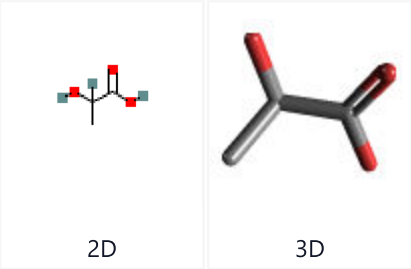
PubChem

OMPOUND SUMMA Y

Lactic Acid

Cite | Download

PubChem CID	612
Structure	 2D 3D
Primary Hazards	 Corrosive Irritant Laboratory Chemical Safety Summary (LCSS) Datasheet
Molecular Formula	$C_3H_6O_3$ $CH_3CHOHCOOH$
Synonyms	lactic acid 2-hydroxypropanoic acid DL-Lactic acid 50-21-5 2-hydroxypropionic acid View More...
Molecular Weight	90.08 g/mol *Computed by PubChem 2.2 (PubChem release 2025.09.15)*
Dates	Create: 2004-09-16 Modify: 2025-11-15

NJOY-1023

escriptio

actic a id appears as a colorless to yellow odorless syrupy liquid. Corrosive to metals and tissue. Used to make cultured dairy products, as a food preservative, and to make chemicals.

▸ CAMEO Chemicals

2-hydroxypropanoic acid is a 2-hydroxy monocarboxylic acid that is propanoic acid in which one of the alpha-hydrogens is replaced by a hydroxy group. It has a role as a Daphnia magna metabolite and an algal metabolite. It is functionally related to a propionic acid. It is a conjugate acid of a lactate.

▸ ChEBI

Based on the available information included in this report, the CIR Expert Panel concludes that Glycolic and Lactic Acid, their common salts and their simple esters, are safe for use in cosmetic products at concentrations less than or equal to 10%, at final formulation pH greater than or equal to 3.5, when formulated to avoid increasing sun sensitivity or when directions for use include the daily use of sun protection. These ingredients are safe for use in salon products at concentrations less than or equal to 30%, at final formulation pH greater than or equal to 3.0, in products designed for brief, discontinuous use followed by thorough rinsing from the skin, when applied by trained professionals, and when application is accompanied by directions for the daily use of sun protection...Lactic Acid...

International Journal of Toxicology 17(S1):1-241, 1998

International Journal of Toxicology 36(Suppl 2):14-58, 2017

▸ Cosmetic Ingredient Review (CIR)

View More...

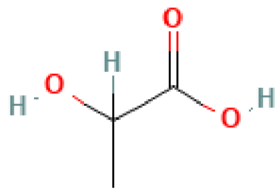
See also: Lactate (has subclass); Citric acid; lactic acid; potassium bitartrate (component of) ... View More ...

Contents

1 Structures

1.1 2D Structure

Chemical Structure Depiction



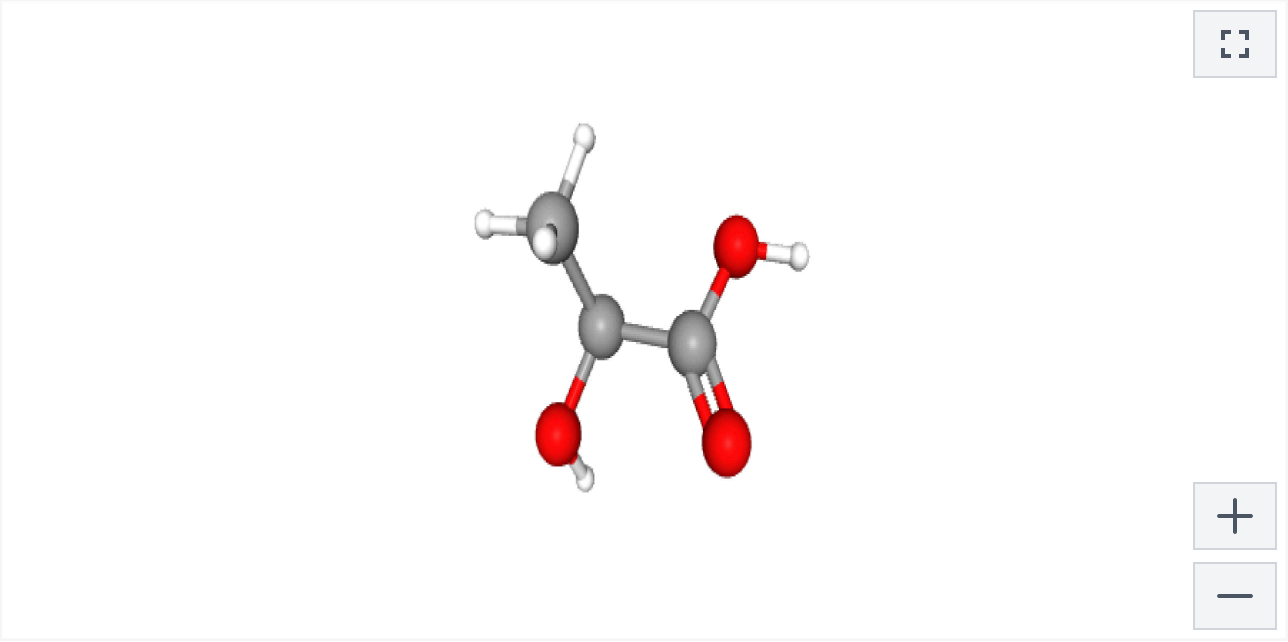
PubChem

1.2 3D Conformer

Interactive Chemical Structure Model

Ball and Stick Sticks Wire-Frame Space-Filling

Show Hydrogens Animate



First Previous Conformer 1 of 4 Next Last

PubChem

2 Names and Identifiers

2.1 Computed Descriptors

2.1.1 IUPAC Name

2-hydroxypropanoic acid

Computed by Lexichem TK 2.9.3 (PubChem release 2025.09.15)

PubChem

2.1.2 InChI

InChI=1S/C3H6O3/c1-2(4)3(5)6/h2,4H,1H3,(H,5,6)

Computed by InChI 1.07.4 (PubChem release 2025.09.15)

PubChem

2.1.3 InChIKey

JVTAAEKCZFNVCJ-UHFFFAOYSA-N

Computed by InChI 1.07.4 (PubChem release 2025.09.15)

▸ PubChem

2.1.4 SMILES

CC(C(=O)O)O

Computed by OEChem 4.2.0 (PubChem release 2025.09.15)

▸ PubChem

2.2 Molecular Formula

$C_3H_6O_3$

Computed by PubChem 2.2 (PubChem release 2025.09.15)

▸ Australian Industrial Chemicals Introduction Scheme (AICIS); CAMEO Chemicals; EU Food Improv…

$C_3H_6O_3$

$CH_3CHOHCOOH$

▸ ILO-WHO International Chemical Safety Cards (ICSCs)

2.3 Other Identifiers

2.3.1 CAS

50-21-5

▸ Australian Industrial Chemicals Introduction Scheme (AICIS); CAMEO Chemicals; CAS Common C…

598823

▸ DTP/NCI

View More...

2.3.2 Related CAS

26100-51-6

Compound: (±)-Poly(lactic acid)

- CAS Common Chemistry

2.3.3 Deprecated CAS

1334714-39-4, 152-36-3, 598-82-3

- ChemIDplus; EPA Chemicals under the TSCA

1334714-39-4, 598-82-3, 849585-22-4

- EPA DSSTox

2.3.4 European Community (EC) Number

200-018-0

- EU Food Improvement Agents; European Chemicals Agency (ECHA)

209-954-4

- European Chemicals Agency (ECHA)

825-250-5

- European Chemicals Agency (ECHA)

2.3.5 UNII

3B8D35Y7S4

- FDA Global Substance Registration System (GSRS)

2.3.6 UN Number

3265 (LACTIC ACID)

- CAMEO Chemicals

2.3.7 ChEBI ID

CHEBI:78320

- ChEBI

2.3.8 ChEMBL ID

CHEMBL1200559

- ChEMBL

2.3.9 DrugBank ID

DB04398

- DrugBank

2.3.10 DSSTox Substance ID

DTXSID7023192

- EPA DSSTox

2.3.11 FEMA Number

2611

- Flavor and Extract Manufacturers Association (FEMA); Joint FAO/WHO Expert Committee on Foo…

2.3.12 ICSC Number

0501

- ILO-WHO International Chemical Safety Cards (ICSCs)

2.3.13 JECFA Number

930

- Joint FAO/WHO Expert Committee on Food Additives (JECFA)

2.3.14 KEGG ID

D00111

- KEGG

C01432

- KEGG

2.3.15 Metabolomics Workbench ID

122706

- Metabolomics Workbench

2.3.16 NCI Thesaurus Code

C80130

- NCI Thesaurus (NCIt)

C76926

- NCI Thesaurus (NCIt)

2.3.17 Nikkaji Number

J1.358G

- Japan Chemical Substance Dictionary (Nikkaji)

2.3.18 NSC Number

367919

- DTP/NCI

2.3.19 RXCUI

1314409

- NLM RxNorm Terminology

28393

- NLM RxNorm Terminology

2.3.20 Wikidata

Q161249

- Wikidata

Q72487130

- Wikidata

2.3.21 Wikipedia

Lactic acid

- Wikipedia

2.4 Synonyms

2.4.1 MeSH Entry Terms

Lactic Acid
2-Hydroxypropanoic Acid
2-Hydroxypropionic Acid

- Medical Subject Headings (MeSH)

2.4.2 Depositor-Supplied Synonyms

lactic acid	Lactovagan	alpha-Hydroxypropionic acid	Cheongin Hae
2-hydroxypropanoic acid	Acidum lacticum	(RS)-2-Hydroxypropionsaeure	SY-83
DL-Lactic acid	Propanoic acid, 2-hydroxy-	FEMA No. 2611	alpha-Hydroxy
50-21-5	Milchsaeure	Milchsaure	AI3-03130
2-hydroxypropionic acid	Lactic acid, dl-	Lurex	HIPURE 88
Milk acid	Kyselina mlecna	Propionic acid, 2-hydroxy-	Lactic acid,buf
Tonsillosan	Lacticum acidum	Purac FCC 80	NSC-367919
Racemic lactic acid	Lactic acid USP	Purac FCC 88	INS NO.270
Ordinary lactic acid	598-82-3	(+-)-2-Hydroxypropanoic acid	DTXSID702319
Ethylidenelactic acid	Aethylidenmilchsaeure	Cheongin Haewoohwan	CHEBI:78320

PubChem

3 Chemical and Physical Properties

3.1 Computed Properties

Property Name	Property Value	Reference
Molecular Weight	90.08 g/mol	Computed by PubChem 2.2 (PubChem release 2025.09.15)
XLogP3	-0.7	Computed by XLogP3 3.0 (PubChem release 2025.09.15)
Hydrogen Bond Donor Count	2	Computed by Cactvs 3.4.8.24 (PubChem release 2025.09.15)
Hydrogen Bond Acceptor Count	3	Computed by Cactvs 3.4.8.24 (PubChem release 2025.09.15)
Rotatable Bond Count	1	Computed by Cactvs 3.4.8.24 (PubChem release 2025.09.15)
Exact Mass	90.031694049 Da	Computed by PubChem 2.2 (PubChem release 2025.09.15)
Monoisotopic Mass	90.031694049 Da	Computed by PubChem 2.2 (PubChem release 2025.09.15)

Topological Polar Surface Area	57.5 Å²	Computed by Cactvs 3.4.8.24 (PubChem release 2025.09.15)
Heavy Atom Count	6	Computed by PubChem
Formal Charge	0	Computed by PubChem
Complexity	59.1	Computed by Cactvs 3.4.8.24 (PubChem release 2025.09.15)
Isotope Atom Count	0	Computed by PubChem
Defined Atom Stereocenter Count	0	Computed by PubChem
Undefined Atom Stereocenter Count	1	Computed by PubChem
Defined Bond Stereocenter Count	0	Computed by PubChem
Undefined Bond Stereocenter Count	0	Computed by PubChem
Covalently-Bonded Unit Count	1	Computed by PubChem
Compound Is Canonicalized	Yes	Computed by PubChem (release 2025.09.15)

▸ PubChem

3.2 Experimental Properties

3.2.1 Physical Description

Lactic acid appears as a colorless to yellow odorless syrupy liquid. Corrosive to metals and tissue. Used to make cultured dairy products, as a food preservative, and to make chemicals.

▸ CAMEO Chemicals

Liquid

▸ EPA Chemical Data Reporting (CDR)

Colourless or yellowish, nearly odourless, syrupy liquid to solid

▸ EU Food Improvement Agents

Thick liquid or crystals, colorless to yellow; mp = 17 deg C; [ICSC]

▸ Haz-Map, Information on Hazardous Chemicals and Occupational Diseases

VISCOUS COLOURLESS-TO-YELLOW LIQUID OR COLOURLESS-TO-YELLOW CRYSTALS.

▸ ILO-WHO International Chemical Safety Cards (ICSCs)

colourless to yellow hygroscopic crystals becoming syrupy liquid; odourless

▸ Joint FAO/WHO Expert Committee on Food Additives (JECFA)

3.2.2 Color / Form

Crystals (melt at 16.8 °C)

O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Cambridge, UK: Royal Society of Chemistry, 2013., p. 990

▸ Hazardous Substances Data Bank (HSDB)

Yellow to colorless crystals or syrupy 50% liquid

Lewis, R.J. Sr.; Hawley's Condensed Chemical Dictionary 15th Edition. John Wiley & Sons, Inc. New York, NY 2007., p. 736

▸ Hazardous Substances Data Bank (HSDB)

Viscous, colorless to yellow liquid or colorless to yellow crystals

*CDC; International Chemical Safety Cards (ICSC) 2012. Atlanta, GA: Centers for Disease Prevention & Control. National Institute for Occupational Safety & Health (NIOSH). Ed Info Div. Available from, as of March 17, 2016: **https://www.cdc.gov/niosh/ipcs***

▸ Hazardous Substances Data Bank (HSDB)

3.2.3 Odor

Odorless

Lewis, R.J. Sr.; Hawley's Condensed Chemical Dictionary 15th Edition. John Wiley & Sons, Inc. New York, NY 2007., p. 736

▸ Hazardous Substances Data Bank (HSDB)

Weak unpleasant odor

NOAA; CAMEO Chemicals. Database of Hazardous Materials. Lactic Acid (50-21-5). Natl Ocean Atmos Admin, Off Resp Rest; NOAA Ocean Serv. Available from, as of March 17, 2016: https://cameochemicals.noaa.gov/

▸ Hazardous Substances Data Bank (HSDB)

Available forms have very slightly acrid odor

Furia, T.E. (ed.). CRC Handbook of Food Additives. 2nd ed. Cleveland: The Chemical Rubber Co., 1972., p. 237

▸ Hazardous Substances Data Bank (HSDB)

3.2.4 Taste

Mild acid taste and does not overpower weaker aromatic flavors

Starr JN, Westhoff G; Lactic Acid. Ullmann's Encyclopedia of Industrial Chemistry. 7th ed. (1999-2016). New York, NY: John Wiley & Sons. Online Posting Date: 31 Jan 2014

▸ Hazardous Substances Data Bank (HSDB)

Taste is acrid

Furia, T.E. (ed.). CRC Handbook of Food Additives. 2nd ed. Cleveland: The Chemical Rubber Co., 1972., p. 237

▸ Hazardous Substances Data Bank (HSDB)

3.2.5 Boiling Point

122 °C at 1.50E+01 mm Hg

PhysProp

▸ DrugBank

122 °C at 15 mm Hg

Haynes, W.M. (ed.). CRC Handbook of Chemistry and Physics. 95th Edition. CRC Press LLC, Boca Raton: FL 2014-2015, p. 3-336

▸ Hazardous Substances Data Bank (HSDB)

3.2.6 Melting Point

16.8 °C

PhysProp

▸ **DrugBank**

16.8 °C

O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Cambridge, UK: Royal Society of Chemistry, 2013., p. 990

▸ **Haz-Map, Information on Hazardous Chemicals and Occupational Diseases; Hazardous Substance…**

Crystals from ether and **isopropyl ether**; melting point = 52.8 °C; pK = 3.83; soluble in **water**, alcohol, **acetone**, ether, **glycerol**; practically insoluble in **chloroform**. /**D-lactic acid**/

O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. 13th Edition, Whitehouse Station, NJ: Merck and Co., Inc., 2001., p. 955

▸ **Hazardous Substances Data Bank (HSDB)**

Crystals from **acetic acid** or **chloroform**; melting point = 53 °C; pK = 3.79 at 25 °C. /**L-lactic acid**/

O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. 13th Edition, Whitehouse Station, NJ: Merck and Co., Inc., 2001., p. 955

▸ **Hazardous Substances Data Bank (HSDB)**

17Â °C

▸ **ILO-WHO International Chemical Safety Cards (ICSCs)**

3.2.7 Flash Point

113 °C (235 °F) - closed cup

Sigma-Aldrich; Safety Data Sheet for DL-Lactic acid. Product Number: 69785, Version 5.4 (Revision Date 12/23/2014). Available from, as of January 29, 2016: ***https://www.sigmaaldrich.com/safety-center.html***

▸ **Hazardous Substances Data Bank (HSDB)**

110Â °C c.c.

▸ **ILO-WHO International Chemical Safety Cards (ICSCs)**

3.2.8 Solubility

1000000 mg/L

MERCK INDEX (1996)

▸ **DrugBank**

Completely soluble in water

Starr JN, Westhoff G; Lactic Acid. Ullmann's Encyclopedia of Industrial Chemistry. 7th ed. (1999-2016). New York, NY: John Wiley & Sons. Online Posting Date: 31 Jan 2014

▸ **Hazardous Substances Data Bank (HSDB)**

Miscible with water

Lewis, R.J. Sr.; Hawley's Condensed Chemical Dictionary 15th Edition. John Wiley & Sons, Inc. New York, NY 2007., p. 736

▸ **Hazardous Substances Data Bank (HSDB)**

Completely soluble in ethanol, diethyl ether, and other organic solvents which are miscible with water. It is virtually insoluble in benzene and chloroform.

Starr JN, Westhoff G; Lactic Acid. Ullmann's Encyclopedia of Industrial Chemistry. 7th ed. (1999-2016). New York, NY: John Wiley & Sons. Online Posting Date: 31 Jan 2014

▸ **Hazardous Substances Data Bank (HSDB)**

Miscible with glycerol

Lewis, R.J. Sr.; Hawley's Condensed Chemical Dictionary 15th Edition. John Wiley & Sons, Inc. New York, NY 2007., p. 736

▸ **Hazardous Substances Data Bank (HSDB)**

Soluble in alcohol and furfurol; slightly soluble in ether; insoluble in chloroform, petroleum ether, carbon disulfide. Miscible with alcohol-ether solution.

Lewis, R.J. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 12th Edition. Wiley-Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2012., p. 2969

▸ **Hazardous Substances Data Bank (HSDB)**

Solubility in water: miscible

▸ **ILO-WHO International Chemical Safety Cards (ICSCs)**

miscible with water, glycerol, glycols, oils

▸ **Joint FAO/WHO Expert Committee on Food Additives (JECFA)**

miscible at room temperature (in ethanol)

▸ Joint FAO/WHO Expert Committee on Food Additives (JECFA)

3.2.9 Density

1.2 at 68 °F (USCG, 1999) - Denser than water; will sink

U.S. Coast Guard. 1999. Chemical Hazard Response Information System (CHRIS) - Hazardous Chemical Data. Commandant Instruction 16465.12C. Washington, D.C.: U.S. Government Printing Office.

▸ CAMEO Chemicals

1.2060 g/cu cm at 21 °C

Haynes, W.M. (ed.). CRC Handbook of Chemistry and Physics. 95th Edition. CRC Press LLC, Boca Raton: FL 2014-2015, p. 3-336

▸ Hazardous Substances Data Bank (HSDB)

Relative density (water = 1): 1.2

▸ ILO-WHO International Chemical Safety Cards (ICSCs)

1.200-1.209

▸ Joint FAO/WHO Expert Committee on Food Additives (JECFA)

3.2.10 Vapor Pressure

0.08 [mmHg]

▸ Haz-Map, Information on Hazardous Chemicals and Occupational Diseases

0.0813 mm Hg at 25 °C

Yaws CL; Handbook Chem Compd Data Process Saf, Houston, TX: Gulf Publishing, p. 33 (1997)

▸ Hazardous Substances Data Bank (HSDB)

3.2.11 LogP

-0.72

HANSCH,C ET AL. (1995)

▸ DrugBank

log Kow = -0.72

Hansch, C., Leo, A., D. Hoekman. Exploring QSAR - Hydrophobic, Electronic, and Steric Constants. Washington, DC: American Chemical Society., 1995., p. 6

▸ **Hazardous Substances Data Bank (HSDB)**

-0.6

▸ **ILO-WHO International Chemical Safety Cards (ICSCs)**

3.2.12 Stability / Shelf Life

Stable under recommended storage conditions.

Sigma-Aldrich; Safety Data Sheet for DL-Lactic acid. Product Number: 69785, Version 5.4 (Revision Date 12/23/2014). Available from, as of January 29, 2016: ***https://www.sigmaaldrich.com/safety-center.html***

▸ **Hazardous Substances Data Bank (HSDB)**

3.2.13 Decomposition

When heated to decompositionit emits acrid smoke and irritating fumes.

