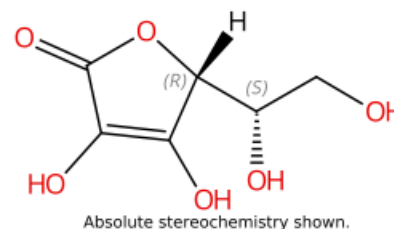


# Certificate of Analysis - Certified Reference Material

## Ascorbic Acid

**Product no.:** PHR1008-10G  
**Lot no.:** LRAE0663  
**Description of CRM:** White powder  
**Expiry date:** June 2029  
**Storage:** REFRIGERATE (2 °C to 8 °C)  
**Certificate version:** LRAE0663.01 (Note: Certificates may be updated due to the availability of new data. Check our website at: [www.sigma-aldrich.com](http://www.sigma-aldrich.com) for the most current version.)  
**Chemical formula:** C<sub>6</sub>H<sub>8</sub>O<sub>6</sub>  
**Molecular mass:** 176.12  
**CAS No.** 50-81-7



| Analyte       | Purity (certification method / basis)                               |
|---------------|---------------------------------------------------------------------|
| Ascorbic Acid | 99.8 % $U_{\text{CRM}} = \pm 0.3$ , $k = 2.00$ (qNMR / as is basis) |

**Metrological traceability:** Traceable to the SI and higher order standards from NIST through an unbroken chain of comparisons. When applicable, additional traceability to Primary Standards is established through comparative assay determinations. See "Details on metrological traceability" on page 2.  
**Measurement method:** Where applicable, the certified value is based on a purity determination by mass balance. See section "Certification process details".  
**Intended use:** Intended for Laboratory Use only. Not for drug, household or other uses  
**Minimum sample size:** 17 mg  
**Health and safety information:** All chemical reference materials should be considered potentially hazardous and should be used only by qualified laboratory personnel. Please refer to the Safety Data Sheet for detailed information about the nature of any hazard and appropriate precautions to be taken.  
**Accreditation:** Sigma-Aldrich RTC is accredited by the US accreditation authority ANAB as a registered reference material producer AR-1470 in accordance with ISO 17034.  
**Certificate issue date:** 27 JUN 2025



[Andy Ommen - QC Authority]

[Christopher Rucinski - QA Authority]



**Instructions for handling and correct use:**

Do not dry, use on the as is basis. The internal pressure of the container may be slightly different from the atmospheric pressure at the user`s location. Open slowly and carefully to avoid dispersion of the material. All values reported on the CoA are for the contents of the unopened standard and apply to the initial use of the standard. Any unused portions remaining after the container has been opened should be carefully stored in accordance with prudent laboratory procedures. Many variables are outside of the control of MilliporeSigma. Therefore, MilliporeSigma makes no warranties concerning the continued suitability of previously opened CRMs. Decisions concerning the proper use of previously opened CRMs are the responsibility of the user. Expiration is at end of month given on certificate and label.

**Packaging:**

vial of 10 g

**Details on metrological traceability:**

This standard has been gravimetrically prepared using balances that have been fully qualified and calibrated to ISO 17025 requirements. All calibrations utilize NIST traceable weights which are calibrated externally by a qualified ISO 17025 accredited calibration laboratory to NIST standards. Qualification of each balance includes the assignment of a minimum weighing by a qualified and ISO 17025 accredited calibration vendor taking into consideration the balance and installed environmental conditions to ensure compliance with USP tolerances of NMT 0.10% relative error. Fill volume to predetermined specifications is gravimetrically verified throughout the dispensing process using qualified and calibrated balances. Further traceability to a corresponding Primary Standard may be achieved through a direct comparison assay. Where a Primary Standard is available, the assay value will be included in the specified section of the COA.

