Osmolarity** A 2.3% w/v aqueous solution is isoosmotic with serum.  
**Refractive index**  $n_D^{20} = 1.4251$   
**Solubility** Miscible with ethanol (95%), ether, and water; practically insoluble in chloroform.  
**Specific heat** 2.11 J/g (0.505 cal/g) at 20°C  
**Specific gravity** 1.21  
**Specific rotation**  $[\alpha]_D^{21} = -2.6^\circ$  (8% w/v aqueous solution) for (R)-form;  $+2.6^\circ$  (2.5% w/v aqueous solution) for (S)-form.  
**Spectroscopy**  
IR spectrum see Figure 1.  
Raman spectrum see Figure 2.  
**Viscosity (dynamic)** 28.5 mPa s (28.5 cP) for 85% aqueous solution at 25°C.

## 11 Stability and Storage Conditions

Lactic acid is hygroscopic and will form condensation products such as polylactic acids on contact with water. The equilibrium between the polylactic acids and lactic acid is dependent on concentration and temperature. At elevated temperatures lactic acid will form lactide, which is readily hydrolyzed back to lactic acid.

Lactic acid should be stored in a well-closed container in a cool, dry place.

## 12 Incompatibilities

Incompatible with oxidizing agents, iodides, and albumin. Reacts violently with hydrofluoric acid and nitric acid.

## 13 Method of Manufacture

Lactic acid is prepared by the fermentation of carbohydrates, such as glucose, sucrose, and lactose, with *Bacillus acidi lacti* or related microorganisms. On a commercial scale, whey, corn starch, potatoes, or molasses are used as a source of carbohydrate. Lactic acid may also be prepared synthetically by the reaction between acetaldehyde and carbon monoxide at 130–200°C under high pressure, or by the hydrolysis of hexoses with sodium hydroxide.<sup>(3)</sup>

Lactic acid prepared by the fermentation of sugars is levorotatory; lactic acid prepared synthetically is racemic. However, lactic acid prepared by fermentation becomes dextrorotatory on dilution with water owing to the hydrolysis of (R)-lactic acid lactate to (S)-lactic acid.

## 14 Safety

Lactic acid occurs in appreciable quantities in the body as an end product of the anaerobic metabolism of carbohydrates and, while