Lewis, R.J. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 11th Edition. Wiley-Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p. 2196

▸ **Hazardous Substances Data Bank (HSDB)**

3.2.14 Viscosity

Viscosities of aqueous lactic acid at 25 °C: 1.042 mPa s (6.29 wt%), 1.752 mPa s (25.02 wt%), 4.68 mPa s (54.94 wt%), 36.9 mPa s (88.60 wt%)

Starr JN, Westhoff G; Lactic Acid. Ullmann's Encyclopedia of Industrial Chemistry. 7th ed. (1999-2016). New York, NY: John Wiley & Sons. Online Posting Date: 31 Jan 2014

▸ **Hazardous Substances Data Bank (HSDB)**

3.2.15 Corrosivity

Caustic in concentrated solutions

O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Cambridge, UK: Royal Society of Chemistry, 2013., p. 990

▸ Hazardous Substances Data Bank (HSDB)

3.2.16 Heat of Combustion

3615 cal/kg

O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Cambridge, UK: Royal Society of Chemistry, 2013., p. 990

▸ Hazardous Substances Data Bank (HSDB)

3.2.17 pH

The pH of a 10 wt% aqueous solution of lactic acid is 1.75

Starr JN, Westhoff G; Lactic Acid. Ullmann's Encyclopedia of Industrial Chemistry. 7th ed. (1999-2016). New York, NY: John Wiley & Sons. Online Posting Date: 31 Jan 2014

▸ Hazardous Substances Data Bank (HSDB)

3.2.18 Refractive Index

Index of refraction = 1.4392 at 20 °C

Haynes, W.M. (ed.). CRC Handbook of Chemistry and Physics. 95th Edition. CRC Press LLC, Boca Raton: FL 2014-2015, p. 3-336

▸ Hazardous Substances Data Bank (HSDB)

1.413-1.429

▸ Joint FAO/WHO Expert Committee on Food Additives (JECFA)

3.2.19 Dissociation Constants

pKa

3.86 (at 20 °C)

KORTUM,G ET AL (1961)

▸ DrugBank

pKa = 3.86 at 20 °C

O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Cambridge, UK: Royal Society of Chemistry, 2013., p. 990

▸ Hazardous Substances Data Bank (HSDB)

▸ IUPAC Digitized pKa Dataset

3.2.20 Collision Cross Section

151.9 Å² $[M-H]^-$

S50 | CCSCOMPEND | The Unified Collision Cross Section (CCS) Compendium | DOI:10.5281/zenodo.2658162

▸ NORMAN Suspect List Exchange

3.2.21 Kovats Retention Index

Standard non-polar	838

▸ NIST Mass Spectrometry Data Center

3.2.22 Other Experimental Properties

Undergoes self-esterification even in aqueous solution ... hydrolysis to monomeric lactic acid occurs upon dilution with water

Furia, T.E. (ed.). CRC Handbook of Food Additives. 2nd ed. Cleveland: The Chemical Rubber Co., 1972., p. 237

▸ **Hazardous Substances Data Bank (HSDB)**

When heated, dehydrates forming series of polylactic acids such as lactyllactic acid, liner trimer, & higher polymers

Furia, T.E. (ed.). CRC Handbook of Food Additives. 2nd ed. Cleveland: The Chemical Rubber Co., 1972., p. 238

▸ **Hazardous Substances Data Bank (HSDB)**

Hygroscopic ... Has one asymmetric **carbon** and two enantiomorphic isomers. The commercial form is a racemic mixture. ... Cannot be distilled at atmospheric pressure without decomposition; when concentrated above 50% it is partially converted to **lactic anhydride**.

Lewis, R.J. Sr.; Hawley's Condensed Chemical Dictionary 15th Edition. John Wiley & Sons, Inc. New York, NY 2007., p. 736

▸ **Hazardous Substances Data Bank (HSDB)**

Specific heat at 20 °C: 0.505 cal/g °C

Furia, T.E. (ed.). CRC Handbook of Food Additives. 2nd ed. Cleveland: The Chemical Rubber Co., 1972., p. 237

▸ **Hazardous Substances Data Bank (HSDB)**

For more Other Experimental Properties (Complete) data for LACTIC ACID (7 total), please visit the **HSDB record page**.

▸ **Hazardous Substances Data Bank (HSDB)**

3.3 Chemical Classes

Other Classes -> Organic Acids

▸ **Haz-Map, Information on Hazardous Chemicals and Occupational Diseases**

3.3.1 Drugs

3.3.1.1 Human Drugs

Human drug -> Active ingredient (LACTIC ACID)

▸ **Drugs@FDA**

3.3.1.2 Animal Drugs

Pharmaceuticals -> UK Veterinary Medicines Directorate List

*S104 | UKVETMED | UK Veterinary Medicines Directorate's List | **DOI:10.5281/zenodo.7802119***

▸ NORMAN Suspect List Exchange

3.3.2 Cosmetics

Cosmetic ingredients (Lactic Acid) -> CIR (Cosmetic Ingredient Review)

International Journal of Toxicology 17(S1):1-241, 1998

International Journal of Toxicology 36(Suppl 2):14-58, 2017

▸ Cosmetic Ingredient Review (CIR)

Buffering; Humectant; Skin conditioning

*S13 | EUCOSMETICS | Combined Inventory of Ingredients Employed in Cosmetic Products (2000) and Revised Inventory (2006) | **DOI:10.5281/zenodo.2624118***

▸ NORMAN Suspect List Exchange

3.3.3 Flavoring Agents

EU Flavoring substances

▸ EU Food Improvement Agents

3.3.4 Food Additives

ANTIMICROBIAL AGENT, CURING OR PICKLING AGENT, FLAVOR ENHANCER, FLAVORING AGENT OR ADJUVANT, PH CONTROL AGENT, SOLVENT OR VEHICLE -> FDA Substance added to food

▸ FDA Substances Added to Food

3.3.5 Food Contact Substances

FCS -> FDA Inventory of Food Contact Substances Listed in 21 CFR

- FDA Packaging & Food Contact Substances (FCS)

3.3.6 Fragrances

Fragrance Ingredient (Lactic acid) -> IFRA transparency List

- International Fragrance Association (IFRA)

3.3.7 Pesticides

Plant Growth Regulators

- EU Pesticides Database

Active substance -> EU Pesticides database: Not approved

- EU Pesticides Database

4 Spectral Information

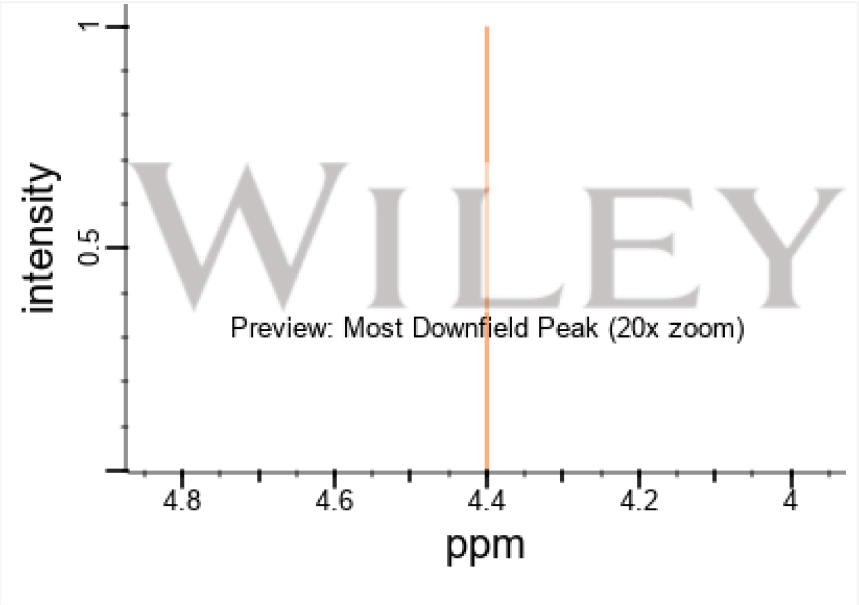
4.1 1D NMR Spectra

1D NMR Spectra	1H NMR: 9265 (Sadtler Research Laboratories Spectral Collection)

- Hazardous Substances Data Bank (HSDB)

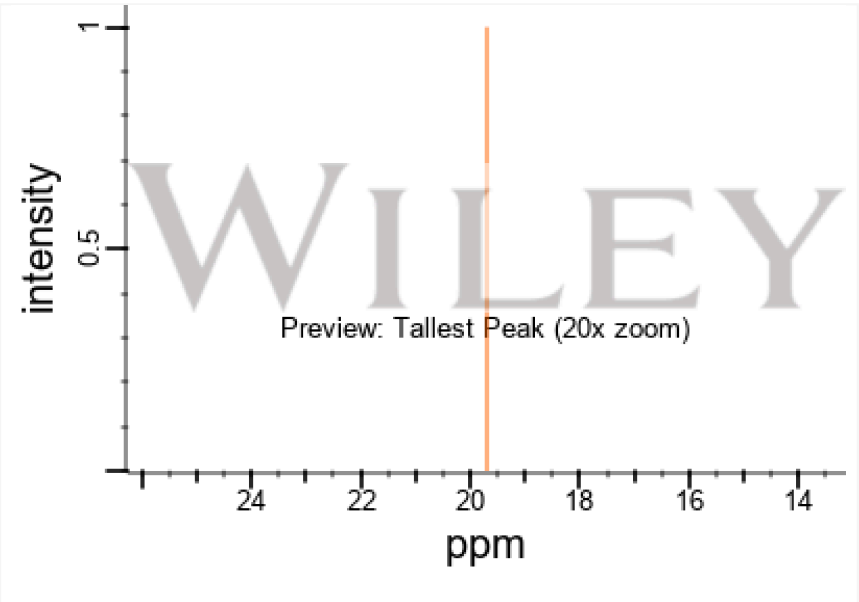
4.1.1 1H NMR Spectra

Instrument Name	Varian A-60
Copyright	

Thumbnail	

▸ SpectraBase

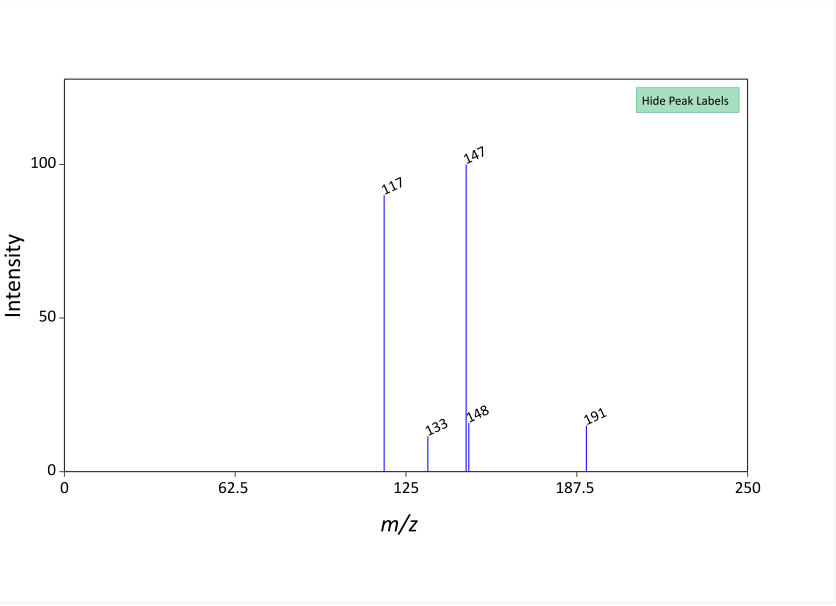
4.1.2 13C NMR Spectra

Source of Sample	Mallinckrodt Chemical Works, St. Louis, Missouri
Copyright	Copyright © 1980, 1981-2025 John Wiley & Sons, Inc. All Rights Reserved.
Thumbnail	

▸ SpectraBase

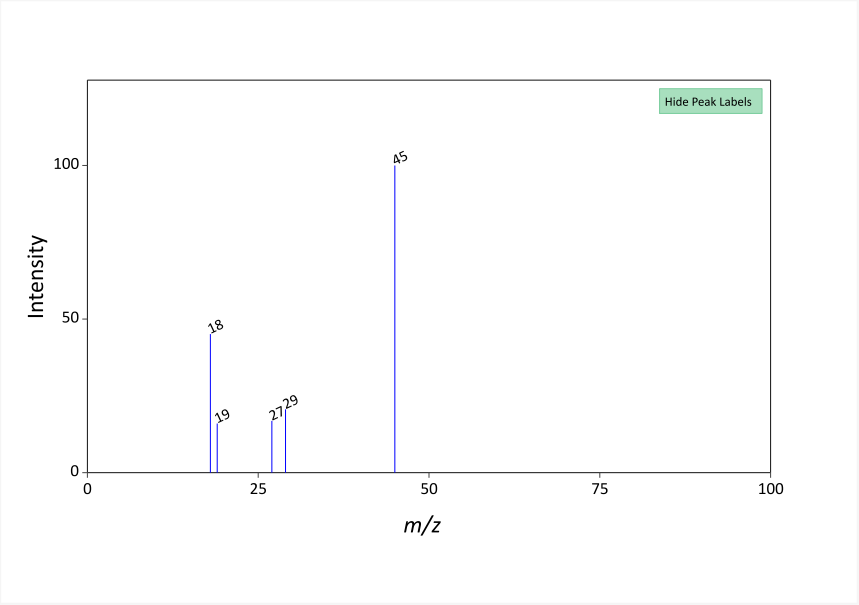
4.2 Mass Spectrometry

4.2.1 GC-MS

1 of 6 items	View All
MoNA ID	FiehnLib001082
MS Category	Experimental
MS Type	GC-MS
MS Level	MS1
Instrument	Leco Pegasus IV
Instrument Type	GC-EI-TOF
Ionization Mode	positive
Top 5 Peaks	147 100 117 89.99 148 15.82 191 15.02 133 11.51
SPLASH	splash10-00kb-0900000000-31df199e59f138c8cc73
Thumbnail	

▸ MassBank of North America (MoNA)

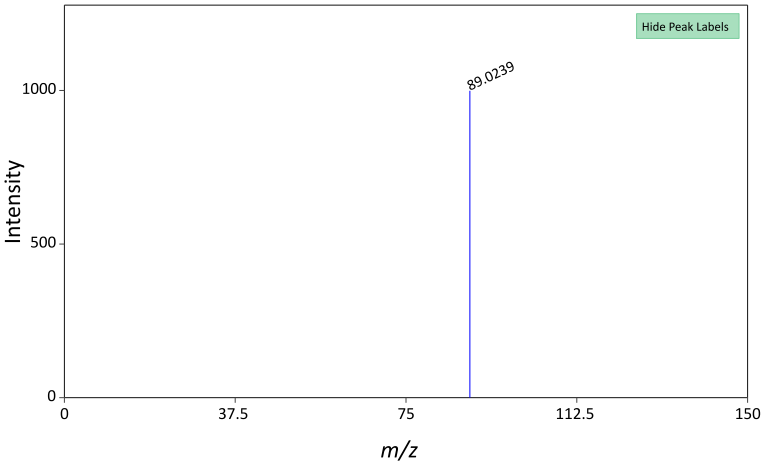
2 of 6 items	View All
MoNA ID	JP011926

MS Category	Experimental
MS Type	GC-MS
MS Level	MS1
Instrument	HITACHI M-2500
Instrument Type	EI-B
Ionization Mode	positive
Top 5 Peaks	45 99.99 18 45.11 29 20.61 27 16.85 19 15.99
SPLASH	splash10-00kb-9000000000-e9462d6d6eeac598b73b
Thumbnail	
License	CC BY-NC-SA

▸ MassBank of North America (MoNA)

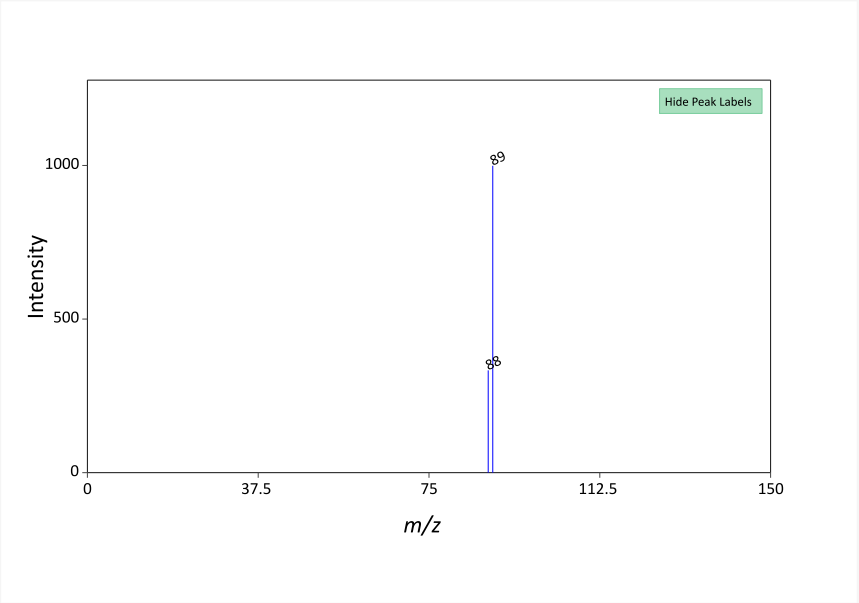
4.2.2 LC-MS

1 of 7 items	View All
Accession ID	MSBNK-RIKEN-PR100774

Authors	Matsuda F, Suzuki M, Sawada Y, Plant Science Center, RIKEN.
Instrument	UPLC Q-Tof Premier, Waters
Instrument Type	LC-ESI-QTOF
MS Level	MS2
Ionization Mode	NEGATIVE
Ionization	ESI
Collision Energy	Ramp 5-60 V
Fragmentation Mode	LOW-ENERGY CID
Precursor m/z	89.02389
Precursor Adduct	[M-H]-
Top 5 Peaks	89.0239 999
SPLASH	splash10-000i-9000000000-32a7c59ca2c276cf73a6
Thumbnail	
License	CC BY-SA

▸ MassBank Europe

2 of 7 items	View All
Accession ID	MSBNK-RIKEN_ReSpect-PS068507
Authors	Sawada Y, Matsuda F, and Hirai MY. Plant Science Center, RIKEN

Instrument	TQD, Waters
Instrument Type	LC-ESI-QQ
MS Level	MS2
Ionization Mode	NEGATIVE
Ionization	ESI
Collision Energy	10
Precursor m/z	89.01
Top 5 Peaks	89 999 88 333
SPLASH	splash10-000i-9000000000-aca553687253b92c8103
Thumbnail	
License	CC BY-NC
Reference	Sawada, Y.; Akiyama, K.; Sakata, A.; Kuwahara, A.; Otsuki, H.; Sakurai, T.; Saito, K.; Hirai, M. Y. Widely Targeted Metabolomics Based on Large-Scale MS/MS Data for Elucidating Metabolite Accumulation Patterns in Plants. Plant and Cell Physiology 2008, 50 (1), 37-47. DOI:10.1093/pcp/pcn183

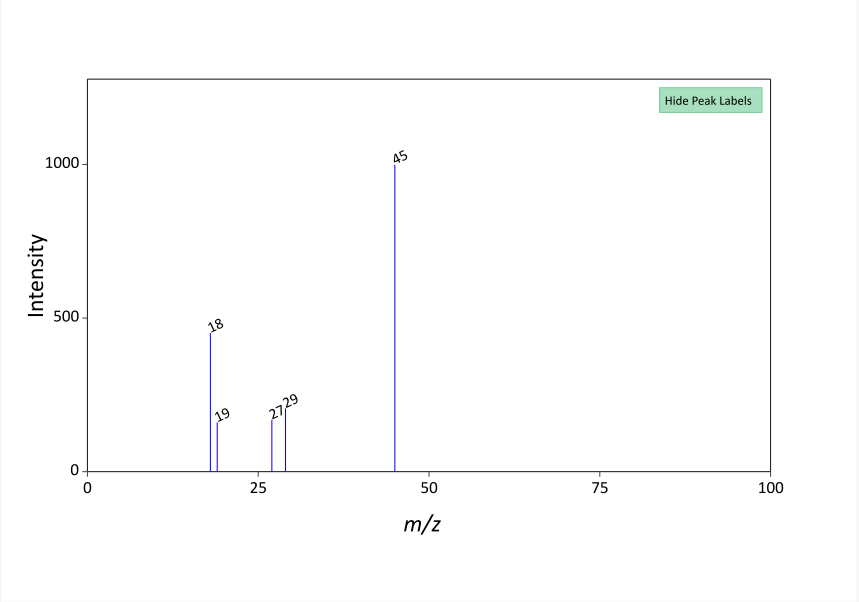
▸ MassBank Europe

4.2.3 Other MS

1 of 2 items	
Other MS	MASS: 176 (Atlas of Mass Spectral Data, John Wiley & Sons, New York) /Lactic acid (D)/
Other MS	MASS: 176 (Atlas of Mass Spectral Data, John Wiley & Sons, New York) /Lactic acid (L)/
Other MS	MASS: 176 (Atlas of Mass Spectral Data, John Wiley & Sons, New York)

▸ Hazardous Substances Data Bank (HSDB)

2 of 2 items	
Accession ID	MSBNK-Fac_Eng_Univ_Tokyo-JP011926
Authors	YAMAMOTO M, DEP. CHEMISTRY, FAC. SCIENCE, NARA WOMEN'S UNIV.
Instrument	HITACHI M-2500
Instrument Type	EI-B
MS Level	MS
Ionization Mode	POSITIVE
Ionization	ENERGY 70 eV
Top 5 Peaks	45 999 18 451 29 206 27 169 19 160
SPLASH	splash10-00kb-9000000000-e9462d6d6eeac598b73b

Thumbnail	
License	CC BY-NC-SA

▸ MassBank Europe

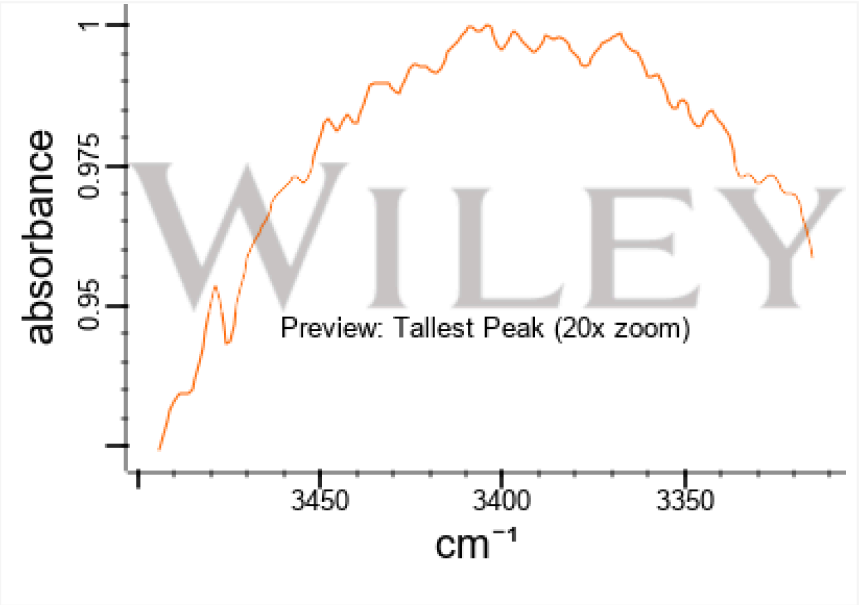
4.3 IR Spectra

IR Spectra	IR: 467 (Sadtler Research Laboratories IR Grating Collection)

▸ Hazardous Substances Data Bank (HSDB)

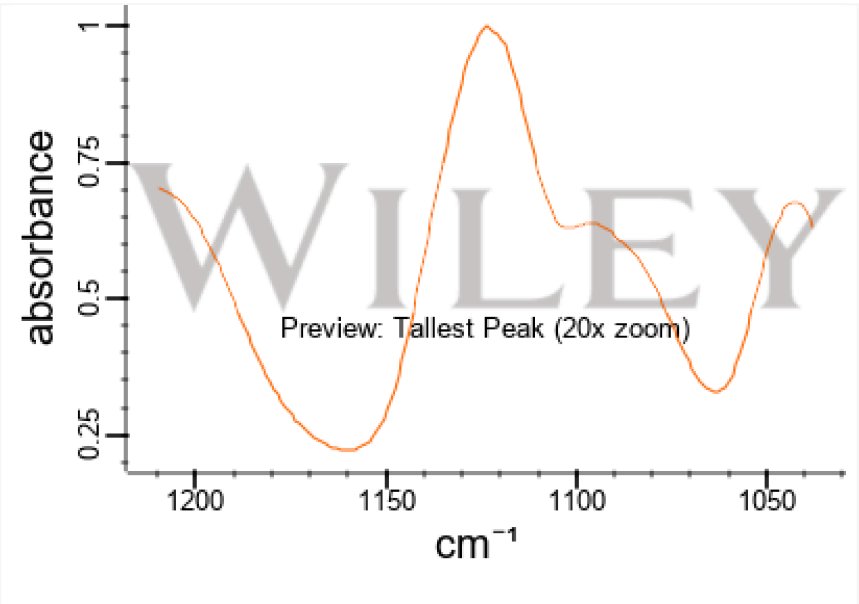
4.3.1 FTIR Spectra

Technique	CAPILLARY CELL: NEAT
Source of Sample	Fluka Chemie AG, Buchs, Switzerland
Copyright	Copyright © 1980, 1981-2025 John Wiley & Sons, Inc. All Rights Reserved.