**Associated uncertainty:**

Uncertainty values in this document are expressed as Expanded Uncertainty ( $U_{CRM}$ ) corresponding to the 95% confidence interval.  $U_{CRM}$  is derived from the combined standard uncertainty multiplied by the coverage factor  $k$ , which is obtained from a  $t$ -distribution and degrees of freedom. If  $k$  is not provided, assume a value of 2.0. The components of combined standard uncertainty include the uncertainties due to characterization, homogeneity, long term stability, and short term stability (transport). The components due to stability are generally considered to be negligible unless otherwise indicated by stability studies.

$$U_{crm} = \left( \sqrt{u_{characterization}^2 + u_{homogeneity}^2 + u_{stability}^2} \right) \times k$$

**TRACEABILITY ASSAY**

Comparative assay demonstrates direct traceability to Pharmacopeial Standards

**TRACEABILITY COMPARISON vs. EP REFERENCE STANDARD A1300000 (as is basis)**

**MilliporeSigma Lot LRAE0663 vs. EP Batch 5.0**

**ASSAY vs. USP REFERENCE STANDARD 1043003 (as is basis)**

**ASSAY VALUE**

**100.3 %**

**vs. USP LOT**

**Y06390**

Labeled Content = 1.00 mg/mg

**ASSAY vs. BP CRS 461 (as is basis)**

**ASSAY VALUE**

**99.6 %**

**vs. BP BATCH**

**4409**

Labeled Content = 99.7 %

**METHOD: HPLC (ref.: Ascorbic Acid, Current Compendial Monographs USP <580>)**

Column: Discovery C18, 25 cm x 4.6mm, 5µm particle size

Mobile Phase A: 2.04 g/L potassium phosphate monobasic (pH 3.0)

