

## Malate Dehydrogenase

Catalog # MD01D-E311H

Lot # A4616-11

### Product Description

Recombinant research grade malate dehydrogenase from a microorganism. This enzyme is sold as a lyophilized white powder.

CAS #: 9001-64-3

Enzyme Commission #: [EC 1.1.1.37](#)

Molecular Weight: 33.4 kDa

### Alternative name (s)

MDH, NAD- L -malate dehydrogenase, malic acid dehydrogenase

### Storage and Stability

Store at -20°C. Once reconstituted, aliquot product into smaller quantities to avoid repeated handling and multiple freeze/thaw cycles and store at -70°C.

### Scientific Background

Malate dehydrogenase is an enzyme that uses the reduction of NAD<sup>+</sup> to NADH to reversibly catalyze the oxidation malate to oxaloacetate (1). It functions in various metabolic pathways including in the Krebs cycle where it protects against oxidative stress as oxaloacetate binds free radicals (2). Release of malate dehydrogenase into the serum is an indicator of tissue damage and has been implicated as a biomarker of several diseases (3,4). Applications of this enzyme include enzymatic determination of L-malate and of glutamate oxaloacetate transaminase (GOT) in clinical analysis.

### References

1. Minárik P., et al. Malate dehydrogenases--structure and function. *Gen Physiol Biophys.* 2002 Sep;21(3):257-65. PMID: 12537350.
2. Takahashi-Iñiguez T., et al. Function, kinetic properties, crystallization, and regulation of microbial malate dehydrogenase. *J Zhejiang Univ Sci B.* 2016 Apr;17(4):247-61. PMID: PMC4829630.
3. Shelli S., et al. Assessment of Emerging Biomarkers of Liver Injury in Human Subjects, *Toxicological Sciences*, Volume 132, Issue 2, April 2013, Pages 276-283.
4. Ma YC, et al: Urinary malate dehydrogenase 2 is a new biomarker for early detection of non-small-cell lung cancer. *Cancer Sci.* Jun;112(6):2349-2360, 2021.

### Activity

Pack Size	Activity
500 U	≥500 U
2500 U	≥2500 U

Unit Definition: One unit causes the oxidation of one micromole of NADH per minute at 30°C pH 8.0.

Enzyme activity was determined using the Malate Dehydrogenase Activity Assay Protocol provided below.

## Malate Dehydrogenase

Catalog #	MD01D-E311H
Lot #	A4616-11
Stability	1yr at -20°C from date of shipment
Storage & Shipping	Store at -20°C. Once reconstituted, aliquot product into smaller quantities to avoid repeated handling and multiple freeze/thaw cycles and store at -70°C. Product shipped on ice pack.

To place your order, please contact us by phone 1-778-326-0223 or 1-888-606-3424 (Toll free) or by email: [orders@signalchemdx.com](mailto:orders@signalchemdx.com) or [info@signalchemdx.com](mailto:info@signalchemdx.com) - [www.signalchemdx.com](http://www.signalchemdx.com)

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# Malate Dehydrogenase Activity Assay Protocol

## Reaction Components

- (A) 0.1M K-phosphate buffer, pH 7.5
- (B) 15mM Oxaloacetate solution [2mg oxaloacetic acid (Sigma, O4126-1G)/ml of ice-cold K-phosphate buffer (A). This reagent is rather unstable and should be stored in an ice-bath during use] (Should be prepared fresh)
- (C) 6.0mM NADH solution (Carbosynth, NN12622, should be prepared fresh)
- (D) 0.1M Enzyme dilution buffer (K-phosphate buffer, pH 7.5 containing 0.2% BSA)

## Assay Protocol

- Step 1.** Reconstitute lyophilized enzyme powder with water to desired concentration.
- Step 2.** Dilute the reconstituted enzyme preparation to 0.05-0.5U/ml with the enzyme diluent (D), immediately before the assay
- Step 3.** Prepare the following reaction mixture in a cuvette (d=1.0cm) and equilibrate at 30°C for about 5 minutes.
- |       |                       |     |
|-------|-----------------------|-----|
| 2.8ml | K-phosphate buffer    | (A) |
| 0.1ml | Oxaloacetate solution | (B) |
| 0.1ml | NADH solution         | (C) |

**Step 4.** Add 0.05ml of the enzyme solution to the reaction mixture and mix gently.

**Step 5.** Record the decrease of optical density at 340nm for 5 minutes in a spectrophotometer. Keep the reaction at a temperature of 30°C.