Thumbnail	

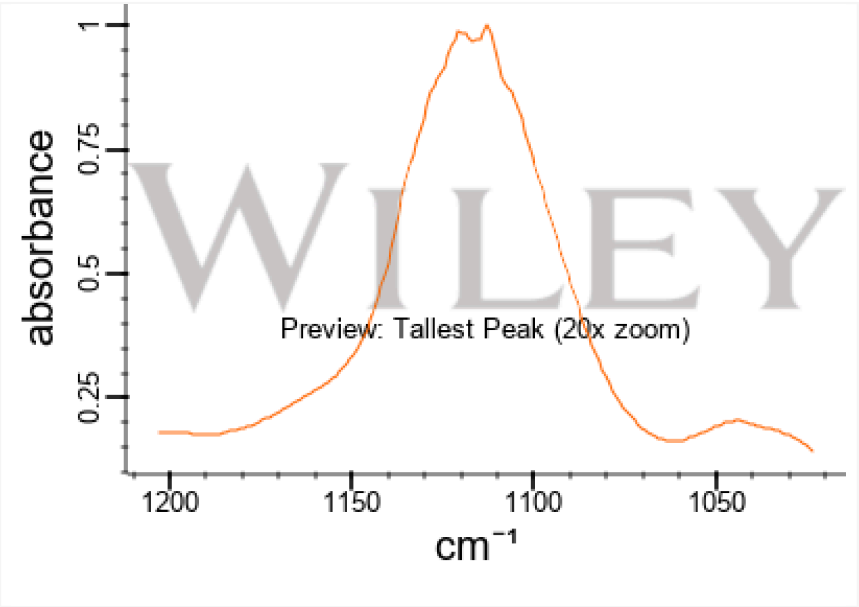
▸ SpectraBase

4.3.2 ATR-IR Spectra

Technique	ATR-Cylindrical Internal Reflectance (CIR)
Copyright	Copyright © 1980, 1981-2025 John Wiley & Sons, Inc. All Rights Reserved.
Thumbnail	

▸ SpectraBase

4.3.3 Vapor Phase IR Spectra

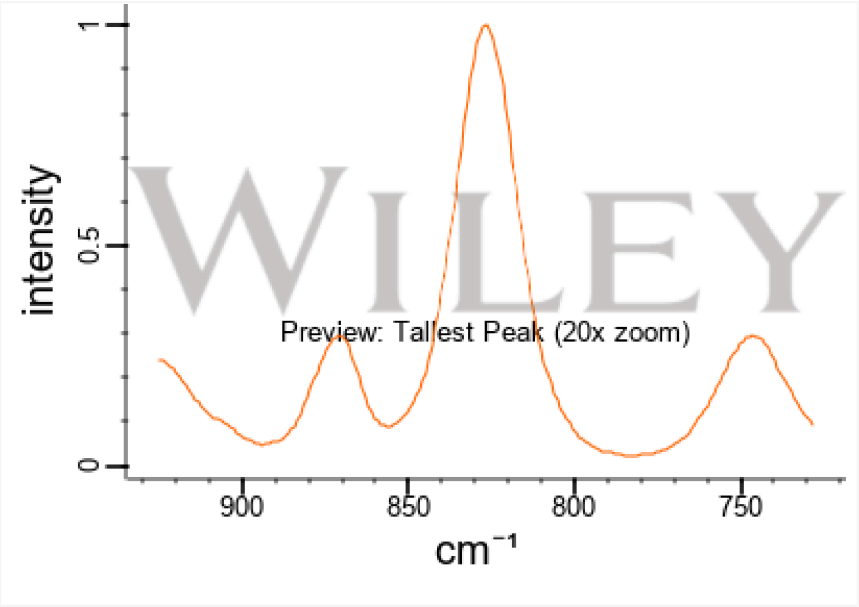
Technique	Vapor Phase
Copyright	Copyright © 1980, 1981-2025 John Wiley & Sons, Inc. All Rights Reserved.
Thumbnail	

▸ SpectraBase

4.4 Raman Spectra

Catalog Number	252476
Copyright	Copyright © 2017-2025 Sigma-Aldrich Co. LLC. - Database Compilation Copyright © 2017-2025 John Wiley & Sons, Inc. All Rights Reserved.

Thumbnail



▸ SpectraBase

4.5 Other Spectra

Sadtler Ref Number: 5338 (IR, Prism)

Weast, R.C. (ed.). Handbook of Chemistry and Physics. 57th ed. Cleveland: CRC Press Inc., 1976., p. C-456

▸ Hazardous Substances Data Bank (HSDB)

5 Related Records

5.1 Related Compounds with Annotation

Follow these links to do a live 2D search or do a live 3D search for this compound, sorted by annotation score. This section is deprecated (see the neighbor discontinuation help page for details), but these live search links provide equivalent functionality to the table that was previously shown here.

▸ PubChem

5.2 Related Compounds

Same Connectivity Count	52
Same Stereo Count	33

Same Isotope Count	3
Same Parent, Connectivity Count	1289
Same Parent, Stereo Count	1101
Same Parent, Isotope Count	1205
Same Parent, Exact Count	1051
Mixtures, Components, and Neutralized Forms Count	5883
Similar Compounds (2D)	View in PubChem Search
Similar Conformers (3D)	View in PubChem Search

PubChem

5.3 Substances

5.3.1 PubChem Reference Collection SID

481107791

PubChem

5.3.2 Related Substances

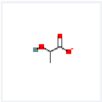
All Count	13965
Same Count	565
Mixture Count	13400

PubChem

5.3.3 Substances by Category

PubChem

5.4 Other Relationships



Lactate (has subclass)

Calcium chloride; dextrose; lactic acid; magnesium chloride; potassium chloride; sodium bicarbonate; sodium chloride (component of)

Citric acid; lactic acid; potassium bitartrate (component of)

PubChem

5.5 Entrez Crosslinks

PubMed Count	36061
Protein Structures Count	87
Taxonomy Count	25

PubChem

5.6 Associated Chemicals

D-Lactic acid; 10326-41-7

Hazardous Substances Data Bank (HSDB)

L-Lactic acid; 79-33-4

- Hazardous Substances Data Bank (HSDB)

5.7 NCBI LinkOut

- NCBI

6 Chemical Vendors

▸ PubChem

7 Drug and Medication Information

7.1 Drug Indication

For use as an alkalinizing agent.

▸ DrugBank

▸ Open Targets

7.2 FDA Approved Drugs

- Drugs@FDA

7.3 FDA Orange Book

- FDA Orange Book

7.4 FDA National Drug Code Directory

- National Drug Code (NDC) Directory

7.5 Drug Labels

Drug and label

- DailyMed

View More...

7.6 Clinical Trials

7.6.1 ClinicalTrials.gov

- ClinicalTrials.gov

7.6.2 EU Clinical Trials Register

- EU Clinical Trials Register

7.6.3 NIPH Clinical Trials Search of Japan

▸ NIPH Clinical Trials Search of Japan

7.7 Therapeutic Uses

/CLINICAL TRIALS/ ClinicalTrials.gov is a registry and results database of publicly and privately supported clinical studies of human participants conducted around the world. The Web site is maintained by the National Library of Medicine (NLM) and the National Institutes of Health (NIH). Each ClinicalTrials.gov record presents summary information about a study protocol and includes the following: Disease or condition; Intervention (for example, the medical product, behavior, or procedure being studied); Title, description, and design of the study; Requirements for participation (eligibility criteria); Locations where the study is being conducted; Contact information for the study locations; and Links to relevant information on other health Web sites, such as NLM's MedlinePlus for patient health information and PubMed for citations and abstracts for scholarly articles in the field of medicine. Lactic acid is included in the database.

NIH/NLM; ClinicalTrials.Gov. Available from, as of March 17, 2016: ***https://clinicaltrials.gov/ct2/results?term=lactic+acid&Search=Search***

▸ Hazardous Substances Data Bank (HSDB)

(VET): Has been used as a caustic, and in dilute solutions to irrigate tissues; as an intestinal antiseptic and antiferment.

O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Cambridge, UK: Royal Society of Chemistry, 2013., p. 990

▸ Hazardous Substances Data Bank (HSDB)

A 10% solution is used as a bactericidal agent on the skin of neonates. ... A 16.7% solution in flexible collodion is used to remove warts and small cutaneous tumors.

Troy, D.B. (Ed); Remmington The Science and Practice of Pharmacy. 21 st Edition. Lippincott Williams & Williams, Philadelphia, PA 2005, p. 1087

▸ Hazardous Substances Data Bank (HSDB)

Acidulant

O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Cambridge, UK: Royal Society of Chemistry, 2013., p. 990

▸ Hazardous Substances Data Bank (HSDB)

8 Food Additives and Ingredients

8.1 Food Additive Classes

Flavoring Agents

- EU Food Improvement Agents; Joint FAO/WHO Expert Committee on Food Additives (JECFA)

JECFA Functional Classes

FLAVOURING_AGENT;

- Joint FAO/WHO Expert Committee on Food Additives (JECFA)

8.2 Food Additive Definition

EU Food Additive Definition

Consists of a mixture of lactic acid (C3H6O3) and lactic acid lactate (C6H10O5). It is obtained by the lactic fermentation of sugars or is prepared synthetically.; Lactic acid is hygroscopic and when concentrated by boiling, it condenses to form lactic acid lactate, which on dilution and heating hydrolyses to lactic acid.

- EU Food Improvement Agents

8.3 FDA Substances Added to Food

Substance	LACTIC ACID
Used for (Technical Effect)	ANTIMICROBIAL AGENT, CURING OR PICKLING AGENT, FLAVOR ENHANCER, FLAVORING AGENT OR ADJUVANT, PH CONTROL AGENT, SOLVENT OR VEHICLE
Document Number (21 eCFR)	172.814 178.1010 184.1061 133.123 133.124 133.129 133.169 133.173 133.178

	133.179
FEMA Number	2611
GRAS Number	3, 25
JECFA Flavor Number	930

▸ FDA Substances Added to Food

8.4 FDA Food Contact Substances (FCS)

Substance	LACTIC ACID
Document Number (21 eCFR)	172.814 178.1010 184.1061

▸ FDA Packaging & Food Contact Substances (FCS)

8.5 Evaluations of the Joint FAO / WHO Expert Committee on Food Additives - JECFA

Chemical Name	LACTIC ACID
Evaluation Year	2001
ADI	NOT LIMITED (1973)
Comments	No safety concern at current levels of intake when used as a flavouring agent
Report	TRS 909-JECFA 57/98
Tox Monograph	FAS 48-JECFA 57/333

▸ Joint FAO/WHO Expert Committee on Food Additives (JECFA)

9 Agrochemical Information

9.1 Agrochemical Category

Pesticide active substances -> Plant Growth Regulators

- EU Pesticides Database

9.2 EU Pesticides Data

Active Substance	lactic acid
Status	Not approved [Reg. (EC) No 1107/2009]
Legislation	2004/129/EC
ADI	Not Applicable
ARfD	Not Applicable
AOEL	Not Applicable

- EU Pesticides Database

10 Pharmacology and Biochemistry

10.1 Pharmacodynamics

Lactic acid produces a metabolic alkalinizing effect.

- DrugBank

10.2 FDA Pharmacological Classification

1 of 5 items	
FDA UNII	33X04XA5AT
Active Moiety	LACTIC ACID, UNSPECIFIED FORM
Pharmacological Classes	Mechanisms of Action [MoA] - Acidifying Activity
FDA Pharmacology Summary	The mechanism of action of lactic acid, unspecified form is as an Acidifying Activity.

- FDA Pharm Classes

2 of 5 items	
Non-Proprietary Name	LACTIC ACID 50 SKIN CHEMICAL PEEL
Pharmacological Classes	Acidifying Activity [MoA]

▸ National Drug Code (NDC) Directory

3 of 5 items	
Non-Proprietary Name	LACTIC ACID 70 SKIN CHEMICAL PEEL
Pharmacological Classes	Acidifying Activity [MoA]

▸ National Drug Code (NDC) Directory

4 of 5 items	
Non-Proprietary Name	ISHANCARE VAGINAL ANTIBACTERIAL GEL
Pharmacological Classes	Acidifying Activity [MoA]

▸ National Drug Code (NDC) Directory

5 of 5 items	
Non-Proprietary Name	LACTIC ACID
Pharmacological Classes	Acidifying Activity [MoA]

▸ National Drug Code (NDC) Directory

10.3 ATC Code

G - Genito urinary system and sex hormones

G01 - Gynecological antiinfectives and antiseptics

G01A - Antiinfectives and antiseptics, excl. combinations with corticosteroids

G01AD - Organic acids

G01AD01 - Lactic acid

▸ WHO Anatomical Therapeutic Chemical (ATC) Classification

ATCvet Code

QP - Antiparasitic products, insecticides and repellents

QP53 - Ectoparasiticides, insecticides and repellents

QP53A - Ectoparasiticides for topical use, incl. insecticides

QP53AG - Organic acids

QP53AG02 - Lactic acid

▸ WHO ATCvet - Classification of Veterinary Medicines

ATCvet Code

QG - Genito urinary system and sex hormones

QG01 - Gynecological antiinfectives and antiseptics

QG01A - Antiinfectives and antiseptics, excl. combinations with corticosteroids

QG01AD - Organic acids

QG01AD01 - Lactic acid

▸ WHO ATCvet - Classification of Veterinary Medicines

10.4 Bionecessity

Lactic acidosis is associated with both inherited and acquired metabolic diseases. Lactic acid metabolism in the presence of altered gluconeogenesis, anaerobic glycolysis, and acid-base balance is a major factor in many disorders. Lactic acid can be formed only from **pyruvic acid**; therefore, disorders that increase **pyruvate** concentration, enhance lactic acid formation, or reduce lactic acid degradation cause lactic acidosis. Inborn metabolic errors that are accompanied by derangement of metabolic pathways of **glucose**, **pyruvate**, amino acids, and organic acids as well as toxic and systemic conditions that promote tissue hypoxia or mitochondrial injury result in lactic acidosis. In the presence of acquired disorders, treatment is directed initially toward modification or cure of the primary condition and then toward eliminating acidosis and other metabolic complications. Specific therapy is available for some inborn errors of metabolism.

PMID:3334198

Evans OB; Pediatr Neurol 2 (1): 5-12 (1986)

▸ Hazardous Substances Data Bank (HSDB)

Macrophages have an important role in the maintenance of tissue homeostasis. To perform this function, macrophages must have the capacity to monitor the functional states of their 'client cells': namely, the parenchymal cells in the various tissues in which macrophages reside. Tumors exhibit many features of abnormally developed organs, including tissue architecture

and cellular composition. Similarly to macrophages in normal tissues and organs, macrophages in tumors (tumor-associated macrophages) perform some key homeostatic functions that allow tumor maintenance and growth. However, the signals involved in communication between tumors and macrophages are poorly defined. Here we show that lactic acid produced by tumor cells, as a by-product of aerobic or anaerobic glycolysis, has a critical function in signalling, through inducing the expression of vascular endothelial growth factor and the M2-like polarization of tumor-associated macrophages. Furthermore, we demonstrate that this effect of lactic acid is mediated by hypoxia-inducible factor 1alpha (HIF1alpha). Finally, we show that the **lactate**-induced expression of arginase 1 by macrophages has an important role in tumor growth. Collectively, these findings identify a mechanism of communication between macrophages and their client cells, including tumor cells. This communication most probably evolved to promote homeostasis in normal tissues but can also be engaged in tumors to promote their growth.

PMID:25043024

*Full text: **https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4301845***

Colegio OR et al; Nature 513 (7519): 559-63 (2014)

▸ **Hazardous Substances Data Bank (HSDB)**

L-lactic acid is a normal metabolic intermediate produced by most mammalian cells and other organisms, such as bacteria; it is metabolized in preference to **D-lactic acid** in man, dogs, and rats. Lactic acid is converted to **pyruvic acid** by lactic acid dehydrogenase.

Cosmetic Ingredient Review Expert Panel; International Journal of Toxicology, 17 (Suppl.1): 1-203 (1998)

▸ **Hazardous Substances Data Bank (HSDB)**

10.5 Absorption, Distribution and Excretion

L-lactic acid occurs in small quantities in the blood and muscle fluid of humans and animals; the concentration of lactic acid in these fluids increases after vigorous activity. **L-lactic acid** is also present in the liver, kidneys, thymus gland, human amniotic fluid, and other organs and body fluids.

Cosmetic Ingredient Review Expert Panel; International Journal of Toxicology, 17 (Suppl.1): 1-203 (1998)

▸ **Hazardous Substances Data Bank (HSDB)**

A primed infusion study was performed /in humans/ using radioactive L-lactic acid. The virtual volume of distribution of **lactate** was 49.4% of body weight. The **lactate** pool size and turnover time were estimated as 0.029 g/kg and 18.4 min, respectively.

Cosmetic Ingredient Review Expert Panel; International Journal of Toxicology, 17 (Suppl.1): 1-203 (1998)

▸ Hazardous Substances Data Bank (HSDB)

In the body, lactate is distributed equivalently to, or slightly less than, total body water. It diffuses readily across cell membranes, primarily by passive transport; under certain conditions, the distribution could be uneven or the lactate pool could consist of several smaller pools with differing rate constants.

Cosmetic Ingredient Review Expert Panel; International Journal of Toxicology, 17 (Suppl.1): 1-203 (1998)

▸ Hazardous Substances Data Bank (HSDB)

The percutaneous absorption of topically applied 5% [14C]-lactic acid in an oil-in-water cream was measured using rats. After 3 days, 50% of the applied lactic acid had penetrated the skin.

Cosmetic Ingredient Review Expert Panel; International Journal of Toxicology, 17 (Suppl.1): 1-203 (1998)

▸ Hazardous Substances Data Bank (HSDB)

For more Absorption, Distribution and Excretion (Complete) data for LACTIC ACID (6 total), please visit the HSDB record page.

▸ Hazardous Substances Data Bank (HSDB)

10.6 Metabolism / Metabolites

... Propylene glycol ... is oxidized to lactic acid or pyruvic acid by two pathways. These two metabolites are then used by the body as sources of energy either by oxidation through the tricarboxylic acid cycle or by generation of glycogen through the glycolytic pathway.

Bingham, E.; Cohrssen, B.; Powell, C.H.; Patty's Toxicology Volumes 1-9 5th ed. John Wiley & Sons. New York, N.Y. (2001)., p. V7 31

▸ Hazardous Substances Data Bank (HSDB)

Lactic acid diffuses through muscle tissue and is transported to the liver in the bloodstream. In the liver, it is converted to glucose by gluconeogenesis. Lactic acid can also be further catabolized in the lactic acid cycle (also known as the Cori cycle).

*Joint FAO/WHO Expert Committee on Food Additives; WHO Food Additives Ser 48: Lactic acid (2002). Available from, as of April 19, 2006: **https://www.inchem.org/documents/jecfa/jecmono/v48je16.htm***

▸ Hazardous Substances Data Bank (HSDB)

L-lactic acid is a normal metabolic intermediate produced by most mammalian cells and other organisms, such as bacteria; it is metabolized in preference to D-lactic acid in man, dogs, and rats. Lactic acid is converted to pyruvic acid by lactic acid dehydrogenase.

Cosmetic Ingredient Review Expert Panel; International Journal of Toxicology, 17 (Suppl.1): 1-203 (1998)

▸ Hazardous Substances Data Bank (HSDB)

In animals, lactate that is generated by anaerobic metabolism can be transported to other more aerobic tissues, such as the liver, where it can be reconverted to pyruvate. The pyruvate can then be further metabolized, reconverted to carbohydrate material as free glucose, or stored as glycogen.

Cosmetic Ingredient Review Expert Panel; International Journal of Toxicology, 17 (Suppl.1): 1-203 (1998)

▸ Hazardous Substances Data Bank (HSDB)

For more Metabolism/Metabolites (Complete) data for LACTIC ACID (8 total), please visit the HSDB record page.

▸ Hazardous Substances Data Bank (HSDB)

10.7 Mechanism of Action

Lactate ions are metabolized ultimately to carbon dioxide and water, which requires the consumption of hydrogen cations.

▸ DrugBank

10.8 Transformations

▸ NORMAN Suspect List Exchange

11 Use and Manufacturing

11.1 Uses

Cosmetic Ingredient Review Link

CIR ingredient: Lactic Acid

International Journal of Toxicology 17(S1):1-241, 1998

International Journal of Toxicology 36(Suppl 2):14-58, 2017

▸ Cosmetic Ingredient Review (CIR)

EPA CPDat Chemical and Product Categories

The Chemical and Products Database, a resource for exposure-relevant data on chemicals in consumer products, Scientific Data, volume 5, Article number: 180125 (2018), DOI:10.1038/sdata.2018.125

▸ EPA Chemical and Products Database (CPDat)

Sources/Uses

Used as a solvent and acidulant in the production of foods, drugs, and dyes; Also used as a mordant in woolen goods printing, a soldering flux, a dehairing agent, and a catalyst for phenolic resins; Also used in leather tanning, oil well acidizing, and as a plant growth regulator; [HSDB]

▸ Haz-Map, Information on Hazardous Chemicals and Occupational Diseases

Industrial Processes with risk of exposure

Petroleum Production and Refining [Category: Industry]

Soldering [Category: Heat or Machine]

Farming (Pesticides) [Category: Industry]

Leather Tanning and Processing [Category: Industry]

Fur Dressing and Dyeing [Category: Industry]

Textiles (Printing, Dyeing, or Finishing) [Category: Industry]

▸ **Haz-Map, Information on Hazardous Chemicals and Occupational Diseases**

The fastest growing use for lactic acid is its use as a monomer for the production of polylactic acid or polylactide (PLA). ... Applications for PLA include containers for the food and beverage industries, films and rigid containers for packaging, and serviceware (cups, plates, utensils). The PLA polymer can also be spun into fibers and used in apparel, fiberfill (pillows, comforters), carpet, and nonwoven applications such as wipes.