Mobile Phase Ratio: Isocratic, 8 min

Flow Rate: 1.0 mL/min

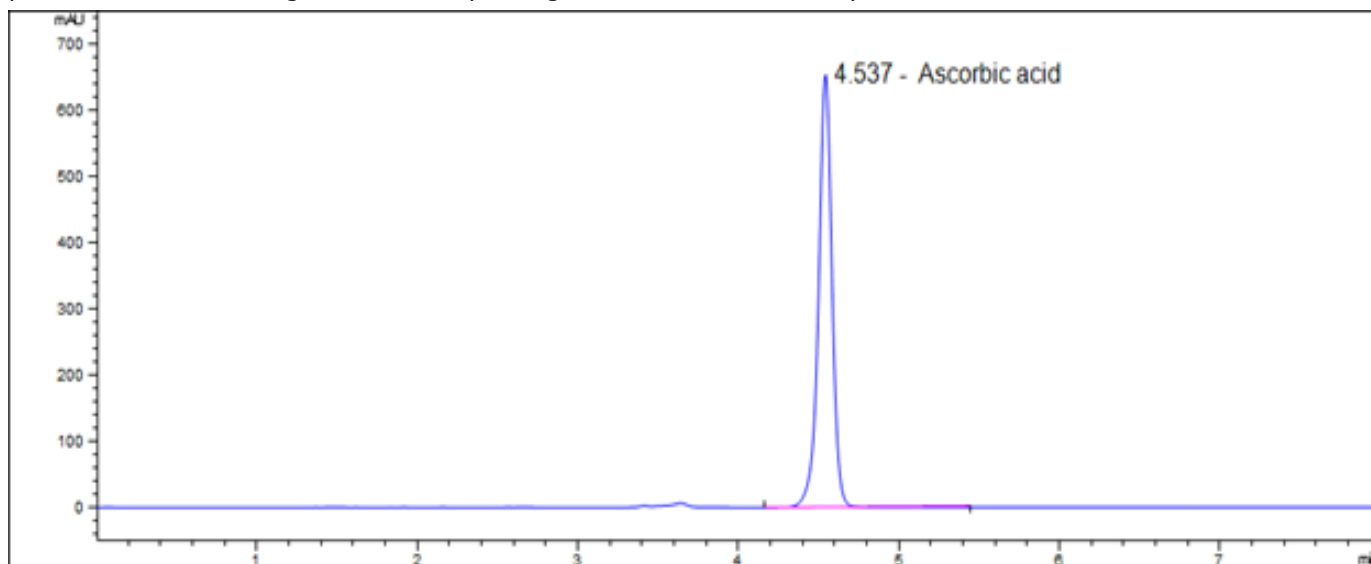
Column Temperature: 30 °C

Injection Volume: 5 µL

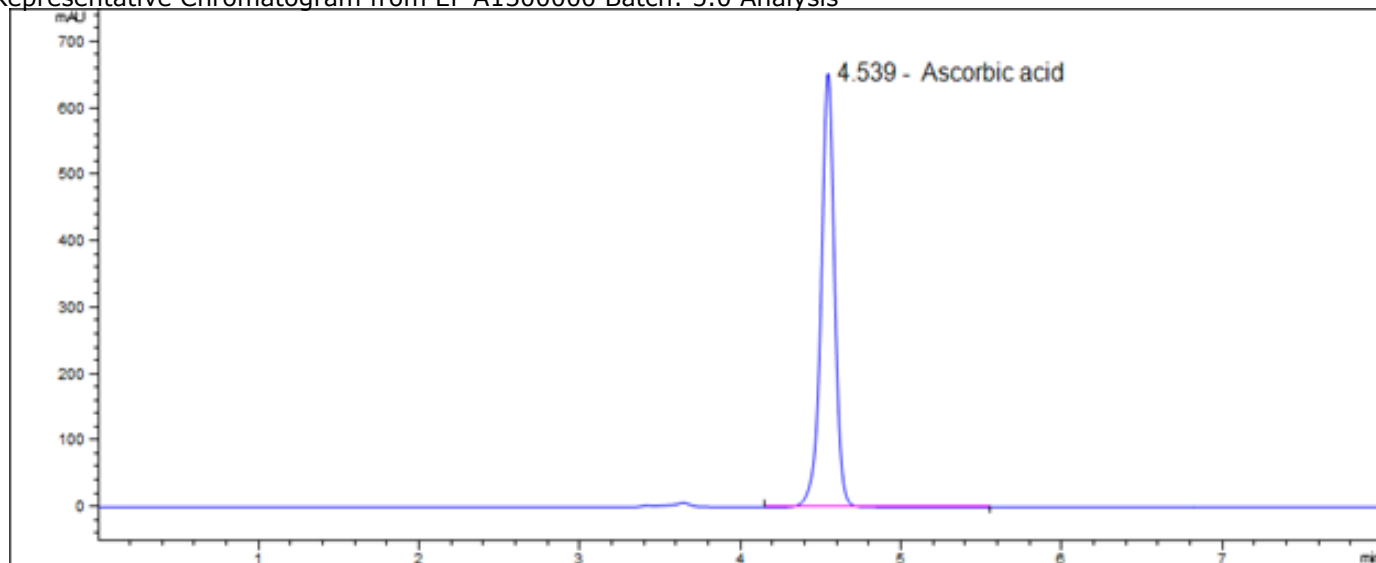
Detector: DAD

Wavelength: 245 nm

Representative Chromatogram from MilliporeSigma Lot:LRAE0663 Analysis



Representative Chromatogram from EP A1300000 Batch: 5.0 Analysis



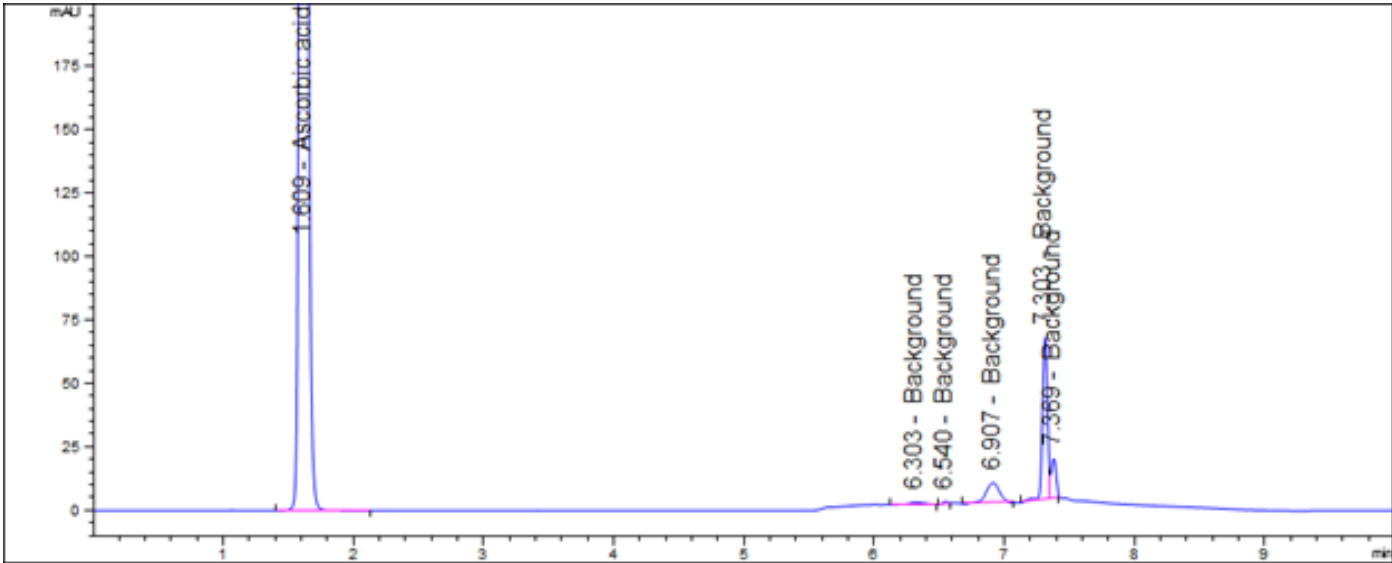
CHROMATOGRAPHIC IMPURITY ANALYSIS

METHOD: HPLC (ref.: Ascorbic Acid, Current Compendial Monographs USP <580>)

Column: Ascentis Express C8, 100 mm x 4.6mm, 2.7µm particle size  
Mobile Phase A: 6.9 g/L Sodium phosphate monobasic in water, pH 2.5  
Mobile Phase B: Methanol  
Mobile Phase Ratio: Gradient  
Flow Rate: 0.8 mL/min  
Column Temperature: 30 °C  
Injection Volume: 10 µL  
Detector: DAD  
Wavelength: 245 nm  
GRADIENT:

| TIME (mins) | MPA (%) | MPB (%) |
|-------------|---------|---------|
| 0           | 100     | 0       |
| 3           | 100     | 0       |
| 5           | 0       | 100     |
| 6           | 50      | 50      |
| 7           | 100     | 0       |
| 10          | 100     | 0       |

Representative Chromatogram from Lot: LRAE0663 Impurities Analysis



Impurities Detected:  
Total Impurities: **None**

## WATER DETERMINATION

Method: Karl Fischer (ref.: Current Compendial Monographs)

Mean of three measurements, Water Content = **None**

### Certification process details:

The certified purity is determined by qNMR and calculated as