Note: Blank the spectrophotometer with water.

**Step 6.** Calculate the  $\Delta OD$  per minute from the initial linear portion of the curve ( $\Delta OD$  test).

**Step 7.** Measure the blank rate ( $\Delta OD$  blank) by the same method as the test except that the enzyme diluent (D) is added instead of the enzyme solution.

Unit definition: One unit causes the oxidation of one micromole of NADH under the conditions described above.

Calculation: Activity can be calculated by using the following formula:

$$\text{Volume Activity (U/mL)} = \frac{\Delta OD/\text{min} (\Delta OD \text{ test} - \Delta OD \text{ blank}) \times V_t \times df}{(6.22 \times 1.0 \times V_s)} = \Delta OD/\text{min} \times 9.81 \times df$$

$$\text{Weight Activity (U/mg)} = (\text{U/mL}) \times 1/C$$

V<sub>t</sub>: Total volume (3.05ml)

V<sub>s</sub>: Sample volume (0.05mL)

6.22: Millimolar extinction coefficient of NADH (cm<sup>2</sup>/micromole)

1.0: Light path length (cm)

df: Dilution factor

c: Enzyme concentration (mg/mL)

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# SAFETY DATA SHEET

## Article 1 - Product Identification

**Product Name: Malate Dehydrogenase****Catalog # MD01D-E311H**

This product is sold only for research use by qualified laboratory personnel, and is not to be used as a drug, medical device, food additive, cosmetic, nor household chemical. It is not to be used in diagnostic, therapeutic, consumer, agricultural, nor pesticidal applications.

Supplier of Datasheet: SignalChem Diagnostics Inc.  
Street Address: 190-13160 Vanier Place  
City, Prov. Postal Code: Richmond, BC, V6V 2J2  
Country: Canada  
Emergency Phone: 1-888-606-3424 (Toll free)  
1-778-326-0223 (local)

## Article 2 - Hazard Identification

- **WHMIS Classification:** Not WHMIS controlled.
- **GHS classification:** Not GHS classified.
- **Hazard Pictograms:** No labelling applicable.
- **Signal words:** None.
- **Hazard statements:** None.
- **Precautionary statements:** None.
- **Other hazards:** None known.

## Article 3 - Composition/Information on Ingredients

**Chemical Characterization:** Mixture.

**Description:** This product contains the substances listed below.

Common name	Chemical name	CAS-No.	Concentration
Triton X-100	2-[4-(2,4,4-trimethylpentan-2-yl)phenoxy]ethanol	9002-93-1	0.005%
Sodium azide	NaN <sub>3</sub>	26628-22-8	0.005%

## Article 4 - First-aid Measures

- **General information:** Consult a physician by providing the SDS.
- **After inhalation:** In case of irritation by inhaling this product, move affected person to fresh air and await recovery. If irritation persists, seek immediate medical attention. If casualty cannot breathe, give artificial respiration and seek immediate medical attention.
- **After skin contact:** Immediately wash with soap and plenty of water and rinse thoroughly. Consult a physician.
- **After eye contact:** Rinse opened eyes with plenty of water for at least 15 minutes. Remove contact lenses, if present and easy to do so. Consult a physician.
- **After swallowing:** Not expected to present a significant ingestion hazard under anticipated conditions of normal use. If you feel unwell, seek medical advice.

## Article 5 - Fire-fighting Measures

- **Suitable extinguishing media:** Use water spray, extinguishing powder, carbon dioxide, or other appropriate measure that is suitable to the environment.
- **Specific hazards arising from the substance or mixture:** None known.
- **Special protective equipment and precautions for fire-fighters:** Self-contained breathing apparatus if necessary.

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## Article 6 – Accidental Release Measures

- **Personal precautions, protective equipment, and emergency procedures:** Apply standard laboratory practices and personal protective equipment. Avoid breathing vapors, mist, or gas. Ensure adequate ventilation.
- **Environmental precautions:** Do not allow to enter drains.
- **Methods and materials for containment and cleaning up:** Absorb on sand or vermiculite and place in closed containers for disposal.

## Article 7 - Handling and Storage

- **Precautions for safe handling:** Wear chemical safety goggles and compatible chemical-resistant gloves. Avoid inhalation, contact with eyes, skin or clothing.
- **Conditions for safe storage:** Store according to product label instructions. Keep container upright and tightly closed.