Starr JN, Westhoff G; Lactic Acid. Ullmann's Encyclopedia of Industrial Chemistry 7th ed. (1999-2016). NY, NY: John Wiley & Sons. Online Posting Date: January 31, 2014

▸ **Hazardous Substances Data Bank (HSDB)**

It is used in metal plating, cosmetics, and the textile and leather industry.

Starr JN, Westhoff G; Lactic Acid. Ullmann's Encyclopedia of Industrial Chemistry 7th ed. (1999-2016). NY, NY: John Wiley & Sons. Online Posting Date: January 31, 2014

▸ **Hazardous Substances Data Bank (HSDB)**

In dyeing baths, as mordant in printing woolen goods, solvent for **water**-insoluble dyes (alcohol-soluble induline, **nigrosine**, spirit-blue). Reducing chromates in mordanting wool. Manufacturing cheese, confectionery. Component of babies' milk formulas; acidulant in beverages; for acidulating worts in brewing. In preparation of **sodium lactate** injections. Ingredient of cosmetics. Component of spermatocidal jellies. For removing Clostridium butyricum in manufacturing of yeast; dehairing, plumping, and decalcifying hides. Solvent for **cellulose formate**. Flux for soft solder. Manufacturing lactates which are used in food products, in medicine, and as solvents. Plasticizer, catalyst in the casting of phenolaldehyde resins.

O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Cambridge, UK: Royal Society of Chemistry, 2013., p. 990

▸ **Hazardous Substances Data Bank (HSDB)**

Plant growth regulator

United States Environmental Protection Agency/ Prevention, Pesticides and Toxic Substances; Status of Pesticides in Registration, Reregistration, and Special Review. (1998) EPA 738-R-98-002, p. 378

- **Hazardous Substances Data Bank (HSDB)**

For more Uses (Complete) data for LACTIC ACID (7 total), please visit the **HSDB record page**.

- **Hazardous Substances Data Bank (HSDB)**

11.1.1 Use Classification

EPA Safer Chemical Functional Use Classes -> Preservatives and Antioxidants;Processing Aids and Additives

- **EPA Safer Choice**

Safer Chemical Classes -> ● Green circle - The chemical has been verified to be of low concern

- **EPA Safer Choice**

Food additives

- **EU Food Improvement Agents**

Human Drugs -> FDA Approved Drug Products with Therapeutic Equivalence Evaluations (Orange Book) -> Active Ingredients

- **FDA Orange Book**

Fragrance Ingredients

- **International Fragrance Association (IFRA)**

FLAVOURING_AGENT; -> JECFA Functional Classes

- **Joint FAO/WHO Expert Committee on Food Additives (JECFA)**

Flavoring Agents -> JECFA Flavorings Index

- **Joint FAO/WHO Expert Committee on Food Additives (JECFA)**

Cosmetics -> Buffering; Humectant; Skin conditioning

*S13 | EUCOSMETICS | Combined Inventory of Ingredients Employed in Cosmetic Products (2000) and Revised Inventory (2006) | **DOI:10.5281/zenodo.2624118***

▸ NORMAN Suspect List Exchange

11.1.2 Industry Uses

Process regulators
Processing aids, not otherwise listed
Plating agents and surface treating agents
Agricultural chemicals (non-pesticidal)
Not Known or Reasonably Ascertainable
Intermediate

https://www.epa.gov/chemical-data-reporting

▸ EPA Chemical Data Reporting (CDR)

11.1.3 Consumer Uses

Intermediate
Preservative
Processing aids, not otherwise listed
Agricultural chemicals (non-pesticidal)

https://www.epa.gov/chemical-data-reporting

▸ EPA Chemical Data Reporting (CDR)

11.1.4 Household Products

Household & Commercial/Institutional Products

Information on 288 consumer products that contain Lactic acid in the following categories is provided:

- Commercial / Institutional
- Home Maintenance
- Inside the Home
- Personal Care

▸ Consumer Product Information Database (CPID)

11.2 Methods of Manufacturing

Lactic acid is produced on an industrial scale by fermentation or a synthetic method. ... The fermentation process requires carbohydrates, nutrients, and a microorganism to produce lactic acid via fermentation. The carbohydrates used in fermentation consist predominantly of hexoses or compounds which can be easily split into hexoses, e.g., **glucose**, corn syrups, molasses, sugar beet juice, whey, as well as rice, wheat, corn, and potato starches. ... The nutrients required by the microorganisms include soluble peptides and amino acids, phosphates and ammonium salts, and vitamins. In many cases, the peptides and amino acids are a complex **nitrogen** source such as yeast extract paste, corn steep liquor, corn gluten meal, malt sprouts, soy peptone, and meat peptone. Only a minimal amount of these complex **nitrogen** sources are used in order to simplify purification of the lactic acid. During fermentation, the pH of the broth must be controlled between 5.0 and 6.5. Lime (**calcium hydroxide**), **calcium carbonate**, **ammonium hydroxide**, and **sodium hydroxide** are typically used to neutralize the lactic acid made in the broth to maintain constant pH. Thus, **calcium lactate**, **ammonium lactate**, or sodium lactate salts are formed in the fermentation broth. ... Lactic acid yields are between 85 and 95% based on fermentable sugars. Typical fermentation byproducts, such as **formic acid** and **acetic acid**, are found in concentrations of less than 0.5 wt%. "Homofermentive" bacterial strains are typically used as they produce the least amount of byproducts. ... After fermentation, the lactic acid broth needs to be purified for its intended use.

Starr JN, Westhoff G; Lactic Acid. Ullmann's Encyclopedia of Industrial Chemistry 7th ed. (1999-2016). NY, NY: John Wiley & Sons. Online Posting Date: January 31, 2014

▸ **Hazardous Substances Data Bank (HSDB)**

It is produced commercially either by fermentation of carbohydrates such as **glucose**, **sucrose**, or **lactose**, or by a procedure involving formation of **lactonitrile** from **acetaldehyde** and **hydrogen cyanide** and subsequent hydrolysis to lactic acid.

*21 CFR 184.1061 (USFDA); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 17, 2016: **https://www.ecfr.gov***

▸ **Hazardous Substances Data Bank (HSDB)**

Chemical preparations from **acetaldehyde** and CO /**carbon monoxide**/ in dilute H2SO4 /**sulfuric acid**/ at 130-200 °C and 900 atm: Loder, United States of America patent 2265945 (1938 to du Pont); by hydrolysis of hexoses with NaOH /**sodium hydroxide**/: Lock, United States of America patent 2382889 (1943).

O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Cambridge, UK: Royal Society of Chemistry, 2013., p. 990

▸ Hazardous Substances Data Bank (HSDB)

Chemical Synthesis: The commercial process is based on lactonitrile, which used to be a by-product of acrylonitrile synthesis. It involves base-catalyzed addition of hydrogen cyanide to acetaldehyde to produce lactonitrile. This is a liquid-phase reaction and occurs at atmospheric pressures. The crude lactonitrile is then recovered and purified by distillation and is hydrolyzed to lactic acid using either concentrated hydrochloric or sulfuric acid, producing the corresponding ammonium salt as a by-product. This crude lactic acid is esterified with methanol, producing methyl lactate. The latter is recovered and purified by distillation and hydrolyzed by water under acid catalysts to produce lactic acid, which is further concentrated, purified, and shipped under different product classifications, and methanol, which is recycled

Datta R; Hydroxycarboxylic Acids. Kirk-Othmer Encyclopedia of Chemical Technology (1999-2016). John Wiley & Sons, Inc. Online Posting Date: December 17, 2004

▸ Hazardous Substances Data Bank (HSDB)

For more Methods of Manufacturing (Complete) data for LACTIC ACID (6 total), please visit the HSDB record page.

▸ Hazardous Substances Data Bank (HSDB)

11.3 Formulations / Preparations

Lactic acid is prepd technically by "lactic acid fermentation" of carbohydrates such as glucose, sucrose, lactose with Bacillus acidi lacti or related organisms such as Lactobacillus delbrueckii, L. bulgaricus etc. The fermentation is carried out at relatively high temps.

O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Cambridge, UK: Royal Society of Chemistry, 2013., p. 990

▸ Hazardous Substances Data Bank (HSDB)

Produced commercially by fermentation of whey, cornstarch, potatoes, molasses.

O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Cambridge, UK: Royal Society of Chemistry, 2013., p. 990

▸ Hazardous Substances Data Bank (HSDB)

A solution of glucose or of starch previously hydrolyzed with diluted sulfuric acid is inoculated, after the addition of suitable nitrogen compounds and mineral salts, with Bacillus lactis. Calcium carbonate is added to neutralize the lactic acid as soon as it is formed, otherwise the fermentation stops when the amount of acid exceeds 0.5%. When fermentation is complete, as indicated by failure of the liquid to give a test for glucose, the solution is

filtered, concentrated, and allowed to stand. The calcium lactate that crystallizes is decomposed with dilute sulfuric acid and filtered with charcoal. The lactic acid in the filtrate is extracted with ethyl or isopropyl ether, the ether is distilled off, and the aqueous solution of the acid is concentrated under reduced pressure.

Troy, D.B. (Ed); Remmington The Science and Practice of Pharmacy. 21 st Edition. Lippincott Williams & Williams, Philadelphia, PA 2005, p. 1087

▸ Hazardous Substances Data Bank (HSDB)

It is usually available in solutions containing 50 to 90% lactic acid.

Burdock, G.A. (ed.). Fenaroli's Handbook of Flavor Ingredients. 6th ed.Boca Raton, FL 2010, p. 1063

▸ Hazardous Substances Data Bank (HSDB)

For more Formulations/Preparations (Complete) data for LACTIC ACID (18 total), please visit the HSDB record page.

▸ Hazardous Substances Data Bank (HSDB)

11.4 Consumption Patterns

50% used as an acidulant in foods and as an intermediate for emulsifiers for leavened bakery products; 50% in other applications (1973)

SRI

▸ Hazardous Substances Data Bank (HSDB)

85% used for food, beverage & bakery; 10% for textile and leather; and 5% for chemicals & miscellaneous (1982)

Chemical Products Synopsis: Lactic Acid, 1983

▸ Hazardous Substances Data Bank (HSDB)

11.5 U.S. Production

Aggregated Product Volume

2019: 500,000,000 - <750,000,000 lb

2018: 500,000,000 - <750,000,000 lb

2017: 500,000,000 - <750,000,000 lb

2016: 250,000,000 - <500,000,000 lb

https://www.epa.gov/chemical-data-reporting

▸ EPA Chemical Data Reporting (CDR)

This chemical is listed as a High Production Volume (HPV) (65FR81686). Chemicals listed as HPV were produced in or imported into the U.S. in >1 million pounds in 1990 and/or 1994. The HPV list is based on the 1990 Inventory Update Rule. (IUR) (40 CFR part 710 subpart B; 51FR21438).

EPA/Office of Pollution Prevention and Toxics; High Production Volume (HPV) Challenge Program. Available from, as of May 17, 2006: ***https://www.epa.gov/hpv/pubs/general/opptsrch.htm***

▸ Hazardous Substances Data Bank (HSDB)

(1975) GREATER THAN 9.1X10+5 GRAMS

SRI

▸ Hazardous Substances Data Bank (HSDB)

(1983) 5.90X10+9 g

CHEMICAL PRODUCTS SYNOPSIS: LACTIC ACID, 1983

▸ Hazardous Substances Data Bank (HSDB)

(1986) >1 million-10 million pounds

US EPA; Non-confidential Production Volume Information Submitted by Companies for Chemicals Under the 1986-2002 Inventory Update Rule (IUR). Lactic acid (50-21-5). Available from, as of May 16, 2006: ***https://www.epa.gov/oppt/iur/tools/data/2002-vol.html***

▸ Hazardous Substances Data Bank (HSDB)

For more U.S. Production (Complete) data for LACTIC ACID (10 total), please visit the **HSDB record page**.

▸ Hazardous Substances Data Bank (HSDB)

11.6 U.S. Imports

(1972) 3.43X10+8 GRAMS

SRI

▸ Hazardous Substances Data Bank (HSDB)

(1973) 6.24X10+8 GRAMS

SRI

▸ Hazardous Substances Data Bank (HSDB)

(1984) 4.96X10+9 g

BUREAU OF THE CENSUS. U.S. IMPORTS FOR CONSUMPTION AND GENERAL IMPORTS 1984 p.1-35

▸ Hazardous Substances Data Bank (HSDB)

11.7 U.S. Exports

(1972) No Data

SRI

▸ Hazardous Substances Data Bank (HSDB)

(1975) No Data

SRI

▸ Hazardous Substances Data Bank (HSDB)

(1986) No Data

▸ Hazardous Substances Data Bank (HSDB)

11.8 General Manufacturing Information

Industry Processing Sectors

Paint and Coating Manufacturing
Agriculture, Forestry, Fishing and Hunting
All Other Basic Organic Chemical Manufacturing
Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing
Food, beverage, and tobacco product manufacturing
All Other Chemical Product and Preparation Manufacturing
Oil and Gas Drilling, Extraction, and Support activities
Plastics Material and Resin Manufacturing
Plastics Product Manufacturing

▸ EPA Chemical Data Reporting (CDR)

EPA TSCA Commercial Activity Status

Propanoic acid, 2-hydroxy-: ACTIVE

▸ EPA Chemicals under the TSCA

Monsanto, with synthetic production, is the only remaining US lactic acid producer

Chemical Products Synopsis: Lactic Acid, 1983

▸ Hazardous Substances Data Bank (HSDB)

12 Identification

12.1 Analytic Laboratory Methods

Analysis of organic acids /including lactic acid/ in wines by capillary electrophoresis and HPLC.

Levi V et al; Amer Lab 25 (1): 29-32 (1993)

▸ Hazardous Substances Data Bank (HSDB)

Method: AOAC 970.31; Procedure: gas chromatographic method; Analyte: lactic acid; Matrix: eggs; Detection Limit: not provided.

Horwitz W, ed.; Official Methods of Analysis of AOAC International 17th ed. (2003). CD-ROM, AOAC International, Gaithersburg, MD

▸ Hazardous Substances Data Bank (HSDB)

Method: AOAC 945.99; Procedure: spectrophotometric method; Analyte: lactic acid; Matrix: canned vegetables; Detection Limit: not provided.

Horwitz W, ed.; Official Methods of Analysis of AOAC International 17th ed. (2003). CD-ROM, AOAC International, Gaithersburg, MD

▸ Hazardous Substances Data Bank (HSDB)

Method: AOAC 944.05; Procedure: colorimetric method; Analyte: lactic acid; Matrix: eggs; Detection Limit: not provided.

Horwitz W, ed.; Official Methods of Analysis of AOAC International 17th ed. (2003). CD-ROM, AOAC International, Gaithersburg, MD

▸ Hazardous Substances Data Bank (HSDB)

For more Analytic Laboratory Methods (Complete) data for LACTIC ACID (10 total), please visit the HSDB record page.

▸ Hazardous Substances Data Bank (HSDB)

13 Safety and Hazards

13.1 Hazards Identification

13.1.1 GHS Classification

1 of 6 items	View All
Note	*This chemical does not meet GHS hazard criteria for 0.2% (5 of 2808) of reports.*
Pictogram(s)	 Corrosive Irritant
Signal	**Danger**
GHS Hazard Statements	H314 (11.8%): Causes severe skin burns and eye damage [**Danger** Skin corrosion/irritation] H315 (87.5%): Causes skin irritation [**Warning** Skin corrosion/irritation] H318 (91.9%): Causes serious eye damage [**Danger** Serious eye damage/eye irritation]
Precautionary Statement Codes	P260, P264, P264+P265, P280, P301+P330+P331, P302+P352, P302+P361+P354, P304+P340, P305+P354+P338, P316, P317, P321, P332+P317, P362+P364, P363, P405, and P501
ECHA C&L Notifications Summary	*Aggregated GHS information provided per 2808 reports by companies from 35 notifications to the ECHA C&L Inventory. Each notification may be associated with multiple companies.* *Reported as not meeting GHS hazard criteria per 5 of 2808 reports by companies.* *There are 34 notifications provided by 2803 of 2808 reports by companies with hazard statement code(s).* *Information may vary between notifications depending on impurities, additives, and other factors. The percentage value in parenthesis indicates the notified classification ratio from companies that provide hazard codes. Only hazard codes with percentage values above 10%*

*are shown. For more detailed information, please visit **ECHA C&L website.***

▸ European Chemicals Agency (ECHA)

13.1.2 Hazard Classes and Categories

Skin Corr. 1C (11.8%)

Skin Irrit. 2 (87.5%)

Eye Dam. 1 (91.9%)

▸ European Chemicals Agency (ECHA)

View More...

13.1.3 EPA Safer Chemical

Chemical: DL-Lactic acid

Green circle - The chemical has been verified to be of low concern based on experimental and modeled data.

▸ EPA Safer Choice

13.1.4 Health Hazards

Inhalation of mist causes coughing and irritation of mucous membranes. Ingestion, even of diluted preparations, has a corrosive effect on the esophagus and stomach. Contact with more concentrated solutions can cause severe burns of skin or eye. (USCG, 1999)

U.S. Coast Guard. 1999. Chemical Hazard Response Information System (CHRIS) - Hazardous Chemical Data. Commandant Instruction 16465.12C. Washington, D.C.: U.S. Government Printing Office.

▸ CAMEO Chemicals

13.1.5 Fire Hazards

Excerpt from ERG Guide 153 [Substances - Toxic and/or Corrosive (Combustible)]:

Combustible material: may burn but does not ignite readily. When heated, vapors may form explosive mixtures with air: indoors, outdoors and sewers explosion hazards. Those substances designated with a (P) may polymerize explosively when heated or involved in a fire. Corrosives

in contact with metals may evolve flammable **hydrogen** gas. Containers may explode when heated. Runoff may pollute waterways. Substance may be transported in a molten form. (ERG, 2024)

*2024 Emergency Response Guidebook, **https://www.phmsa.dot.gov/training/hazmat/erg/emergency-response-guidebook-erg***

▸ **CAMEO Chemicals**

Combustible.

▸ **ILO-WHO International Chemical Safety Cards (ICSCs)**

13.1.6 Hazards Summary

Corrosive to skin; [Quick CPC] A skin and respiratory tract irritant; Corrosive to eyes; [ICSC] Causes burns to skin and eyes; Vapors cause eye and mucous membrane irritation and can cause coughing and difficulty breathing; [CHRIS] Safe when used as a flavoring agent in food; [JECFA] Corrosive to rabbit skin, mildly irritating to guinea pig skin, and not irritating to pig skin; Not sensitizing in a study of guinea pigs; A 13-week oral study of rats produced a NOAEL of 500 mg/kg/day (highest tested dose); Studies on reproductive and developmental toxicity not considered necessary because lactic acid is a product of human intermediary metabolism; [EPA ChAMP] A skin and strong eye irritant; [Aldrich MSDS]

Quick CPC - Forsberg K, Mansdorf SZ. Quick Selection Guide to Chemical Protective Clothing, 5th Ed. Hoboken, NJ: Wiley-Interscience, 2007.

▸ **Haz-Map, Information on Hazardous Chemicals and Occupational Diseases**

13.1.7 Skin, Eye, and Respiratory Irritations

A severe skin and eye irritant.

Lewis, R.J. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 11th Edition. Wiley-Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p. 2196

▸ **Hazardous Substances Data Bank (HSDB)**

In general, on the basis of animal studies and human use, the most significant effects caused by exposure to **lactate** esters are respiratory, dermal, and ocular irritation. Irritation may be associated with the formation of lactic acid, a product of hydrolysis of **lactate** esters. /Hydroxyal esters: lactates/

Bingham, E.; Cohrssen, B.; Powell, C.H.; Patty's Toxicology Volumes 1-9 5th ed. John Wiley & Sons. New York, N.Y. (2001)., p. V6 619

- Hazardous Substances Data Bank (HSDB)

13.2 First Aid Measures

Inhalation First Aid

Fresh air, rest. Refer for medical attention.

- ILO-WHO International Chemical Safety Cards (ICSCs)

Skin First Aid

Remove contaminated clothes. Rinse skin with plenty of water or shower.

- ILO-WHO International Chemical Safety Cards (ICSCs)

Eye First Aid

First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then refer for medical attention.

- ILO-WHO International Chemical Safety Cards (ICSCs)

Ingestion First Aid

Rinse mouth. Do NOT induce vomiting. Give nothing to drink. Refer for medical attention .

- ILO-WHO International Chemical Safety Cards (ICSCs)

13.2.1 First Aid

INHALATION: move to fresh air.

INGESTION: give large amount of water.

EYES: flush with water for at least 15 min.

SKIN: flush with water; wash well with soap and water. (USCG, 1999)

U.S. Coast Guard. 1999. Chemical Hazard Response Information System (CHRIS) - Hazardous Chemical Data. Commandant Instruction 16465.12C. Washington, D.C.: U.S. Government Printing Office.

- CAMEO Chemicals

13.3 Fire Fighting

Excerpt from ERG Guide 153 [Substances - Toxic and/or Corrosive (Combustible)]:

SMALL FIRE: Dry chemical, CO2 or water spray.

LARGE FIRE: Dry chemical, CO2, alcohol-resistant foam or water spray. If it can be done safely, move undamaged containers away from the area around the fire. Dike runoff from fire control for later disposal.

FIRE INVOLVING TANKS, RAIL TANK CARS OR HIGHWAY TANKS: Fight fire from maximum distance or use unmanned master stream devices or monitor nozzles. Do not get water inside containers. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks in direct contact with flames. (ERG, 2024)

*2024 Emergency Response Guidebook, **https://www.phmsa.dot.gov/training/hazmat/erg/emergency-response-guidebook-erg***

▸ CAMEO Chemicals

Use water spray, powder, alcohol-resistant foam, carbon dioxide.

▸ ILO-WHO International Chemical Safety Cards (ICSCs)

13.3.1 Fire Fighting Procedures

Suitable extinguishing media: Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

*Sigma-Aldrich; Safety Data Sheet for DL-Lactic acid. Product Number: 69785, Version 5.4 (Revision Date 12/23/2014). Available from, as of January 29, 2016: **https://www.sigmaaldrich.com/safety-center.html***

▸ Hazardous Substances Data Bank (HSDB)

Advice for firefighters: Wear self-contained breathing apparatus for firefighting if necessary.