$$P_{\text{Sample}} = \frac{I_{\text{Analyte}}}{I_{\text{CRM}}} \cdot \frac{N_{\text{CRM}}}{N_{\text{Analyte}}} \cdot \frac{M_{\text{Analyte}}}{M_{\text{CRM}}} \cdot \frac{m_{\text{CRM}}}{m_{\text{Sample}}} \cdot P_{\text{CRM}}$$

- $P_{\text{Sample}}$  Purity of samples as mass fraction (%)
- $P_{\text{CRM}}$  Purity of CRM as mass fraction (%)
- $I_{\text{Analyte}}$  Integral of the analyte signal
- $I_{\text{CRM}}$  Integral of CRM signal
- $N_{\text{Analyte}}$  Number of analyte nuclei
- $N_{\text{CRM}}$  Number of CRM nuclei
- $M_{\text{Analyte}}$  Molecular mass of the analyte (g/mol)
- $M_{\text{CRM}}$  Molecular mass of the CRM (g/mol)
- $m_{\text{Sample}}$  Mass of sample (mg)
- $m_{\text{CRM}}$  Mass of CRM (mg)

### METHOD: quantitative NMR spectroscopy

Condition: Bruker 500 MHz

Solvent: D2O

Internal standard(CRM): Dimethyl sulfone Part No. 41867 lot BCCH9571

### **CERTIFIED PURITY BY qNMR** (Mass Fraction, n = 9)

**99.8 %  $U_{\text{CRM}} = \pm 0.3 \%$ , k = 2.00 (qNMR / as is basis)**

#### **Homogeneity assessment:**

Homogeneity was assessed in accordance with ISO Guide 35. Completed units were sampled using a random stratified sampling protocol. The results of chemical analysis were then compared by Single Factor Analysis of Variance (ANOVA). The uncertainty due to homogeneity was derived from the ANOVA. Heterogeneity was not detected under the conditions of the ANOVA. Analytical method: qNMR