## Article 8 - Exposure Controls/Personal Protection

- **Components with limit monitoring values at workplace:**  
NA
- **Appropriate engineering controls:**  
Apply adequate ventilation including mechanical exhaust or laboratory fume hood. Follow standard laboratory practices.
- **Individual protection measures:**  
**Respiratory protection:**  
Use appropriate respirator if there is inadequate ventilation by following the government standards.  
**Hand protection:**  
Wear gloves and use proper glove removal technique to avoid skin contact. Discard gloves after use by following the applicable laboratory regulations. Wash and dry hands.  
**Eye/face protection:**  
Safety goggles with side-shields approved under appropriate government standards.  
**Skin/body protection:**  
Use appropriate clothing, footwear and any additional protection measures to protect from splashing or contamination.

## Article 9 – Physical and Chemical Properties

<b>Appearance:</b> White Powder	<b>Danger of explosion:</b> Product does not present an explosion hazard.
<b>Odour/Odour Threshold:</b> Not determined.	<b>Explosion limits:</b> Not available.
<b>pH:</b> Not available.	<b>Decomposition temperature:</b> Not available.
<b>Melting point/freezing point:</b> Not determined.	<b>Vapor pressure at 20 °C:</b> Not available.
<b>Boiling point/Boiling range:</b> Not determined.	<b>Density:</b> Not determined.
<b>Flash point:</b> Not determined.	<b>Relative density:</b> Not determined.
<b>Flammability (solid, gaseous):</b> Not determined.	<b>Vapor density:</b> Not determined.
<b>Ignition temperature:</b> Not determined.	<b>Evaporation rate:</b> Not determined.
<b>Auto-igniting:</b> Product is not self-igniting.	<b>Solubility in / Miscibility with Water:</b> Fully miscible.

## Article 10 - Stability and Reactivity

- **Reactivity:** Stable under recommended transport and storage conditions.
- **Chemical stability:** Stable under recommended transport and storage conditions.
- **Possible hazardous reactions:** No dangerous reactions known.
- **Conditions to avoid:** Heat and moisture.
- **Incompatible materials:** Not determined.
- **Hazardous decomposition products:** Not determined.

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# SAFETY DATA SHEET

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## Article 11 - Toxicological Information

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- **Acute toxicity:** Not available.
- **LD/LC50:** Not available.
- **Skin corrosion/irritation:** Not available.
- **Serious eye damage/eye irritation:** Not available.
- **Respiratory or skin sensitization:** Not available.
- **Germ cell mutagenicity:** Not available.
- **Carcinogenicity:** No components are listed in IARC, or NTP, or OSHA, or ACGIH.
- **Reproductive toxicity:** Not available.
- **Teratogenicity:** Not available.
- **Specific target organ toxicity - single exposure/ - repeated exposure (GHS):** Not available.
- **Aspiration hazard:** Not available.
- **Potential health effects:**
  - Inhalation: No data available
  - Ingestion: No data available
  - Skin: No data available
  - Eyes: No data available
- **Signs and Symptoms of Exposure:** No data available
- **Synergistic effects:** Not available.

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## Article 12 - Ecological Information

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- **Eco-toxicity:** No data available.
- **Biodegradability:** Not applicable.
- **Bio-accumulative potential:** Not applicable.
- **Mobility in soil:** Not applicable.
- **PBT and vPvB assessment:** Not applicable.
- **Other adverse effects:** Not applicable.

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## Article 13 - Disposal Considerations

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- **Disposal methods:** In accordance to applicable national, regional, or local laws and regulations. For additional handling information and protection of employees please refer to Article 7 and 8.
- **Contaminated packaging:** Disposal should be made in accordance to official regulations. Use water or cleansing agents to clean the area.

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## Article 14 - Transport Information

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- **DOT:** Not dangerous goods.
- **IMDG:** Not dangerous goods.
- **IATA:** Not dangerous goods.

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## Article 15 - Regulatory Information

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- **WHMIS Classification:** Non-hazardous.
- **GHS label elements:** Not applicable.
- **Signal word:** Not applicable.
- **Hazard statements:** Not applicable.

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## Article 16 - Other Information

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The above information is believed to be correct but does not purport to be all-inclusive and shall be used only as a guide. SignalChem shall not be held liable for any damage resulting from handling or from contact with the above product. See the Technical Specification, Packing Slip, Invoice, and Product Catalog for additional terms and conditions of sale.

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