*Sigma-Aldrich; Safety Data Sheet for DL-Lactic acid. Product Number: 69785, Version 5.4 (Revision Date 12/23/2014). Available from, as of January 29, 2016: **https://www.sigmaaldrich.com/safety-center.html***

▸ Hazardous Substances Data Bank (HSDB)

13.4 Accidental Release Measures

13.4.1 Isolation and Evacuation

Excerpt from ERG Guide 153 [Substances - Toxic and/or Corrosive (Combustible)]:

IMMEDIATE PRECAUTIONARY MEASURE: Isolate spill or leak area in all directions for at least 50 meters (150 feet) for liquids and at least 25 meters (75 feet) for solids.

SPILL: Increase the immediate precautionary measure distance, in the downwind direction, as necessary.

FIRE: If tank, rail tank car or highway tank is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions. (ERG, 2024)

2024 Emergency Response Guidebook, ***https://www.phmsa.dot.gov/training/hazmat/erg/emergency-response-guidebook-erg***

▸ **CAMEO Chemicals**

13.4.2 Spillage Disposal

Collect leaking and spilled liquid in sealable containers as far as possible. Cautiously neutralize spilled liquid with weak alkaline solution such as **disodium carbonate**. Then wash away with plenty of **water**.

▸ **ILO-WHO International Chemical Safety Cards (ICSCs)**

13.4.3 Cleanup Methods

ACCIDENTAL RELEASE MEASURES: Personal precautions, protective equipment and emergency procedures: Use personal protective equipment. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas; Environmental precautions: Do not let product enter drains; Methods and materials for containment and cleaning up: Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.

Sigma-Aldrich; Safety Data Sheet for DL-Lactic acid. Product Number: 69785, Version 5.4 (Revision Date 12/23/2014). Available from, as of January 29, 2016: ***https://www.sigmaaldrich.com/safety-center.html***

▸ **Hazardous Substances Data Bank (HSDB)**

Collect leaking liquid in sealable containers. Cautiously neutralize spilled liquid with weak alkaline solution, e.g. **disodium carbonate**. Then wash away with plenty of **water**.

IPCS, CEC; International Chemical Safety Card on Lactic acid. (April 1997). Available from, as of April 13, 2006: ***https://www.inchem.org/documents/icsc/icsc/eics0501.htm***

▸ **Hazardous Substances Data Bank (HSDB)**

13.4.4 Disposal Methods

SRP: Expired or waste pharmaceuticals shall carefully take into consideration applicable DEA, EPA, and FDA regulations. It is not appropriate to dispose by flushing the pharmaceutical down the toilet or discarding to trash. If possible return the pharmaceutical to the manufacturer for proper disposal being careful to properly label and securely package the material. Alternatively, the waste pharmaceutical shall be labeled, securely packaged and transported by a state licensed medical waste contractor to dispose by burial in a licensed hazardous or toxic waste landfill or incinerator.

▸ **Hazardous Substances Data Bank (HSDB)**

Product: Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material; Contaminated packaging: Dispose of as unused product.

Sigma-Aldrich; Safety Data Sheet for DL-Lactic acid. Product Number: 69785, Version 5.4 (Revision Date 12/23/2014). Available from, as of January 29, 2016: ***https://www.sigmaaldrich.com/safety-center.html***

▸ **Hazardous Substances Data Bank (HSDB)**

The following wastewater treatment technology has been investigated for lactic acid: Concentration process: Biological treatment.

USEPA; Management of Hazardous Waste Leachate, EPA Contract No.68-03-2766 p.E-35 (1982)

▸ **Hazardous Substances Data Bank (HSDB)**

13.4.5 Preventive Measures

SRP: The scientific literature for the use of contact lenses by industrial workers is inconsistent. The benefits or detrimental effects of wearing contact lenses depend not only upon the substance, but also on factors including the form of the substance, characteristics and duration of the exposure, the uses of other eye protection equipment, and the hygiene of the lenses. However, there may be individual substances whose irritating or corrosive properties are such that the wearing of contact lenses would be harmful to the eye. In those specific cases, contact lenses should not be worn. In any event, the usual eye protection equipment should be worn even when contact lenses are in place.

▸ **Hazardous Substances Data Bank (HSDB)**

Precautions for safe handling: Avoid contact with skin and eyes. Avoid inhalation of vapor or mist.

Sigma-Aldrich; Safety Data Sheet for DL-Lactic acid. Product Number: 69785, Version 5.4 (Revision Date 12/23/2014). Available from, as of January 29, 2016: ***https://www.sigmaaldrich.com/safety-center.html***

▸ Hazardous Substances Data Bank (HSDB)

Appropriate engineering controls: Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Sigma-Aldrich; Safety Data Sheet for DL-Lactic acid. Product Number: 69785, Version 5.4 (Revision Date 12/23/2014). Available from, as of January 29, 2016: ***https://www.sigmaaldrich.com/safety-center.html***

▸ Hazardous Substances Data Bank (HSDB)

Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Sigma-Aldrich; Safety Data Sheet for DL-Lactic acid. Product Number: 69785, Version 5.4 (Revision Date 12/23/2014). Available from, as of January 29, 2016: ***https://www.sigmaaldrich.com/safety-center.html***

▸ Hazardous Substances Data Bank (HSDB)

13.5 Handling and Storage

13.5.1 Nonfire Spill Response

Excerpt from ERG Guide 153 [Substances - Toxic and/or Corrosive (Combustible)]:

ELIMINATE all ignition sources (no smoking, flares, sparks or flames) from immediate area. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. DO NOT GET **WATER** INSIDE CONTAINERS. (ERG, 2024)

2024 Emergency Response Guidebook, ***https://www.phmsa.dot.gov/training/hazmat/erg/emergency-response-guidebook-erg***

▸ CAMEO Chemicals

13.5.2 Safe Storage

Separated from strong bases.

▸ ILO-WHO International Chemical Safety Cards (ICSCs)

13.5.3 Storage Conditions

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage. Hygroscopic.

Sigma-Aldrich; Safety Data Sheet for DL-Lactic acid. Product Number: 69785, Version 5.4 (Revision Date 12/23/2014). Available from, as of January 29, 2016: ***https://www.sigmaaldrich.com/safety-center.html***

▸ **Hazardous Substances Data Bank (HSDB)**

Separated from strong bases.

IPCS, CEC; International Chemical Safety Card on Lactic acid. (April 1997). Available from, as of April 13, 2006: ***https://www.inchem.org/documents/icsc/icsc/eics0501.htm***

▸ **Hazardous Substances Data Bank (HSDB)**

When heated to decomposition it emits acrid smoke and irritating fumes.

Lewis, R.J. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 11th Edition. Wiley-Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p. 2196

▸ **Hazardous Substances Data Bank (HSDB)**

13.6 Exposure Control and Personal Protection

13.6.1 Inhalation Risk

No indication can be given about the rate at which a harmful concentration of this substance in the air is reached on evaporation at 20Â °C.

▸ **ILO-WHO International Chemical Safety Cards (ICSCs)**

13.6.2 Effects of Short Term Exposure

The substance is corrosive to the eyes. The substance is irritating to the skin and respiratory tract. Corrosive on ingestion.

▸ **ILO-WHO International Chemical Safety Cards (ICSCs)**

13.6.3 Allowable Tolerances

Lactic acid (2-hydroxypropanoic acid) is exempted from the requirement of a tolerance when used as a plant growth regulator in or on all raw agricultural commodities.

40 CFR 180.1090 (USEPA); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 17, 2016: ***https://www.ecfr.gov***

▸ **Hazardous Substances Data Bank (HSDB)**

Residues of lactic acid are exempted from the requirement of a tolerance when used in accordance with good agricultural practice as inert (or occasionally active) ingredients in pesticide formulations applied to growing crops or to raw agricultural commodities after harvest. Use: solvent.

40 CFR 180.910 (USEPA); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 17, 2016: ***https://www.ecfr.gov***

▸ **Hazardous Substances Data Bank (HSDB)**

Residues of lactic acid are exempted from the requirement of a tolerance when used in accordance with good agricultural practice as inert (or occasionally active) ingredients in pesticide formulations applied to animals. Use: solvent.

40 CFR 180.930 (USEPA); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 17, 2016: ***https://www.ecfr.gov***

▸ **Hazardous Substances Data Bank (HSDB)**

Residues of the following chemical substances are exempted from the requirement of a tolerance when used in accordance with good manufacturing practice as ingredients in an antimicrobial pesticide formulation, provided that the substance is applied on a semi-permanent or permanent food-contact surface (other than being applied on food packaging) with adequate draining before contact with food. ... (b) The following chemical substances when used as ingredients in an antimicrobial pesticide formulation may be applied to: Dairy processing equipment, and food-processing equipment and utensils. Lactic acid is included on this list. Limit: When ready for use, the end-use concentration is not to exceed 138 ppm.

40 CFR 180.940(b); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 17, 2016: ***https://www.ecfr.gov***

▸ **Hazardous Substances Data Bank (HSDB)**

Residues of the following chemical substances are exempted from the requirement of a tolerance when used in accordance with good manufacturing practice as ingredients in an antimicrobial pesticide formulation, provided that the substance is applied on a semi-permanent or permanent food-contact surface (other than being applied on food packaging) with adequate draining before contact with food. ... (c) The following chemical substances

when used as ingredients in an antimicrobial pesticide formulation may be applied to: Food-processing equipment and utensils. Lactic acid is included on this list.

40 CFR 180.940(c); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 17, 2016: ***https://www.ecfr.gov***

▸ **Hazardous Substances Data Bank (HSDB)**

13.6.4 Personal Protective Equipment (PPE)

Rubber gloves; goggles; self-contained breathing apparatus where high concentrations of mist are present (USCG, 1999)

U.S. Coast Guard. 1999. Chemical Hazard Response Information System (CHRIS) - Hazardous Chemical Data. Commandant Instruction 16465.12C. Washington, D.C.: U.S. Government Printing Office.

▸ **CAMEO Chemicals**

Eye/face protection: Tightly fitting safety goggles. Faceshield (8-inch minimum). Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Sigma-Aldrich; Safety Data Sheet for DL-Lactic acid. Product Number: 69785, Version 5.4 (Revision Date 12/23/2014). Available from, as of January 29, 2016: ***https://www.sigmaaldrich.com/safety-center.html***

▸ **Hazardous Substances Data Bank (HSDB)**

Skin protection: Handle with gloves.

Sigma-Aldrich; Safety Data Sheet for DL-Lactic acid. Product Number: 69785, Version 5.4 (Revision Date 12/23/2014). Available from, as of January 29, 2016: ***https://www.sigmaaldrich.com/safety-center.html***

▸ **Hazardous Substances Data Bank (HSDB)**

Body Protection: Complete suit protecting against chemicals. The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Sigma-Aldrich; Safety Data Sheet for DL-Lactic acid. Product Number: 69785, Version 5.4 (Revision Date 12/23/2014). Available from, as of January 29, 2016: ***https://www.sigmaaldrich.com/safety-center.html***

▸ **Hazardous Substances Data Bank (HSDB)**

Respiratory protection: Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multipurpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of

protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Sigma-Aldrich; Safety Data Sheet for DL-Lactic acid. Product Number: 69785, Version 5.4 (Revision Date 12/23/2014). Available from, as of January 29, 2016: ***https://www.sigmaaldrich.com/safety-center.html***

▸ **Hazardous Substances Data Bank (HSDB)**

Persons working with pure acid or concentrated solutions should wear protective clothing, eye and face protection, hand and arm protection and respiratory protective equipment.

International Labour Office. Encyclopaedia of Occupational Health and Safety. 4th edition, Volumes 1-4 1998. Geneva, Switzerland: International Labour Office, 1998., p. 104.15

▸ **Hazardous Substances Data Bank (HSDB)**

13.6.5 Fire Prevention

NO open flames.

▸ **ILO-WHO International Chemical Safety Cards (ICSCs)**

13.6.6 Exposure Prevention

STRICT HYGIENE!

▸ **ILO-WHO International Chemical Safety Cards (ICSCs)**

13.6.7 Inhalation Prevention

Use local exhaust or breathing protection.

▸ **ILO-WHO International Chemical Safety Cards (ICSCs)**

13.6.8 Skin Prevention

Protective gloves.

▸ **ILO-WHO International Chemical Safety Cards (ICSCs)**

13.6.9 Eye Prevention

Wear safety goggles or face shield.

- ILO-WHO International Chemical Safety Cards (ICSCs)

13.6.10 Ingestion Prevention

Do not eat, drink, or smoke during work.

- ILO-WHO International Chemical Safety Cards (ICSCs)

13.7 Stability and Reactivity

13.7.1 Air and Water Reactions

Soluble in water.

- CAMEO Chemicals

13.7.2 Reactive Group

Acids, Carboxylic

Alcohols and Polyols

- CAMEO Chemicals

13.7.3 Reactivity Profile

LACTIC ACID is a carboxylic acid. Carboxylic acids donate **hydrogen** ions if a base is present to accept them. They react in this way with all bases, both organic (for example, the amines) and inorganic. Their reactions with bases, called "neutralizations", are accompanied by the evolution of substantial amounts of heat. Neutralization between an acid and a base produces **water** plus a salt. Carboxylic acids with six or fewer **carbon** atoms are freely or moderately soluble in **water**; those with more than six carbons are slightly soluble in **water**. Soluble carboxylic acid dissociate to an extent in **water** to yield **hydrogen** ions. The pH of solutions of carboxylic acids is therefore less than 7.0. Many insoluble carboxylic acids react rapidly with aqueous solutions containing a chemical base and dissolve as the neutralization generates a soluble salt. Carboxylic acids in aqueous solution and liquid or molten carboxylic acids can react with active metals to form gaseous **hydrogen** and a metal salt. Such reactions occur in

principle for solid carboxylic acids as well, but are slow if the solid acid remains dry. Even "insoluble" carboxylic acids may absorb enough **water** from the air and dissolve sufficiently in it to corrode or dissolve **iron**, steel, and **aluminum** parts and containers. Carboxylic acids, like other acids, react with cyanide salts to generate gaseous **hydrogen cyanide**. The reaction is slower for dry, solid carboxylic acids. Insoluble carboxylic acids react with solutions of cyanides to cause the release of gaseous **hydrogen cyanide**. Flammable and/or toxic gases and heat are generated by the reaction of carboxylic acids with diazo compounds, dithiocarbamates, isocyanates, mercaptans, nitrides, and sulfides. Carboxylic acids, especially in aqueous solution, also react with sulfites, nitrites, thiosulfates (to give H2S and SO3), dithionites (SO2), to generate flammable and/or toxic gases and heat. Their reaction with carbonates and bicarbonates generates a harmless gas (**carbon dioxide**) but still heat. Like other organic compounds, carboxylic acids can be oxidized by strong oxidizing agents and reduced by strong reducing agents. These reactions generate heat. A wide variety of products is possible. Like other acids, carboxylic acids may initiate polymerization reactions; like other acids, they often catalyze (increase the rate of) chemical reactions. Slowly corrodes most metals (USCG, 1999).

U.S. Coast Guard. 1999. Chemical Hazard Response Information System (CHRIS) - Hazardous Chemical Data. Commandant Instruction 16465.12C. Washington, D.C.: U.S. Government Printing Office.

▸ **CAMEO Chemicals**

13.7.4 Hazardous Reactivities and Incompatibilities

Incompatible materials: Bases, Oxidizing agents, Reducing agents

Sigma-Aldrich; Safety Data Sheet for DL-Lactic acid. Product Number: 69785, Version 5.4 (Revision Date 12/23/2014). Available from, as of January 29, 2016: ***https://www.sigmaaldrich.com/safety-center.html***

▸ **Hazardous Substances Data Bank (HSDB)**

Mixtures with **nitric acid** + **hydrofluoric acid** may react vigorously and are storage hazards.

Lewis, R.J. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 11th Edition. Wiley-Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p. 2196

▸ **Hazardous Substances Data Bank (HSDB)**

Volatile with superheated steam.

Lewis, R.J. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 11th Edition. Wiley-Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p. 2196

▸ **Hazardous Substances Data Bank (HSDB)**

A mixture of 5 parts lactic acid, 5 parts nitric acid, 2 parts water, and 1 part hydrofluoric acid being stored in a plastic bottle ruptured with explosive force.

National Fire Protection Association; Fire Protection Guide to Hazardous Materials. 14TH Edition, Quincy, MA 2010, p. 491-126

▸ Hazardous Substances Data Bank (HSDB)

Mixtures of /lactic acid, hydrofluoric acid and nitric acid/, used as metal polishing solutions, are unstable and should not be stored. Lactic acid and nitric acid react autocatalytically after a quiescent period, attaining a temperature of about 90 °C with vigorous gas evolution after about 12 hr. Prepare freshly, discard after use and handle carefully. /Nitric acid/

Bretherick, L. Handbook of Reactive Chemical Hazards. 4th ed. Boston, MA: Butterworth-Heinemann Ltd., 1990, p. 1166

▸ Hazardous Substances Data Bank (HSDB)

13.8 Transport Information

13.8.1 DOT Label

Corrosive

▸ CAMEO Chemicals

13.9 Regulatory Information

The Australian Inventory of Industrial Chemicals

Chemical: Propanoic acid, 2-hydroxy-

▸ Australian Industrial Chemicals Introduction Scheme (AICIS)

EFSA Legal Basis

Regulation (EC) No 178/2002 (amended)

▸ EFSA OpenFoodTox

Status Regulation (EC)

2004/129/EC

▸ EU Pesticides Database

REACH Registered Substance

Status: Active Update: 04-01-2023 https://echa.europa.eu/registration-dossier/-/registered-dossier/5165

▸ European Chemicals Agency (ECHA)

New Zealand EPA Inventory of Chemical Status

Lactic acid: Does not have an individual approval but may be used under an appropriate group standard

▸ New Zealand Environmental Protection Authority (EPA)

13.9.1 FIFRA Requirements

Lactic acid (2-hydroxypropanoic acid) is exempted from the requirement of a tolerance when used as a plant growth regulator in or on all raw agricultural commodities.

*40 CFR 180.1090 (USEPA); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 17, 2016: **https://www.ecfr.gov***

▸ Hazardous Substances Data Bank (HSDB)

Residues of lactic acid are exempted from the requirement of a tolerance when used in accordance with good agricultural practice as inert (or occasionally active) ingredients in pesticide formulations applied to growing crops or to raw agricultural commodities after harvest. Use: solvent.

*40 CFR 180.910 (USEPA); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 17, 2016: **https://www.ecfr.gov***

▸ Hazardous Substances Data Bank (HSDB)

Residues of lactic acid are exempted from the requirement of a tolerance when used in accordance with good agricultural practice as inert (or occasionally active) ingredients in pesticide formulations applied to animals. Use: solvent.

*40 CFR 180.930 (USEPA); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 17, 2016: **https://www.ecfr.gov***

▸ Hazardous Substances Data Bank (HSDB)

Residues of the following chemical substances are exempted from the requirement of a tolerance when used in accordance with good manufacturing practice as ingredients in an antimicrobial pesticide formulation, provided that the substance is applied on a semi-permanent or permanent food-contact surface (other than being applied on food packaging)

with adequate draining before contact with food. ... (b) The following chemical substances when used as ingredients in an antimicrobial pesticide formulation may be applied to: Dairy processing equipment, and food-processing equipment and utensils. Lactic acid is included on this list. Limit: When ready for use, the end-use concentration is not to exceed 138 ppm.

40 CFR 180.940(b) (USEPA); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 17, 2016: ***https://www.ecfr.gov***

▸ **Hazardous Substances Data Bank (HSDB)**

For more FIFRA Requirements (Complete) data for LACTIC ACID (6 total), please visit the **HSDB record page**.

▸ **Hazardous Substances Data Bank (HSDB)**

13.9.2 FDA Requirements

Substance added directly to human food affirmed as generally recognized as safe (GRAS).

21 CFR 184.1061 (USFDA); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 17, 2016: ***https://www.ecfr.gov***

▸ **Hazardous Substances Data Bank (HSDB)**

Drug products containing certain active ingredients offered over-the-counter (OTC) for certain uses. A number of active ingredients have been present in OTC drug products for various uses, as described below. However, based on evidence currently available, there are inadequate data to establish general recognition of the safety and effectiveness of these ingredients for the specified uses: lactic acid is included in digestive drug products.

21 CFR 310.545(a) (8) (USFDA); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 17, 2016: ***https://www.ecfr.gov***

▸ **Hazardous Substances Data Bank (HSDB)**

Lactic acid used as a general purpose food additive in animal drugs, feeds, and related products is generally recognized as safe when used in accordance with good manufacturing or feeding practice.

21 CFR 582.1061 (USFDA); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 17, 2016: ***https://www.ecfr.gov***

▸ **Hazardous Substances Data Bank (HSDB)**

13.10 Other Safety Information

Chemical Assessment

Evaluation - Lactic acid isomers

- Australian Industrial Chemicals Introduction Scheme (AICIS)

13.10.1 Toxic Combustion Products

Special hazards arising from the substance or mixture: Carbon oxides

Sigma-Aldrich; Safety Data Sheet for DL-Lactic acid. Product Number: 69785, Version 5.4 (Revision Date 12/23/2014). Available from, as of January 29, 2016: ***https://www.sigmaaldrich.com/safety-center.html***

- Hazardous Substances Data Bank (HSDB)

13.10.2 Other Hazardous Reactions

Caustic in concd solns.

O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Cambridge, UK: Royal Society of Chemistry, 2013., p. 990

- Hazardous Substances Data Bank (HSDB)

13.10.3 Special Reports

Leung HW, Paustenbach DJ; Organic Acids and Bases: Review of Toxicological Studies; Am J Ind Med 18 (6): 717-35 (1990).

- Hazardous Substances Data Bank (HSDB)

14 Toxicity

14.1 Toxicological Information

14.1.1 Toxicity Summary

Cosmetic Ingredient Review Conclusion

Based on the available information included in this report, the CIR Expert Panel concludes that Glycolic and Lactic Acid, their common salts and their simple esters, are safe for use in cosmetic products at concentrations less than or equal to 10%, at final formulation pH greater

than or equal to 3.5, when formulated to avoid increasing sun sensitivity or when directions for use include the daily use of sun protection. These ingredients are safe for use in salon products at concentrations less than or equal to 30%, at final formulation pH greater than or equal to 3.0, in products designed for brief, discontinuous use followed by thorough rinsing from the skin, when applied by trained professionals, and when application is accompanied by directions for the daily use of sun protection...Lactic Acid...