Sample size: 17 mg

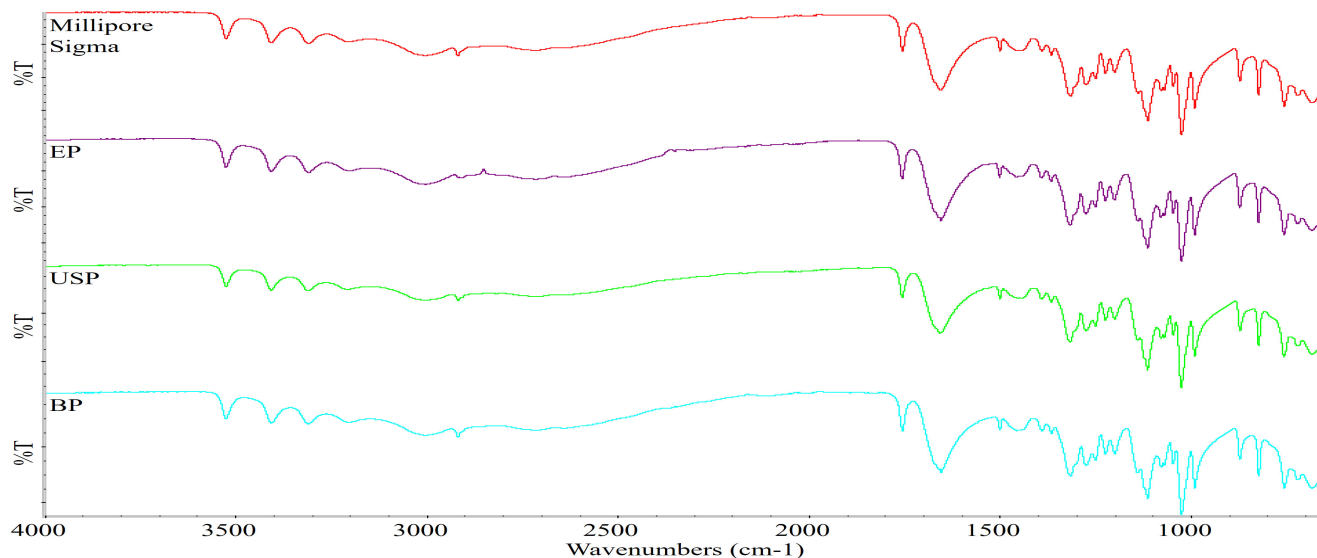
#### **Stability assessment:**

Significance of the stability assessment will be demonstrated if the analytical result of the study and the range of values represented by the Expanded Uncertainty do not overlap the result of the original assay and the range of its values represented by the Expanded Uncertainty. The method employed will usually be the same method used to characterize the assay value in the initial evaluation.

Long Term Stability Evaluation - An assessment, or re-test, versus a Compendial Reference Standard may be scheduled, within the 3 year anniversary date of a release of a Secondary Standard. The re-test interval will be determined on a case-by-case basis. Short Term Stability Study - It is useful to assess stability under reasonably anticipated, short term transport conditions by simulating exposure of the product to humidity and temperature stress. This type of study is conducted under controlled conditions of elevated temperature and humidity.

## Identification Test:

**INFRARED SPECTROPHOTOMETRY** (Comparative identification analysis demonstrates direct traceability to Pharmacopeial standards)