International Journal of Toxicology 17(S1):1-241, 1998

International Journal of Toxicology 36(Suppl 2):14-58, 2017

▸ **Cosmetic Ingredient Review (CIR)**

Cosmetic Ingredient Review Finding(s)

Safe for use in cosmetics, with qualifications

International Journal of Toxicology 17(S1):1-241, 1998

International Journal of Toxicology 36(Suppl 2):14-58, 2017

▸ **Cosmetic Ingredient Review (CIR)**

IDENTIFICATION AND USE: Lactic acid forms yellow to colorless crystals or syrupy 50% liquid. It has multiple uses in dyeing baths, as mordant in printing woolen goods, solvent for **water**-insoluble dyes. It is also used for reducing chromates in mordanting wool, in manufacture of cheese, confectionery. Lactic acid is a component of babies' milk formulas; acidulant in beverages; also used for acidulating worts in brewing. It is used in prepn of **sodium lactate** injections, and as ingredient of cosmetics, component of spermatocidal jellies. Other uses: for removing Clostridium butyricum in manufacture of yeast; dehairing, plumping, and decalcifying hides, solvent for **cellulose formate**, flux for soft solder. Lactic acid is used to manufacture lactates which are used in food products, in medicine, and as solvents. It is also a plasticizer, catalyst in the casting of phenolaldehyde resins. HUMAN EXPOSURE AND TOXICITY: Its effect on eye is similar to that of other acid of moderate strength, causing initial epithelial coagulation on cornea and conjunctiva, but having good prognosis if promptly washed off with **water**. In man, accidental intraduodenal administration of 100 mL 33% lactic acid was fatal within 12 hours. Hyperlactatemia and lactic acidosis are among the most dangerous and life-threatening side effect that occurs during therapy with some nucleoside reverse transcriptase inhibitors. Lactic acidosis is associated with both inherited and acquired metabolic diseases. Lactic acid metabolism in the presence of altered gluconeogenesis, anaerobic glycolysis, and acid-base balance is a major factor in many disorders. Lactic acid can be formed only from **pyruvic acid**; therefore, disorders that increase **pyruvate** concentration, enhance lactic acid formation, or reduce lactic acid degradation cause lactic acidosis. Inborn metabolic errors that are accompanied by derangement of metabolic pathways of **glucose**, **pyruvate**, amino acids, and organic acids as well as toxic and systemic conditions that promote tissue hypoxia or mitochondrial injury result in lactic acidosis. ANIMAL STUDIES: Applied to rabbit eyes in a

standard manner, the reaction at twenty-four hours has been graded 8 on scale of 1 to 10. If allowed to remain on rabbit eyes, both the full strength acid and a 50% solution in water have caused corneal necrosis and persistent stromal scarring. Groups of male rats, five per group, were dosed with 0.5 mL of 130, 650, or 1300 mg/2000 kg body wt lactic acid via stomach tube; the control group received the same volume of water. Two rats of the 650-mg group and one rat of the 1300-mg group died within 24 hr of dosing. The rats were dosed with the same amounts of lactic acid after 8 days. Two rats of the 1300 mg group died; dyspnea, snivel, vomiting, and abdominal inflation were observed in these animals immediately after dosing. No overt toxic effects were observed in pigs given approximately 3.6-18 g/kg lactic acid in feed or water for up to 5 months. Drunken lamb syndrome has been described as lamb D-lactic acidosis syndrome. In developmental study, twelve mice were dosed daily with 570 mg/kg lactic acid by gavage on days 6 to 15 of gestation; a control group of 13 mice received distilled water. All dams were killed on day 18 of gestation. No significant difference was observed in gestational body weight gain between test and control animals, but feed consumption was significantly decreased as compared to control values. Also, relative maternal liver weight was significantly decreased as compared to controls. The only observed effect on the fetus was a statistically significant increase in delayed ossification of the parietal bones. Female rabbits were dosed orally with 0.1 - 0.2 g/kg lactic acid in 100 -150 mL water twice daily for 5 months, and five female rabbits were dosed orally with 0.1 - 0.7 g/kg lactic acid in 50 - 100 mL water twice daily for 16 months (13 months actual treatment). No tumors were reported after 5 or 16 months, respectively. Negative results were obtained when the mutagenic potential of lactic acid, 90.5% pure, in phosphate buffer was assayed in an Ames test using S. typhimurium strains TA92, TA1535, TA100, TA1537, TA94, and TA98 with metabolic activation. Negative results were obtained in an Ames test for 1000 ug/mL 11 mM lactic acid using a clonal subline of Chinese hamster fibroblasts derived from lung tissue in the absence of metabolic activation. Lactic acid was negative for chromosomal aberrations. ECOTOXICITY STUDIES: Feeding of 10% lactic acid to birds has been blamed for the development of polyneuritic crises resembling B1 deficiency on diets rich in carbohydrates, proteins or fats.

- Hazardous Substances Data Bank (HSDB)

Accumulation of L-lactic acid in the body has been shown to be toxic. At times of lactic acidosis, when excess intracellular lactate is released into the blood, maintenance of electroneutrality of the blood requires that a cation be released into the blood, as well. This can reduce blood pH. Lactate may exert a strong action over GABAergic networks in the developing brain, making them more inhibitory than it was previously assumed, acting either through better support of metabolites, or alterations in base intracellular pH levels, or both. (Wikipedia)

- Toxin and Toxin Target Database (T3DB)

14.1.2 Carcinogen Classification

Carcinogen Classification	Not listed by IARC.

▸ Toxin and Toxin Target Database (T3DB)

14.1.3 Health Effects

Chronically high levels of Lactic acid are associated with at least a dozen inborn errors of metabolism including: 2-Methyl-3-hydroxybutyryl CoA dehydrogenase deficiency, Biotinidase deficiency, Fructose-1,6-diphosphatase deficiency, Glycogen Storage Disease Type 1A (GSD1A) or Von Gierke Disease, Glycogenosis, Type IB, Glycogenosis, Type IC, Glycogenosis, Type VI. Hers disease, Lactic Acidemia, Leigh Syndrome, Methylmalonate Semialdehyde Dehydrogenase Deficiency, Pyruvate Decarboxylase E1 Component Deficiency, Pyruvate dehydrogenase complex deficiency, Pyruvate dehydrogenase deficiency, Short Chain Acyl CoA Dehydrogenase Deficiency (SCAD Deficiency).

▸ Toxin and Toxin Target Database (T3DB)

14.1.4 Exposure Routes

The substance can be absorbed into the body by inhalation of its aerosol and by ingestion.

▸ ILO-WHO International Chemical Safety Cards (ICSCs)

14.1.5 Signs and Symptoms

Inhalation Exposure

Burning sensation. Cough. Sore throat. Shortness of breath.

▸ ILO-WHO International Chemical Safety Cards (ICSCs)

Skin Exposure

Redness. Pain.

▸ ILO-WHO International Chemical Safety Cards (ICSCs)

Eye Exposure

Redness. Pain. Severe deep burns.

- ILO-WHO International Chemical Safety Cards (ICSCs)

Ingestion Exposure

Sore throat. Burning sensation. Abdominal pain. Abdominal cramps. Nausea. Vomiting.

- ILO-WHO International Chemical Safety Cards (ICSCs)

14.1.6 Adverse Effects

Dermatotoxin - Skin burns.

- Haz-Map, Information on Hazardous Chemicals and Occupational Diseases

14.1.7 Acute Effects

- ChemIDplus

14.1.8 Toxicity Data

LC50 (rat) = 7,940 mg/m3/4hr

- Haz-Map, Information on Hazardous Chemicals and Occupational Diseases

14.1.9 Interactions

The effects of local myocardial administration of lactic acid and low-dose **edaravone** were investigated to determine if this combination provides benefits similar to mechanical postconditioning. We randomly divided 108 rats into 6 groups: sham, reperfusion injury, postconditioning (Post), lacticacid (Lac), low-dose **edaravone** (Eda), and lactic acid + low-dose **edaravone** (Lac+Eda). The left coronary arteries of the rats were occluded for 45 minutes, before the administration of the treatments. The rats were euthanized at different time points to examine the infarct size and serum markers of myocardial injury and apoptosis and measure the expression of signal pathway markers. We found that the infarct areas caused by ischemic-reperfusion injury were reduced largely by postconditioning and Lac+Eda injection; a similar trend was observed for serum markers of myocardial injury, apoptosis, and hemodynamic parameters. Compared with the Post group, the Lac+Eda group had similar blood pH values, levels of reactive oxygen species, mitochondrial absorbance, and levels of signal pathway marker. The Lac and Eda groups partly mimicked the protective role. These data suggest that local myocardial administration of lactic acid and low dose of **edaravone** initiates protective signal pathways of mechanical postconditioning and replicates the myocardial protection.

PMID:23884160

Zhang G et al; J Cardiovasc Pharmacol 62 (4): 369-78 (2013)

▸ **Hazardous Substances Data Bank (HSDB)**

Excretion of **carbon dioxide** and **L-lactic acid** through exhalation and perspiration provides olfactory signals to mosquitoes which allow them to find and bite humans; however, mosquito species differ in this regard. This study investigated upwind responses of Anopheles stephensi, mysorensis form, an important malaria vector in Asia, to **carbon dioxide** and **L-lactic acid** under laboratory conditions. While a minimal dose of **carbon dioxide** (90 ppm) activated the mosquitoes, 10 times this amount suppressed them. **L-lactic acid** alone did not produce a significant effect by itself, but addition of 6 ug/min of **L-lactic acid** to a range of 90 to 410 ppm **carbon dioxide** resulted in attraction. The results provide further support for the hypothesis that CO2 plays an important role in the host-seeking behavior of zoophilic mosquitoes, and suggests that **L-lactic acid** might play a more critical role than CO2 in the attraction of An. stephensi.

PMID:23301376

Omrani SM et al; East Mediterr Health J 18 (11): 1134-42 (2012)

▸ **Hazardous Substances Data Bank (HSDB)**

During the pulmonary edema stage ... metabolic acidosis may occur because of increased lactic acid production in response to hypoxemia. /NO2-induced acute lung injury/

Bingham, E.; Cohrssen, B.; Powell, C.H.; Patty's Toxicology Volumes 1-9 5th ed. John Wiley & Sons. New York, N.Y. (2001)., p. V3 642

▸ **Hazardous Substances Data Bank (HSDB)**

Burning and/or stinging is one of the most common concerns expressed by patients using topical therapies for treatment of dermatologic disorders. Topical lactic acid preparations often are used to treat dry scaly skin. In this study, we compared the level of burning/stinging reported by participants with application of lactic acid cream 10% containing **strontium** versus **ammonium lactate** lotion 12% and cetearyl alcohol lotion. The mean rating of burning/stinging reported for lactic acid cream 10% with **strontium** and cetearyl alcohol lotion was lower than **ammonium lactate** lotion 12% (P<.0001). Based on the study results, lactic acid cream 10% with strontium causes less burning/stinging than ammonium lactate lotion 12%.

PMID:23772434

Haddican M et al; Cutis 91 (5): 260-2 (2013)

▸ **Hazardous Substances Data Bank (HSDB)**

For more Interactions (Complete) data for LACTIC ACID (6 total), please visit the **HSDB record page**.

▸ **Hazardous Substances Data Bank (HSDB)**

14.1.10 Antidote and Emergency Treatment

Immediate First Aid: Ensure that adequate decontamination has been carried out. If patient is not breathing, start artificial respiration, preferably with a demand-valve resuscitator, bag-valve-mask device, or pocket mask, as trained. Perform CPR if necessary. Immediately flush contaminated eyes with gently flowing **water**. Do not induce vomiting. If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain an open airway and prevent aspiration. Keep patient quiet and maintain normal body temperature. Obtain medical attention.

Currance, P.L. Clements, B., Bronstein, A.C. (Eds).; Emergency Care For Hazardous Materials Exposure. 3rd revised edition, Elsevier Mosby, St. Louis, MO 2007, p. 176

▸ **Hazardous Substances Data Bank (HSDB)**

Basic treatment: Establish a patent airway (oropharyngeal or nasopharyngeal airway, if needed). Suction if necessary. Watch for signs of respiratory insufficiency and assist respirations if necessary. Administer **oxygen** by nonrebreather mask at 10 to 15 L/min. Monitor for pulmonary edema and treat if necessary ... . Monitor for shock and treat if necessary ... . For eye contamination, flush eyes immediately with **water**. Irrigate each eye continuously with

0.9% saline (NS) during transport. ... Do not use emetics. For ingestion, rinse mouth and administer 5 mL/kg up to 200 mL of **water** for dilution if the patient can swallow, has a strong gag reflex, and does not drool. Activated **charcoal** is not effective ... . Do not attempt to neutralize, because of exothermic reaction. Cover skin burns with dry, sterile dressings after decontamination ... . /Organic acids and related compounds/

Currance, P.L. Clements, B., Bronstein, A.C. (Eds).; Emergency Care For Hazardous Materials Exposure. 3rd revised edition, Elsevier Mosby, St. Louis, MO 2007, p. 176-7

▸ **Hazardous Substances Data Bank (HSDB)**

Advanced treatment: Consider orotracheal or nasotracheal intubation for airway control in the patient who is unconscious, has severe pulmonary edema, or is in severe respiratory distress. Early intubation, at the first sign of upper airway obstruction, may be necessary. Positive-pressure ventilation techniques with a bag-valve-mask device may be beneficial. Consider drug therapy for pulmonary edema ... . Consider administering a beta agonist such as **albuterol** for severe bronchospasm ... . Monitor cardiac rhythm and treat arrhythmias as necessary ... . Start IV administration of D5W TKO /SRP: "To keep open", minimal flow rate/. Use 0.9% saline (NS) or lactated Ringer's (LR) if signs of hypovolemia are present. For hypotension with signs of hypovolemia, administer fluid cautiously. Consider vasopressors if patient is hypotensive with a normal fluid volume. Watch for signs of fluid overload... . Use **proparacaine hydrochloride** to assist eye irrigation ... . /Organic acids and related compounds/

Currance, P.L. Clements, B., Bronstein, A.C. (Eds).; Emergency Care For Hazardous Materials Exposure. 3rd revised edition, Elsevier Mosby, St. Louis, MO 2007, p. 177

▸ **Hazardous Substances Data Bank (HSDB)**

Lactic acidosis occurs in a number of clinical conditions, e.g. in surgeries, orthotopic liver transplant, and anesthetic agent administration, which has deleterious effects on the patient's survival. The most rational therapy for these patients, the **sodium bicarbonate** administration, cannot prevent those accompanying deficiencies and may actually be harmful. In addition, **tromethamine** adjusts the blood pH, it does not affect the **lactate** accumulation. Therefore, discovery of a therapeutic agent is still a major unsolved problem. In this study, the rats were divided into different groups and lactic acidosis type B was induced in them. Then, the effect of different injection doses of **spermidine** (0-20 nmol) on lactic acidosis was analyzed by measuring the **lactate** level and pH in the rat blood samples. The results showed that **spermidine** effectively and simultaneously inhibited the **lactate** and **pyruvate** accumulations, and also adjusted the pH of bloodstream. On the other hand, it has been shown that **spermidine** increases the activity of phosphatase, leading to prevention of **lactate** accumulation. The results indicate that administration of only nanomole level of **spermidine** may be the best treatment in the liver transplant and other patients suffering from lactic acidosis type B.

PMID:25201010

Sedigh-Ardekani M et al; Regul Toxicol Pharmacol 70 (2): 514-8 (2014)

▸ Hazardous Substances Data Bank (HSDB)

For more Antidote and Emergency Treatment (Complete) data for LACTIC ACID (6 total), please visit the HSDB record page.

▸ Hazardous Substances Data Bank (HSDB)

14.1.11 Human Toxicity Excerpts

/HUMAN EXPOSURE STUDIES/ When 0.35% DL-lactic acid was administered to healthy babies from the tenth to the twentieth day of life, a threefold increase in the urinary excretion of the physiological L(+)-lactic acid and a twelvefold increase in the D(-)-lactic acid was observed. On withdrawing lactic acid from the diet the level of lactic acid excreted in the urine returned to normal. Since the racemic mixture used consisted of 80% of the L(+) and 20% of the D(-) forms it seems that the metabolism of the D(-) form by the young full-term baby is more difficult than the L(+) form. The increase in the urinary excretion of either form of lactic acid indicated that the young infant cannot utilize lactic acid at a rate which can keep up with 0.35% in the diet. A number of babies could not tolerate lactic acid. In such cases there was rapid loss of weight, frequent diarrhoea, reduction of plasma bicarbonate and increased excretion of organic acids in the urine. All these effects were reversed on withdrawing lactic acid from the diet

*Joint FAO/WHO Expert Committee on Food Additives; WHO Food Additives Ser 40 a,b,c: Lactic acid (1966). Available from, as of April 19, 2006: **https://www.inchem.org/documents/jecfa/jecmono/40abcj44.htm***

▸ Hazardous Substances Data Bank (HSDB)

/HUMAN EXPOSURE STUDIES/ A skin test was performed using 49 a topic and 56 nonatopic patients to determine whether application of 2.5% lactic acid in water produces an urticarial reaction. Finn chambers containing 20 uL of test solution were fixed on the skin using porous tape for 20 min. Lactic acid produced no immediate reactions.

Cosmetic Ingredient Review Expert Panel; International Journal of Toxicology, 17 (Suppl.1): 1-203 (1998)

▸ Hazardous Substances Data Bank (HSDB)

/HUMAN EXPOSURE STUDIES/ The ability of lactic acid to induce hyperkeratosis was evaluated. Lactic acid, 3 and 8%, pH 3, was applied to the outer aspect of the calf to induce scaling. When visible scaling and irritation occurred, the skin desquamation profile was altered. Control values were 5.7% for cell renewal and 1 for irritation, clinical scaling, desquamation amount, and desquame size. After 3 weeks of application of 3% lactic acid, the values

increased to 27.8% for cell renewal, 1.9 for irritation, 1.5 for scaling and the desquamation amount, and 1.6 for desquame size. With 8% lactic acid, these values increased to 44.2% for cell renewal, 4.2 for irritation, 3.5 for scaling, 1.8 for desquamation amount, and 3.8 for desquame size.

Cosmetic Ingredient Review Expert Panel; International Journal of Toxicology, 17 (Suppl.1): 1-203 (1998)

▸ Hazardous Substances Data Bank (HSDB)

/SIGNS AND SYMPTOMS/ In general, on the basis of animal studies and human use, the most significant effects caused by exposure to lactate esters are respiratory, dermal, and ocular irritation. Irritation may be associated with the formation of lactic acid, a product of hydrolysis of lactate esters. /Hydroxyal esters: lactates/

Bingham, E.; Cohrssen, B.; Powell, C.H.; Patty's Toxicology Volumes 1-9 5th ed. John Wiley & Sons. New York, N.Y. (2001)., p. V6 619

▸ Hazardous Substances Data Bank (HSDB)

For more Human Toxicity Excerpts (Complete) data for LACTIC ACID (13 total), please visit the HSDB record page.

▸ Hazardous Substances Data Bank (HSDB)

14.1.12 Non-Human Toxicity Excerpts

/LABORATORY ANIMALS: Acute Exposure/ Groups of male Fischer 344 rats, five per group, were dosed with 0.5 mL of 130, 650, or 1300 mg/2000 kg body wt lactic acid via stomach tube; the control group received the same volume of water. Two rats of the 650-mg group and one rat of the 1300-mg group died within 24 hr of dosing. The concentrations of lactic acid in the blood were 0.43 and 0.47 mg/mL for rats of the control and 1300-mg groups, respectively, one day after dosing. The rats were dosed with the same amounts of lactic acid after 8 days. Two rats of the 1300 mg readministration group died; dyspnea, snivel, vomiting, and abdominal inflation were observed in these animals immediately after dosing.

Cosmetic Ingredient Review Expert Panel; International Journal of Toxicology, 17 (Suppl.1): 1-203 (1998)

▸ Hazardous Substances Data Bank (HSDB)

/LABORATORY ANIMALS: Acute Exposure/ A 5% aqueous solution of Lactic Acid, 0.2 mL, was "very slightly irritant" after repeated application to shaved rat skin (number of animals not stated). One-half milliliter of 5 and 10% aq. Lactic Acid was applied for 4 hr to the clipped dorsum of rabbits (number and sex not stated) using occlusive patches; the treatment sites had been prehydrated for 60 min immediately prior to dosing. The 5% solution was "virtually

nonirritant," and the 10% solution was "only slightly irritant, causing similar effects to those of marketed skin care creams."

Cosmetic Ingredient Review Expert Panel; International Journal of Toxicology, 17 (Suppl.1): 1-203 (1998)

▸ Hazardous Substances Data Bank (HSDB)

/LABORATORY ANIMALS: Acute Exposure/ A maximization study was performed using guinea pigs (number of animals not stated) in which induction consisted of intradermal injection of 0.2% and topical application of 50% Lactic Acid; challenge consisted of intradermal injection of 0.2% and application of 10%. Lactic Acid was not a sensitizer.

Cosmetic Ingredient Review Expert Panel; International Journal of Toxicology, 17 (Suppl.1): 1-203 (1998)

▸ Hazardous Substances Data Bank (HSDB)

/LABORATORY ANIMALS: Acute Exposure/ Five phototoxicity assays were performed on a face cream containing 0.25% of 85% aq. lactic acid using six New Zealand White rabbits per test. The undiluted test materials and the positive control, **8-methoxypsoralen** (1/128% in **ethanol**), were applied to the shaved left side of the back and allowed to penetrate for 30 min; one application/animal was made in all tests except one (test 3) in which two applications/animal were made. The backs of the animals were irradiated with a UV light source (FL40-BL, >320 nm) placed 8 inches above the midline. In tests 1 and 4, there was one 1-hr irradiation period; in test 2, there was one 1-hr and one 2-hr irradiation period; and in tests 3 and 5, there was one 2-hr irradiation period. Following irradiation, the test materials were applied to the shaved right side of the back in the same manner. Test sites were scored using the Draize scale for erythema and edema at 24, 48, 72, and 96 hr after application. Upon examination of all results, it was concluded that the face cream containing 0.25% of 85% aq. lactic acid was a "weak phototoxin."

Cosmetic Ingredient Review Expert Panel; International Journal of Toxicology, 17 (Suppl.1): 1-203 (1998)

▸ Hazardous Substances Data Bank (HSDB)

For more Non-Human Toxicity Excerpts (Complete) data for LACTIC ACID (31 total), please visit the **HSDB record page**.

▸ Hazardous Substances Data Bank (HSDB)

14.1.13 Non-Human Toxicity Values

LD50 Rat oral 3730 mg/kg

Lewis, R.J. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 11th Edition. Wiley-Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p. 2196

▸ Hazardous Substances Data Bank (HSDB)

LD50 Guinea pigs oral 1810 mg/kg

Lewis, R.J. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 11th Edition. Wiley-Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p. 2196

▸ Hazardous Substances Data Bank (HSDB)

LD50 Mouse sc 4500 mg/kg

Lewis, R.J. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 11th Edition. Wiley-Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p. 2196

▸ Hazardous Substances Data Bank (HSDB)

View More...

14.1.14 Ongoing Test Status

EPA has released the Interactive Chemical Safety for Sustainability (iCSS) Dashboard. The iCSS Dashboard provides an interactive tool to explore rapid, automated (or in vitro high-throughput) chemical screening data generated by the Toxicity Forecaster (ToxCast) project and the federal Toxicity Testing in the 21st century (Tox21) collaboration. /The title compound was tested by ToxCast and/or Tox21 assays/[USEPA; ICSS Dashboard Application; Available from, as of December 17, 2015: http://actor.epa.gov/dashboard/]

▸ Hazardous Substances Data Bank (HSDB)

14.2 Ecological Information

14.2.1 Ecotoxicity Values

LC50; Species: Moina micrura (**Water** Flea) length 0.09 mm and breadth 0.06 mm; Conditions: freshwater, renewal; Concentration: 329120 ug/L for 96 hr (95% confidence interval: 315810-342430 ug/L) /88% purity/

Saha NC et al; Hum Ecol Risk Assess 12 (1): 192-202 (2006) as cited in the ECOTOX database. Available from, as of February 15, 2016: ***https://cfpub.epa.gov/ecotox/***

▸ Hazardous Substances Data Bank (HSDB)

LC50; Species: Oreochromis mossambicus (Mozambique Tilapia) adult, male and female, weight 11.83 g; Conditions: freshwater, renewal; Concentration: 257730 ug/L for 96 hr (95%

confidence interval: 210540-315810 ug/L) /88% purity/

Saha NC et al; Hum Ecol Risk Assess 12 (1): 192-202 (2006) as cited in the ECOTOX database. Available from, as of February 15, 2016: ***https://cfpub.epa.gov/ecotox/***

▸ **Hazardous Substances Data Bank (HSDB)**

LC50; Species: Branchiura sowerbyi (Oligochaete) weight 0.002 g, length 20 mm; Conditions: freshwater, renewal; Concentration: 50820 ug/L for 96 hr (95% confidence interval: 48400-53240 ug/L) /88% purity/

Saha NC et al; Hum Ecol Risk Assess 12 (1): 192-202 (2006) as cited in the ECOTOX database. Available from, as of February 15, 2016: ***https://cfpub.epa.gov/ecotox/***

▸ **Hazardous Substances Data Bank (HSDB)**

View More...

14.2.2 Ecotoxicity Excerpts

/BIRDS and MAMMALS/ Feeding of 10% lactic acid /to birds/ has been blamed for the development of polyneuritic crises resembling B1 deficiency on diets rich in carbohydrates, proteins or fats.

WHO Food Additive Series 5: LACTIC ACID AND ITS AMMONIUM, CALCIUM, POTASSIUM AND SODIUM SALTS (1974). Available from, as of May 9, 2006: ***https://www.inchem.org/pages/jecfa.html***

▸ **Hazardous Substances Data Bank (HSDB)**

14.2.3 Environmental Fate / Exposure Summary

Lactic acid's production and use as an acidulant, in cultured dairy products, in chemicals (salts, plasticizers, adhesives, pharmaceuticals), as a mordant in dyeing wool, in general-purpose food additive, in the manufacture of lactates, in dehairing, plumping, and decalcifying hides, and as a solvent may result in its release to the environment through various waste streams. Lactic acid is a principal metabolic intermediate in most living organisms and also occurs in sour milk, foods, and some higher plants. If released to air, a vapor pressure of 0.0813 mm Hg at 25 °C indicates lactic acid will exist solely as a vapor in the atmosphere. Vapor-phase lactic acid will be degraded in the atmosphere by reaction with photochemically-produced **hydroxyl** radicals; the half-life for this reaction in air is estimated to be 2.7 days. Lactic acid does not contain chromophores that absorb at wavelengths >290 nm and therefore is not expected to be susceptible to direct photolysis by sunlight. If released to soil, lactic acid is expected to have very high mobility based upon experimental Koc values ranging from <0.08 to <20.9. The pKa of lactic acid is 3.86, indicating that this compound will exist partially to almost entirely as an

anion in the environment and anions generally do not adsorb more strongly to soils containing organic carbon and clay than their neutral counterparts. Volatilization from moist soil surfaces is not expected to be an important fate process based upon an estimated Henry's Law constant of 9.6X10-9 atm-cu m/mole. Lactic acid is not expected to volatilize from dry soil surfaces based upon its vapor pressure. Utilizing the Japanese MITI test, 76% of the Theoretical BOD was reached in 2 weeks indicating that biodegradation is an important environmental fate process. If released into water, lactic acid is not expected to adsorb to suspended solids and sediment based upon the Koc values. Various screening tests have found lactic acid to biodegrade readily. Volatilization from water surfaces is not expected to be an important fate process based upon this compound's estimated Henry's Law constant. An estimated BCF of 3 suggests the potential for bioconcentration in aquatic organisms is low. Hydrolysis is not expected to be an important environmental fate process since this compound lacks functional groups that hydrolyze under environmental conditions. Occupational exposure to lactic acid may occur through dermal contact with this compound at workplaces where lactic acid is produced or used. Monitoring data indicate that the general population may be exposed to lactic acid via ingestion of food and drinking water and dermal contact with consumer products containing lactic acid. (SRC)

▸ Hazardous Substances Data Bank (HSDB)

14.2.4 Natural Pollution Sources

Lactic acid occurs in sour milk as a result of lactic acid bacteria(1). It also is found in molasses due to partial conversion of sugars, in apples and other fruits, tomato juice, beer, wines, opium, ergot, foxglove, and several higher plants, especially during germination(1). Lactic acid is ubiquitous in nature and is a principal metabolic intermediate in most living organisms(2). It is a constituent in blood(2).

(1) O'Neil MJ, ed; The Merck Index. 15th ed., Cambridge, UK: Royal Society of Chemistry, p. 990 (2013)

(2) Datta R; Hydrocarboxylic Acids. Kirk-Othmer Encyclopedia of Chemical Technology. (1999-2016). New York, NY: John Wiley & Sons. Online Posting Date: 17 Dec 2004

▸ Hazardous Substances Data Bank (HSDB)

14.2.5 Artificial Pollution Sources

Lactic acid's production and use as an acidulant, in cultured dairy products, in chemicals (salts, plasticizers, adhesives, pharmaceuticals), as a mordant in dyeing wool, in general-purpose food additive, in the manufacture of lactates, in dehairing, plumping, and decalcifying hides, and as a solvent(1,2) may result in its release to the environment through various waste streams(SRC).

Lactic acid may be formed in the ambient atmosphere as a result of photooxidation (OH radicals or ozone) of hydrocarbons(3).

(1) O'Neil MJ, ed; The Merck Index. 15th ed., Cambridge, UK: Royal Society of Chemistry, p. 990 (2013)

(2) Lewis RJ Sr; Hawley's Condensed Chemical Dictionary. 15th ed., New York, NY: John Wiley & Sons, Inc., p. 736 (2007)

(3) Yu J et al; Environ Sci Technol 32: 2357-2370 (1998)

▸ **Hazardous Substances Data Bank (HSDB)**

14.2.6 Environmental Fate

TERRESTRIAL FATE: Based on a classification scheme(1), experimentally-derived Koc values ranging from <0.08 to <20.9(2,3), indicate that lactic acid is expected to have very high mobility in soil(SRC). The pKa of lactic acid is 3.86(4), indicating that this compound will exist partially to almost entirely as an anion in the environment and anions generally do not adsorb more strongly to soils containing organic carbon and clay than their neutral counterparts(5). Volatilization of lactic acid from moist soil surfaces is not expected to be an important fate process(SRC) given an estimated Henry's Law constant of 9.6X10-9 atm-cu m/mole(SRC), derived from its vapor pressure, 0.0813 mm Hg(6), and an assigned value for water solubility of 1.0X10+6 mg/L (miscible)(7). Lactic acid is not expected to volatilize from dry soil surfaces(SRC) based upon its vapor pressure(6). A 76% of theoretical BOD using activated sludge in a 2-week Japanese MITI test indicates lactic acid is readily biodegradable(8) and suggests that biodegradation is an important environmental fate process in soil(SRC). Other screening tests have also found lactic acid to biodegrade readily(9-11).

(1) Swann RL et al; Res Rev 85: 17-28 (1983)

(2) Sansone FJ et al; Geochim Cosmochin Acta 51: 1889-96 (1987)

(3) ECHA; Search for Chemicals. Lactic Acid (CAS 50-21-5), Registered Substances Dossier. European Chemical Agency. Available from, as of March 17, 2016: ***https://echa.europa.eu/***

(4) O'Neil MJ, ed; The Merck Index. 15th ed., Cambridge, UK: Royal Society of Chemistry, p. 990 (2013)

(5) Doucette WJ; pp. 141-188 in Handbook of Property Estimation Methods for Chemicals. Boethling RS, Mackay D, eds. Boca Raton, FL: Lewis Publ (2000)

(6) Yaws CL; Handbook Chem Compd Data Process Saf, Houston, TX: Gulf Publishing, p. 33 (1997)

(7) Lewis RJ Sr; Hawley's Condensed Chemical Dictionary. 15th ed., New York, NY: John Wiley & Sons, Inc., p. 736 (2007)

(8) NITE; Chemical Risk Information Platform (CHRIP). Biodegradation and Bioconcentration. Tokyo, Japan: Natl Inst Tech Eval. Available from, as of March 17, 2016: ***https://www.safe.nite.go.jp/english/db.html***

(9) Malaney GW, Gerhold RM; J Water Pollut Control Fed 41: R18-R33 (1969)

(10) Fischer WK et al; Wasser-Und Abwasser-Forschung 7: 99-118 (1974)

(11) Heukelekian H, Rand MC; J Water Pollut Contr Assoc 27: 1040-53 (1955)

AQUATIC FATE: Based on a classification scheme(1), experimentally-derived Koc values ranging from <0.08 to <20.9(2,3), indicate that lactic acid is not expected to adsorb to suspended solids and sediment(SRC). Volatilization from water surfaces is not expected(4) based upon an estimated Henry's Law constant of 9.6X10-9 atm-cu m/mole(SRC), derived from its vapor pressure, 0.0813 mm Hg(5), and an assigned value for water solubility of 1.0X10+6 mg/L (miscible)(6). The pKa of lactic acid is 3.86(7), indicating that this compound will exist partially to almost entirely in the anion form in the environment(SRC). The anion form will not volatilize, but by analogy to the similar acetic acid(8), lactic acid is expected to have a measurable Henry's Law constant even when almost entirely ionized. According to a classification scheme(9), an estimated BCF of 3(SRC), from a log Kow of -0.72(10) and a regression-derived equation(11), suggests the potential for bioconcentration in aquatic organisms is low(SRC). A 76% of theoretical BOD using activated sludge in a 2-week Japanese MITI test indicates lactic acid is readily biodegradable(12) and suggests that biodegradation is an important environmental fate process in water(SRC). Other screening tests have also found lactic acid to biodegrade readily(13-15). Hydrolysis is not expected to be an important environmental fate process since this compound lacks functional groups that hydrolyze under environmental conditions(4).

(1) Swann RL et al; Res Rev 85: 17-28 (1983)

(2) Sansone FJ et al; Geochim Cosmochin Acta 51: 1889-96 (1987)

(3) ECHA; Search for Chemicals. Lactic Acid (CAS 50-21-5), Registered Substances Dossier. European Chemical Agency; Available from, as of March 17, 2016: ***https://echa.europa.eu/***

(4) Lyman WJ et al; Handbook of Chemical Property Estimation Methods. Washington, DC: Amer Chem Soc pp. 7-4, 7-5, 15-1 to 15-29 (1990)

(5) Yaws CL; Handbook Chem Compd Data Process Saf, Houston, TX: Gulf Publishing p. 33 (1997)

(6) Lewis RJ Sr; Hawley's Condensed Chemical Dictionary 15th ed., New York, NY: John Wiley & Sons, Inc., p. 736 (2007)

(7) O'Neil MJ, ed; The Merck Index. 15th ed., Cambridge, UK: Royal Society of Chemistry, p. 990 (2013)

(8) Gaffney JS et al; Environ Sci Technol 21: 519-524 (1987)

(9) Franke C et al; Chemosphere 29: 1501-14 (1994)

(10) Hansch C et al; Exploring QSAR. Hydrophobic, Electronic, and Steric Constants. ACS Prof Ref Book. Heller SR, consult. ed., Washington, DC: Amer Chem Soc p. 6 (1995)

(11) US EPA; Estimation Program Interface (EPI) Suite. Ver. 4.11. Nov, 2012. Available from, as of March 17, 2016: ***https://www2.epa.gov/tsca-screening-tools***

(12) NITE; Chemical Risk Information Platform (CHRIP). Biodegradation and Bioconcentration. Tokyo, Japan: Natl Inst Tech Eval. Available from, as of March 17, 2016: ***https://www.safe.nite.go.jp/english/db.html***

(13) Malaney GW, Gerhold RM; J Water Pollut Control Fed 41: R18-R33 (1969)

(14) Fischer WK et al; Wasser-Und Abwasser-Forschung 7: 99-118 (1974)

(15) Heukelekian H, Rand MC; J Water Pollut Contr Assoc 27: 1040-53 (1955)

▸ **Hazardous Substances Data Bank (HSDB)**

ATMOSPHERIC FATE: According to a model of gas/particle partitioning of semivolatile organic compounds in the atmosphere(1), lactic acid, which has a vapor pressure of 0.0813 mm Hg at 25 °C(2), is expected to exist solely as a vapor in the ambient atmosphere. Vapor-phase lactic acid is degraded in the atmosphere by reaction with photochemically-produced **hydroxyl** radicals(SRC); the half-life for this reaction in air is estimated to be 2.7 days(SRC), calculated from its rate constant of 5.9X10-12 cu cm/molecule-sec at 25 °C(SRC) that was derived using a structure estimation method(3). Lactic acid does not contain chromophores that absorb at wavelengths >290 nm and therefore is not expected to be susceptible to direct photolysis by sunlight(4).

(1) Bidleman TF; Environ Sci Technol 22: 361-367 (1988)

(2) Yaws CL; Handbook Chem Compd Data Process Saf, Houston, TX: Gulf Publishing p. 33 (1997)

*(3) US EPA; Estimation Program Interface (EPI) Suite. Ver. 4.11. Nov, 2012. Available from, as of March 17, 2016: **https://www2.epa.gov/tsca-screening-tools***

(4) Lyman WJ et al; Handbook of Chemical Property Estimation Methods. Washington, DC: Amer Chem Soc pp. 8-12 (1990)

▸ **Hazardous Substances Data Bank (HSDB)**

14.2.7 Environmental Biodegradation

AEROBIC: Lactic acid reached 22% of its theoretical BOD in 5 days using a sewage inoculum(1). In a closed bottle screening test, lactic acid, present at 2 mg/L, reached 12, 67, and 88% of its theoretical BOD after 5, 15, and 30 days, respectively, using an activated sludge inoculum(2). Lactic acid reached 59% of its theoretical BOD in 5 days using a sludge inoculum and the Warburg screening test(3). Lactic acid, present at 500 mg/L, reached 27.5, 29.4, and 33.3% of its theoretical BOD in 6, 12, and 24 hours, respectively, using an activated sludge inoculum at 2500 mg/L(4). Lactic acid was found to be easily biodegradable by biological sewage treatment(5). Lactic acid, present at 100 mg/L, reached 76% of its theoretical BOD in 2 weeks using an activated sludge inoculum at 30 mg/L in the Japanese MITI test which classified the compound as readily biodegradable(6).

(1) Dore M et al; Trib Cebedeau 28: 3-11 (1975)

(2) Fischer WK et al; Wasser-Und Abwasser-Forschung 7: 99-118 (1974)

(3) Heukelekian H, Rand MC; J Water Pollut Contr Assoc 27: 1040-53 (1955)

(4) Malaney GW, Gerhold RM; J Water Pollut Control Fed 41: R18-R33 (1969)

(5) Thom NS, Agg AR; Proc R Soc Lond B 189: 347-57 (1975)

(6) NITE; Chemical Risk Information Platform (CHRIP). Biodegradation and Bioconcentration. Tokyo, Japan: Natl Inst Tech Eval. Available from, as of March 17, 2016: ***https://www.safe.nite.go.jp/english/db.html***

▸ **Hazardous Substances Data Bank (HSDB)**

ANAEROBIC: Lactic acid was rapidly oxidized to **carbon dioxide** by **sulfate**-reducing bacteria in anaerobic salt marsh sediments with a rate of about 125 nmoles oxidized/g dry mud/hour(1). Lactic acid was found to be amenable to ultimate anaerobic biodegradation in industrial wastewater(2).

(1) Dicker HJ, Smith DW; Microb Ecol 11: 317-35 (1985)

(2) Speece RE; Environ Sci Technol 17: 416A-24A (1983)

▸ **Hazardous Substances Data Bank (HSDB)**

14.2.8 Environmental Abiotic Degradation

The rate constant for the vapor-phase reaction of lactic acid with photochemically-produced **hydroxyl** radicals has been estimated as 5.9X10-12 cu cm/molecule-sec at 25 °C(SRC) using a structure estimation method(1). This corresponds to an atmospheric half-life of about 2.7 days at an atmospheric concentration of 5X10+5 **hydroxyl** radicals per cu cm(1). The rate constant for the reaction of **hydroxyl** radicals in aqueous solutions at pH 1 is 4.8X10+8 L/mol-sec(2); this corresponds to an aquatic half-life of about 4.6 years at an aquatic concentration of 1X10-17 **hydroxyl** radicals per liter(3). Lactic acid is not expected to undergo hydrolysis in the environment due to the lack of functional groups that hydrolyze under environmental conditions(4). Laboratory studies found aqueous solutions of lactic acid to be very stable with an estimated shelf-life of 70 years(5). Lactic acid does not contain chromophores that absorb at wavelengths >290 nm and therefore is not expected to be susceptible to direct photolysis by sunlight(4).

(1) US EPA; Estimation Program Interface (EPI) Suite. Ver. 4.11. Nov, 2012. Available from, as of March 17, 2016: ***https://www2.epa.gov/tsca-screening-tools***

(2) Buxton GV et al; J Phys Chem Ref Data 17: 513-882 (1988)

(3) Mill T et al; Science 207: 886-887 (1980)

(4) Lyman WJ et al; Handbook of Chemical Property Estimation Methods. Washington, DC: Amer Chem Soc pp. 7-4, 7-5, 8-12 (1990)

(5) de Villiers MM et al; J Soc Cosmet Chem 48: 165-174 (1998)

▸ **Hazardous Substances Data Bank (HSDB)**

14.2.9 Environmental Bioconcentration

An estimated BCF of 3 was calculated for lactic acid(SRC), using a log Kow of -0.72(1) and a regression-derived equation(2). According to a classification scheme(3), this BCF suggests the potential for bioconcentration in aquatic organisms is low(SRC).

(1) Hansch C et al; Exploring QSAR. Hydrophobic, Electronic, and Steric Constants. ACS Prof Ref Book. Heller SR, consult. ed., Washington, DC: Amer Chem Soc p. 6 (1995)

*(2) US EPA; Estimation Program Interface (EPI) Suite. Ver. 4.11. Nov, 2012. Available from, as of March 17, 2016: **https://www2.epa.gov/tsca-screening-tools***

(3) Franke C et al; Chemosphere 29: 1501-14 (1994)

▸ **Hazardous Substances Data Bank (HSDB)**

14.2.10 Soil Adsorption / Mobility

Experimental Koc values for lactic acid on a clastic mud (3.5% organic **carbon**) and a lateritic muddy sand (1.3% organic **carbon**) were 5.7 and <0.08, respectively(1). Utilizing an HPLC method, the Koc of lactic acid (93% aqueous solution) on soil and sewage sludge at neutral pH and pH 2 was <20.9(2). According to a classification scheme(3), these Koc values suggest that lactic acid is expected to have very high mobility in soil. The pKa of lactic acid is 3.86(4), indicating that this compound will exist partially to almost entirely in anion form in the environment and anions generally do not adsorb more strongly to soils containing organic carbon and clay than their neutral counterparts(5).

(1) Sansone FJ et al; Geochim Cosmochin Acta 51: 1889-96 (1987)

*(2) ECHA; Search for Chemicals. Lactic Acid (CAS 50-21-5), Registered Substances Dossier. European Chemical Agency; Available from, as of March 17, 2016: **https://echa.europa.eu/***

(3) Swann RL et al; Res Rev 85: 17-28 (1983)

(4) O'Neil MJ, ed; The Merck Index. 15th ed., Cambridge, UK: Royal Society of Chemistry, p. 990 (2013)

(5) Doucette WJ; pp. 141-188 in Handbook of Property Estimation Methods for Chemicals. Boethling RS, Mackay D, eds. Boca Raton, FL: Lewis Publ (2000)

▸ **Hazardous Substances Data Bank (HSDB)**

14.2.11 Volatilization from Water / Soil

The Henry's Law constant for lactic acid is estimated as 9.6X10-9 atm-cu m/mole(SRC) derived from its vapor pressure, 0.0813 mm Hg(1), and an assigned value for **water** solubility of 1.00X10+6 mg/L (miscible)(2). This Henry's Law constant indicates that lactic acid is expected to be essentially nonvolatile from **water** surfaces(3). Lactic acid's estimated Henry's Law constant indicates that volatilization from moist soil surfaces is not expected to occur(SRC).

Lactic acid is not expected to volatilize from dry soil surfaces(SRC) based upon its vapor pressure(1).

(1) Yaws CL; Handbook Chem Compd Data Process Saf, Houston, TX: Gulf Publishing (1997)

(2) Lewis RJ Sr; Hawley's Condensed Chemical Dictionary. 15th ed., New York, NY: John Wiley & Sons, Inc., p. 736 (2007)

(3) Lyman WJ et al; Handbook of Chemical Property Estimation Methods. Washington, DC: Amer Chem Soc pp. 15-1 to 15-29 (1990)

▸ **Hazardous Substances Data Bank (HSDB)**

14.2.12 Environmental Water Concentrations

DRINKING **WATER**: Lactic acid was qualitatively detected in grab samples of treated drinking **water** taken from waterworks during March to December 1976(1).

(1) Fielding M et al; Organic Micropollutants in Drinking Water. TR-159. Medmenham, Eng. Water Res Cent pp. 49 (1981)

▸ **Hazardous Substances Data Bank (HSDB)**

SEAWATER: Lactic acid was detected at concentrations of 0.2 (2 samples), 0.2-4.9 (4 samples), and 0.6-1.6 umol/L (2 samples) in Sheldt estuary **water**, Belgian coastal **water** of the North Sea, and English Channel open sea **water**, respectively, collected between July 1997 and July 1998(1).

(1) Billen G et al; Estuarine Coastal Mar Sci 11: 279-94 (1980)

▸ **Hazardous Substances Data Bank (HSDB)**

14.2.13 Effluent Concentrations

Lactic acid was qualitatively detected in the effluent of kraft mills in Springfield, OR and Everett, WA(1). Lactic acid was found in source-separated organic household waste collected from Uppsala, Sweden in February 1995 at a concentration range of 0.28-0.71% fresh weight(2).

(1) Hrutfiord BF et al; Tappi 58: 98-100 (1975)

(2) Eklind Y et al; Swedish J Agric Res 27: 167-78 (1997)

▸ **Hazardous Substances Data Bank (HSDB)**

14.2.14 Sediment / Soil Concentrations

SEDIMENT: Sediments collected at a depth of 0-3 cm from Loch Eil, Scotland from three different sampling stations had lactic acid concentrations of 14.4, 21.4, and 27.2 ug/g dry weight sediment(1).

(1) Miller D et al; Marine Biology 50: 375-83 (1979)

▸ Hazardous Substances Data Bank (HSDB)

14.2.15 Food Survey Values

Lactic acid was detected as a flavoring constituent of Nigerian gari (a type of tapioca made from cassava (Manihot esculenta) tubers)(1). Lactic acid occurs in sour milk as a result of lactic acid bacteria(2). Lactic acid is also found in molasses due to partial conversion of sugars, in apples and other fruits, tomato juice, beer, wines, opium, ergot, foxglove, and several higher plants, especially during germination(2). Lactic acid is present in many foods both naturally or as a product of in situ microbial fermentation, as in sauerkraut, yogurt, buttermilk, sourdough breads, and many other fermented foods(3).

(1) Dougan J et al; J Sci Food Agric 34: 874-84 (1983)

(2) O'Neil MJ, ed; The Merck Index. 15th ed., Cambridge, UK: Royal Society of Chemistry, p. 990 (2013)

(3) Datta R; Hydrocarboxylic Acids. Kirk-Othmer Encyclopedia of Chemical Technology. (1999-2016). New York, NY: John Wiley & Sons. Online Posting Date: 17 Dec 2004.

▸ Hazardous Substances Data Bank (HSDB)

Lactic acid occurrence in plants(1).

Genus species	Family	Common name(s)	Part	Low/High concn (ppm)
Papaver somniferum	Papaveraceae	Opium Poppy, Poppyseed Poppy	Latex Exudate	10000.0/20000.0
Stevia rebaudiana;	Asteraceae	Stevia, Sweet Leaf of Paraguay	Plant	-/2600.0
Sambucus nigra	Adoxaceae	Black Elder, Elder, European Elder, European Elderberry	Fruit	-/1800.0
Lycopersicon esculentum	Solanaceae	Tomato	Fruit	not reported
Vitis vinifera	Vitaceae	Grapevine, Wine Grape, European	Fruit	not reported

		Grape		
Rubus idaeus	Rosaceae	Raspberry, Red Raspberry	Leaf	not reported
Helianthus annuus	Asteraceae	Girasol, Sunflower	Leaf	not reported
Arnica montana	Asteraceae	Mountain Tobacco	Rhizome	not reported
Ammi visnaga	Apiaceae	Visnaga	Plant	not reported
Digitalis purpurea	Scrophulariaceae	Purple Foxglove	Leaf	not reported

(1) USDA; Dr. Duke's Phytochemical and Ethnobotanical Databases. Plants with a chosen chemical. Lactic Acid. Washington, DC: US Dept Agric, Agric Res Service. Available from, as of March 17, 2016: ***https://phytochem.nal.usda.gov/phytochem/search***

▸ **Hazardous Substances Data Bank (HSDB)**

14.2.16 Fish / Seafood Concentrations

The mean percentage of lactic acid in the muscle of haddock, cod, hake, flounder and halibut ranged from 0.12 to 0.26(1).

(1) Ritchie AD; Journal of Experimental Biology 4(4): 327-332 (1927). Available from, as of March 18, 2016: ***https://jeb.biologists.org/content/jexbio/4/4/327.full.pdf***

▸ **Hazardous Substances Data Bank (HSDB)**

14.2.17 Milk Concentrations

ENVIRONMENTAL: The purpose of this study was to determine if breast milk composition changed significantly following exercise conducted at different intensities. Nine postpartum women exercised on a treadmill up to maximal **oxygen** uptake (100% of VO2max) on the first laboratory visit, for 30 minutes on two subsequent occasions (50% and 75% of VO2max) and also performed a nonexercise control session. Blood and breast milk were collected prior to exercise, immediately after exercise, and at 30, 60, and 90 minutes postexercise. Blood samples were analyzed for lactic acid (LA) while milk samples were analyzed for LA, pH, lipid, **ammonium**, and **urea**. Milk LA after the 100% intensity session was significantly elevated through 90 minutes postexercise, while there was no significant increase in milk LA at any collection time after the 50% or 75% intensity sessions. There were no significant differences in milk pH, lipid, **ammonium**, or **urea** measurements after any of the exercise sessions. These data show that unlike maximum intensity exercise, moderate intensity exercise does not increase breast milk LA content.

PMID:9233201

Carey GB et al; J Hum Last 13(2): 115-20 (1997)

▸ Hazardous Substances Data Bank (HSDB)

ENVIRONMENTAL: The purpose of this study was to observe the infant acceptance of postexercise breast milk. Twenty-six lactating postpartum women exercised to maximum (maximum **oxygen** consumption = 35.1 +/- 9.2 [SD] mL min-1 kg-1) on a treadmill. Breast milk was collected via self-expression at rest before exercise and at 10 and 30 minutes postexercise and analyzed for lactic acid by enzymatic methods. Following exercise, infants were presented with their mothers' pre-exercise and postexercise milk in a double-blind design. The mother rated the infant's acceptance of the milk samples. There was a significant difference in acceptance of pre-exercise and postexercise milk as analyzed by analysis of variance. Maximal exercise resulted in a significant increase in lactic acid concentration in breast milk that may be high enough to affect the taste of the milk. The decreased acceptance of postexercise milk was associated with increased lactic acid concentration. Suggestions to circumvent the decreased acceptance are offered.

PMID:1306643

Wallace JP et al; Pediatrics 89(6 Pt 2): 1245-7 (1992)

▸ Hazardous Substances Data Bank (HSDB)

14.2.18 Probable Routes of Human Exposure

According to the 2012 **TSCA** Inventory Update Reporting data, 7 reporting facilities estimate the number of persons reasonably likely to be exposed during the manufacturing, processing, or use of lactic acid in the United States may be as low as 10-24 workers and as high as 500-999 workers per plant; the data may be greatly underestimated due to confidential business information (CBI) or unknown values(1).

*(1) US EPA; Chemical Data Reporting (CDR). Non-confidential 2012 Chemical Data Reporting information on chemical production and use in the United States. Available from, as of March 17, 2016: **https://java.epa.gov/oppt_chemical_search/***

▸ Hazardous Substances Data Bank (HSDB)

NIOSH (NOES Survey 1981-1983) has statistically estimated that 107,962 workers (63,436 of these are female) are potentially exposed to lactic acid in the US(1). Occupational exposure to lactic acid may occur through dermal contact with this compound at workplaces where lactic acid is produced or used(SRC). Monitoring data indicate that the general population may be exposed to lactic acid via ingestion of food and drinking **water** and dermal contact with consumer products containing lactic acid(SRC).

*(1) NIOSH; NOES. National Occupational Exposure Survey conducted from 1981-1983. Estimated numbers of employees potentially exposed to specific agents by 2-digit standard industrial classification (SIC). Available from, as of March 17, 2016: **https://www.cdc.gov/noes/noes1/agtindex.html***

▸ Hazardous Substances Data Bank (HSDB)

14.2.19 Body Burden

Lactic acid was found to be excreted by humans through urine at a rate of 40 mg/kg body weight/day and through sweat at 45-452 mg/100 mL(1).

(1) Verschueren K; Handbook of Environmental Data on Organic Chemicals, Vol 1-2, 4th ed. Bew York, NY: John Wiley and Sons (2001)

▸ Hazardous Substances Data Bank (HSDB)

14.3 EFSA OpenFoodTox

14.3.1 EFSA Outputs

▸ EFSA OpenFoodTox

14.3.2 EFSA Hazard Characterization: Reference Points

▸ EFSA OpenFoodTox

14.3.3 EFSA Hazard Characterization: Reference Values

▸ EFSA OpenFoodTox

14.3.4 EFSA Genotoxicity

▸ EFSA OpenFoodTox

15 Associated Disorders and Diseases

▸ Open Targets

16 Literature

16.1 Consolidated References

- PubChem

16.2 NLM Curated PubMed Citations

- Medical Subject Headings (MeSH)

16.3 Springer Nature References

▸ Springer Nature

16.4 Thieme References

▸ Thieme Chemistry

▸ Thieme Chemistry

16.5 Wiley References

- Wiley

- Wiley

16.6 Nature Journal References

Fets et al. MCT2 mediates concentration-dependent inhibition of glutamine metabolism by MOG. Nature Chemical Biology, doi: 10.1038/s41589-018-0136-y, published online 8 October 2018

- Nature Chemical Biology

16.7 Chemical Co-Occurrences in Literature

- PubChem

16.8 Chemical-Gene Co-Occurrences in Literature

- PubChem

16.9 Chemical-Disease Co-Occurrences in Literature

▸ PubChem

16.10 Chemical-Organism Co-Occurrences in Literature

▸ PubChem

17 Patents

US6077836
US6248726

▸ DrugBank

17.1 Depositor-Supplied Patent Identifiers

▸ PubChem

Link to all deposited patent identifiers

▸ PubChem

17.2 WIPO PATENTSCOPE

Patents are available for this chemical structure:

https://patentscope.wipo.int/search/en/result.jsf?inchikey=JVTAAEKCZFNVCJ-UHFFFAOYSA-N

▸ PATENTSCOPE (WIPO)

17.3 FDA Orange Book Patents

- FDA Orange Book

17.4 Chemical Co-Occurrences in Patents

- PubChem

17.5 Chemical-Disease Co-Occurrences in Patents

▸ PubChem

17.6 Chemical-Gene Co-Occurrences in Patents

▸ PubChem

17.7 Chemical-Organism Co-Occurrences in Patents

- PubChem

18 Interactions and Pathways

18.1 Protein Bound 3D Structures

View 87 proteins in NCBI Structure

- PubChem

18.2 Chemical-Target Interactions

- Drug Gene Interaction database (DGIdb); Toxin and Toxin Target Database (T3DB)

▸ DrugBank

19 Biological Test Results

19.1 BioAssay Results

▸ PubChem

20 Taxonomy

- LOTUS - the natural products occurrence database; Natural Product Activity and Species Source (…

21 Classification

21.1 MeSH Tree

- Medical Subject Headings (MeSH)

21.2 NCI Thesaurus Tree

▸ NCI Thesaurus (NCIt)

21.3 ChEBI Ontology

▸ ChEBI

21.4 KEGG: Drug

▸ KEGG

21.5 KEGG: ATC

▸ KEGG

21.6 KEGG: JP15

▸ KEGG

21.7 KEGG: Risk Category of Japanese OTC Drugs

▸ KEGG

21.8 WHO ATC Classification System

▸ WHO Anatomical Therapeutic Chemical (ATC) Classification

21.9 FDA Pharm Classes

▸ FDA Pharm Classes

21.10 EPA Safer Choice

▸ EPA Safer Choice

21.11 ChemIDplus

▸ ChemIDplus

21.12 CAMEO Chemicals

▸ CAMEO Chemicals

21.13 ChEMBL Target Tree

▸ ChEMBL

21.14 Household Products Database Tree

▸ Consumer Product Information Database (CPID)

21.15 UN GHS Classification

▸ GHS Classification (UNECE)

21.16 EPA CPDat Classification

▸ EPA Chemical and Products Database (CPDat)

21.17 NORMAN Suspect List Exchange Classification

- NORMAN Suspect List Exchange

21.18 EPA DSSTox Classification

- EPA DSSTox

21.19 Consumer Product Information Database Classification

- Consumer Product Information Database (CPID)

21.20 EPA TSCA and CDR Classification

▸ EPA Chemicals under the TSCA

21.21 LOTUS Tree

▸ LOTUS - the natural products occurrence database

21.22 FDA Drug Type and Pharmacologic Classification

▸ National Drug Code (NDC) Directory

21.23 EPA Substance Registry Services Tree

▸ EPA Substance Registry Services

21.24 MolGenie Organic Chemistry Ontology

▸ MolGenie

21.25 Chemicals in PubChem from Regulatory Sources

▸ PubChem

21.26 ATCvet Classification

- WHO ATCvet - Classification of Veterinary Medicines

22 Information Sources

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Propanoic acid, 2-hydroxy-

https://services.industrialchemicals.gov.au/search-assessments/

Propanoic acid, 2-hydroxy-

https://services.industrialchemicals.gov.au/search-inventory/

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LACTIC ACID

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CAMEO Chemical Reactivity Classification

https://cameochemicals.noaa.gov/browse/react

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Lactic acid

https://commonchemistry.cas.org/detail?cas_rn=50-21-5

(±)-Poly(lactic acid)

https://commonchemistry.cas.org/detail?cas_rn=26100-51-6

4. ## ChemIDplus

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Lactic acid [USP:JAN]

https://pubchem.ncbi.nlm.nih.gov/substance/?source=chemidplus&sourceid=0000050215

ChemIDplus Chemical Information Classification

https://pubchem.ncbi.nlm.nih.gov/source/chemidplus

5. ## DrugBank

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Lactic acid

https://www.drugbank.ca/drugs/DB04398

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Propanoic acid, (+-)

https://dtp.cancer.gov/dtpstandard/servlet/dwindex?searchtype=NSC&outputformat=html&searchlist=367919

7. ## EFSA OpenFoodTox

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8. ## EPA Chemical Data Reporting (CDR)

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9. ## EPA Chemicals under the TSCA

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EPA TSCA Classification

https://www.epa.gov/tsca-inventory

10. EPA DSSTox

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Lactic acid

https://comptox.epa.gov/dashboard/DTXSID7023192

CompTox Chemicals Dashboard Chemical Lists

https://comptox.epa.gov/dashboard/chemical-lists/

11. European Chemicals Agency (ECHA)

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Lactic acid

https://chem.echa.europa.eu/100.000.017

Dl-lactic acid

https://echa.europa.eu/substance-information/-/substanceinfo/100.009.051

2-hydroxypropanoic acid

https://echa.europa.eu/substance-information/-/substanceinfo/100.260.318

Lactic acid (EC: 200-018-0)

https://echa.europa.eu/information-on-chemicals/cl-inventory-database/-/discli/details/34653

Dl-lactic acid (EC: 209-954-4)

https://echa.europa.eu/information-on-chemicals/cl-inventory-database/-/discli/details/115597

2-hydroxypropanoic acid (EC: 825-250-5)

https://echa.europa.eu/information-on-chemicals/cl-inventory-database/-/discli/details/268491

12. FDA Global Substance Registration System (GSRS)

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LACTIC ACID, DL-

https://gsrs.ncats.nih.gov/ginas/app/beta/substances/3B8D35Y7S4

13. Hazardous Substances Data Bank (HSDB)

LACTIC ACID

https://pubchem.ncbi.nlm.nih.gov/source/hsdb/800

14. ILO-WHO International Chemical Safety Cards (ICSCs)

LACTIC ACID

https://chemicalsafety.ilo.org/dyn/icsc/showcard.display?p_card_id=0501

15. International Fragrance Association (IFRA)

Lactic acid

https://ifrafragrance.org/priorities/ingredients/ifra-transparency-list

16. New Zealand Environmental Protection Authority (EPA)

Lactic acid

https://www.epa.govt.nz/industry-areas/hazardous-substances/guidance-for-importers-and-manufacturers/hazardous-substances-databases/

17. EU Food Improvement Agents

LACTIC ACID

https://eur-lex.europa.eu/eli/reg/2012/231/oj

Lactic acid

https://eur-lex.europa.eu/eli/reg_impl/2012/872/oj

18. EU Pesticides Database

Lactic acid

https://ec.europa.eu/food/plant/pesticides/eu-pesticides-database/start/screen/active-substances/details/995

19. Haz-Map, Information on Hazardous Chemicals and Occupational Diseases

Lactic acid

https://haz-map.com/Agents/1416

20. Joint FAO/WHO Expert Committee on Food Additives (JECFA)

Lactic acid

https://www.fao.org/food/food-safety-quality/scientific-advice/jecfa/jecfa-flav/details/en/c/781/

LACTIC ACID

https://apps.who.int/food-additives-contaminants-jecfa-database/Home/Chemical/3367

21. ChEBI

2-hydroxypropanoic acid

https://www.ebi.ac.uk/chebi/searchId.do?chebiId=CHEBI:78320

ChEBI Ontology

http://www.ebi.ac.uk/chebi/userManualForward.do#ChEBI%20Ontology

22. Cosmetic Ingredient Review (CIR)

Lactic Acid

https://cir-reports.cir-safety.org/cir-ingredient-status-report/?id=0af63e9d-9778-ec11-8d21-000d3a991547

23. FDA Pharm Classes

LACTIC ACID, UNSPECIFIED FORM

https://dailymed.nlm.nih.gov/dailymed/browse-drug-classes.cfm

FDA Pharmacological Classification

https://www.fda.gov/industry/structured-product-labeling-resources/pharmacologic-class

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https://lotus.nprod.net/

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https://www.wikidata.org/wiki/Q161249

LOTUS Tree

https://lotus.naturalproducts.net/

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https://ncit.nci.nih.gov

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LACTIC ACID

https://platform.opentargets.org/drug/CHEMBL1200559

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L-Lactic acid

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https://www.whatsinproducts.com/contents/view/1/6

Lactic acid

https://www.whatsinproducts.com/chemicals/view/1/681/000050-21-5

Household Products Classification

https://hpd.nlm.nih.gov/

Consumer Products Category Classification

https://www.whatsinproducts.com/

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https://comptox.epa.gov/dashboard/DTXSID7023192#exposure

EPA CPDat Classification

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(S)-Lactic Acid

NORMAN Suspect List Exchange Classification

https://www.norman-network.com/nds/SLE/

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LACTIC ACID

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DL-LACTIC ACID

https://www.dgidb.org/drugs/rxcui:1314409

35. IUPAC Digitized pKa Dataset

propanoic acid, 2-hydroxy-

https://github.com/IUPAC/Dissociation-Constants

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DL-Lactic acid

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LACTIC ACID

https://www.fda.gov/drugs/drug-approvals-and-databases/approved-drug-products-therapeutic-equivalence-evaluations-orange-book

39. EU Clinical Trials Register

https://www.clinicaltrialsregister.eu/

40. NITE-CMC

Lactic acid (DL-, L-, D-) - FY2012 (New/original classication)

https://www.chem-info.nite.go.jp/chem/english/ghs/12-mhlw-0048e.html

41. FDA Packaging & Food Contact Substances (FCS)

LACTIC ACID

https://www.hfpappexternal.fda.gov/scripts/fdcc/index.cfm?set=IndirectAdditives

42. National Drug Code (NDC) Directory

LACTIC ACID 50 SKIN CHEMICAL PEEL

https://www.fda.gov/drugs/drug-approvals-and-databases/national-drug-code-directory

43. FDA Substances Added to Food

LACTIC ACID

https://www.hfpappexternal.fda.gov/scripts/fdcc/index.cfm?set=FoodSubstances&id=LACTICACID

44. Flavor and Extract Manufacturers Association (FEMA)

LACTIC ACID

https://www.femaflavor.org/flavor-library/lactic-acid

45. MassBank Europe

LACTIC ACID

https://massbank.eu/MassBank/search?inchi_key=JVTAAEKCZFNVCJ-UHFFFAOYSA-N

46. Japan Chemical Substance Dictionary (Nikkaji)

http://jglobal.jst.go.jp/en/redirect?Nikkaji_No=J1.358G

47. KEGG

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https://www.kegg.jp/entry/D00111

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Therapeutic category of drugs in Japan
http://www.genome.jp/kegg-bin/get_htext?br08301.keg

Anatomical Therapeutic Chemical (ATC) classification
http://www.genome.jp/kegg-bin/get_htext?br08303.keg

Drugs listed in the Japanese Pharmacopoeia
http://www.genome.jp/kegg-bin/get_htext?br08311.keg

Risk category of Japanese OTC drugs
http://www.genome.jp/kegg-bin/get_htext?br08312.keg

48. Natural Product Activity and Species Source (NPASS)

Lactic Acid
https://bidd.group/NPASS/compound.php?compoundID=NPC76217

49. MassBank of North America (MoNA)

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DL-Lactic acid
https://mona.fiehnlab.ucdavis.edu/spectra/browse?
query=exists(compound.metaData.name:%27InChIKey%27%20and%20compound.metaData.value:%27JVTAAEKCZFNVCJ-UHFFFAOYSA-N%27)

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Lactic acid
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LACTIC ACID
https://spectrabase.com/spectrum/2mxI21J9UEi

LACTIC ACID
https://spectrabase.com/spectrum/794Os8g2Y3Z

LACTIC ACID

https://spectrabase.com/spectrum/11Kuvr3w3lA

lactic acid

https://spectrabase.com/spectrum/HKshS42hWet

Lactic acid

https://spectrabase.com/spectrum/6uwY88I1cm8

Lactic acid solution, 85+% solution in H2O

https://spectrabase.com/spectrum/JrHkE0G3US1

52. Metabolomics Workbench

Lactic Acid

https://www.metabolomicsworkbench.org/data/StructureData.php?RegNo=122706

53. Nature Chemical Biology

https://pubchem.ncbi.nlm.nih.gov/substance/375628032

54. NIPH Clinical Trials Search of Japan

https://rctportal.niph.go.jp/en/

55. NLM RxNorm Terminology

DL-lactic acid

https://rxnav.nlm.nih.gov/id/rxnorm/1314409

lactic acid

https://rxnav.nlm.nih.gov/id/rxnorm/28393

56. Springer Nature

https://pubchem.ncbi.nlm.nih.gov/substance/341138967

57. Thieme Chemistry

https://pubchem.ncbi.nlm.nih.gov/substance/516740071

https://pubchem.ncbi.nlm.nih.gov/substance/516727361

58. WHO Anatomical Therapeutic Chemical (ATC) Classification

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Lactic acid

https://atcddd.fhi.no/atc_ddd_index/?code=G01AD01

ATC Classification

https://atcddd.fhi.no/atc_ddd_index/

59. WHO ATCvet - Classification of Veterinary Medicines

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Lactic acid

https://atcddd.fhi.no/atcvet/atcvet_index/?code=QP53AG02

Lactic acid

https://atcddd.fhi.no/atcvet/atcvet_index/?code=QG01AD01

ATCvet Classification

https://atcddd.fhi.no/atcvet/atcvet/

60. Wikidata

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https://www.wikidata.org/wiki/Q161249

DL-Lactic acid

https://www.wikidata.org/wiki/Q72487130

61. Wikipedia

lactic acid

https://en.wikipedia.org/wiki/Lactic_acid

62. Wiley

https://pubchem.ncbi.nlm.nih.gov/substance/386277535

https://pubchem.ncbi.nlm.nih.gov/substance/386201974

63. Medical Subject Headings (MeSH)

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