MilliporeSigma Lot: LRAE0663

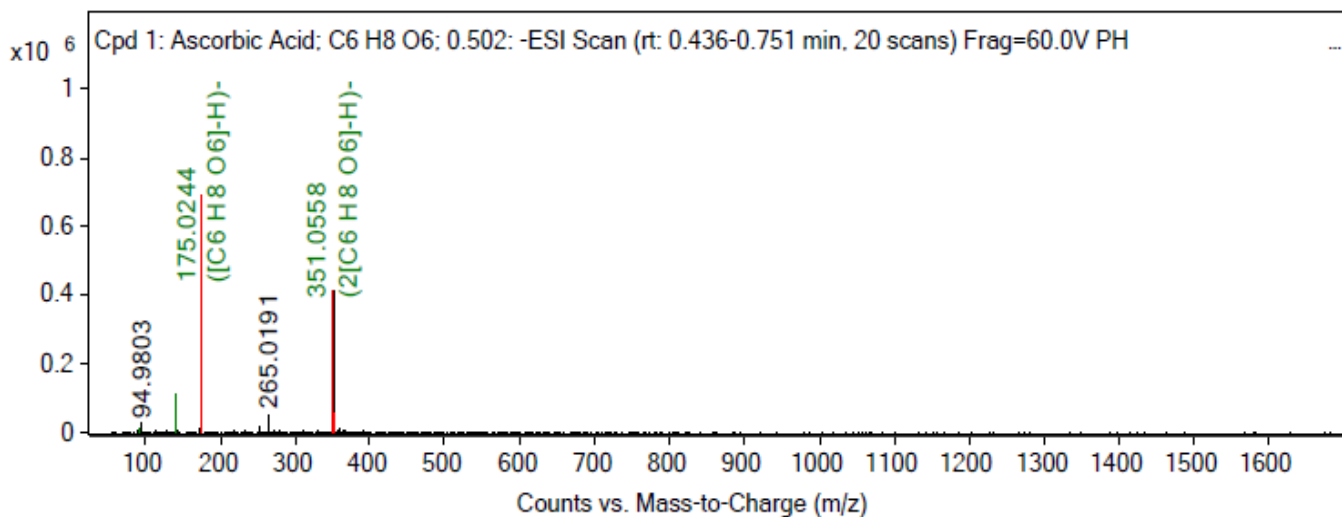
BP 461 LOT: 4409

USP 1043003 LOT: Y06390

EP A1300000 BATCH: 5.0

## MASS SPECTRUM

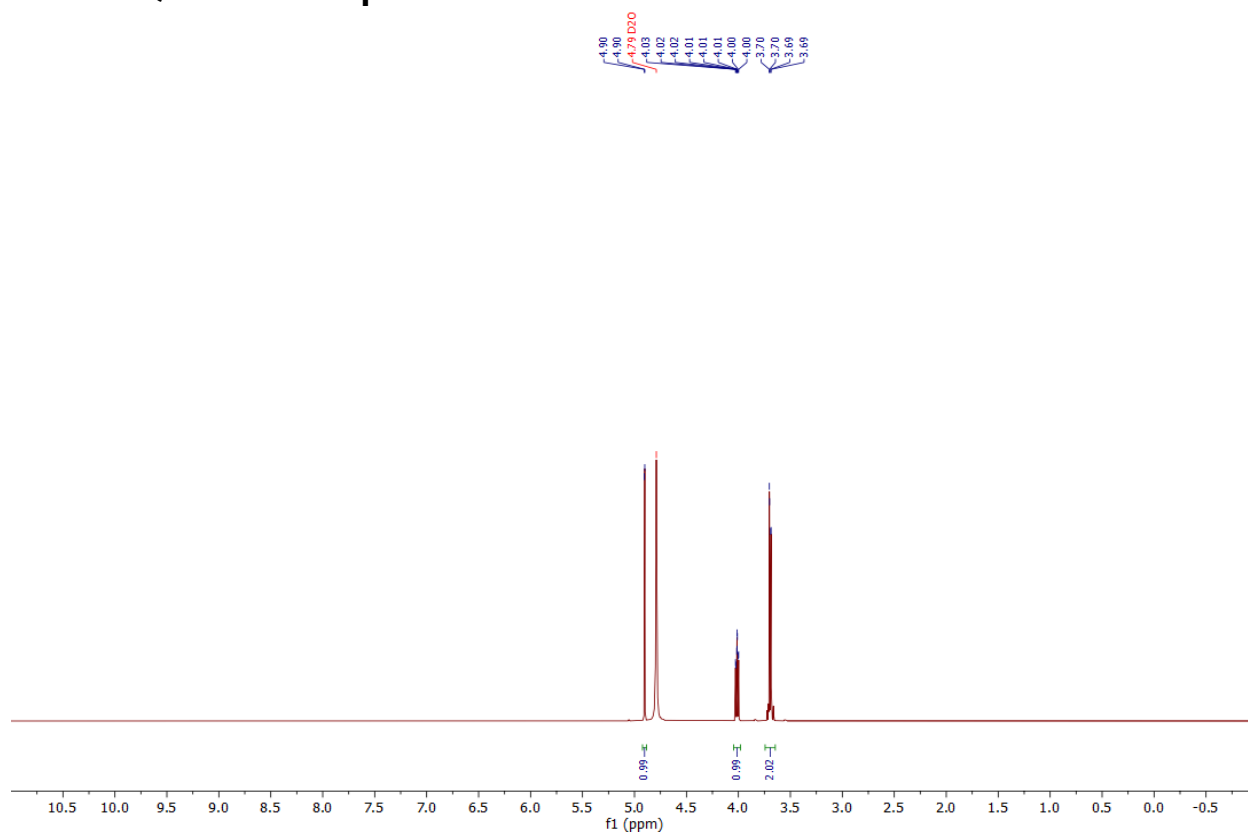
Method: HR-QTOF; 4.0 kV ESI-; temperature: 325 °C



Theoretical value: 175.0243 *m/z*

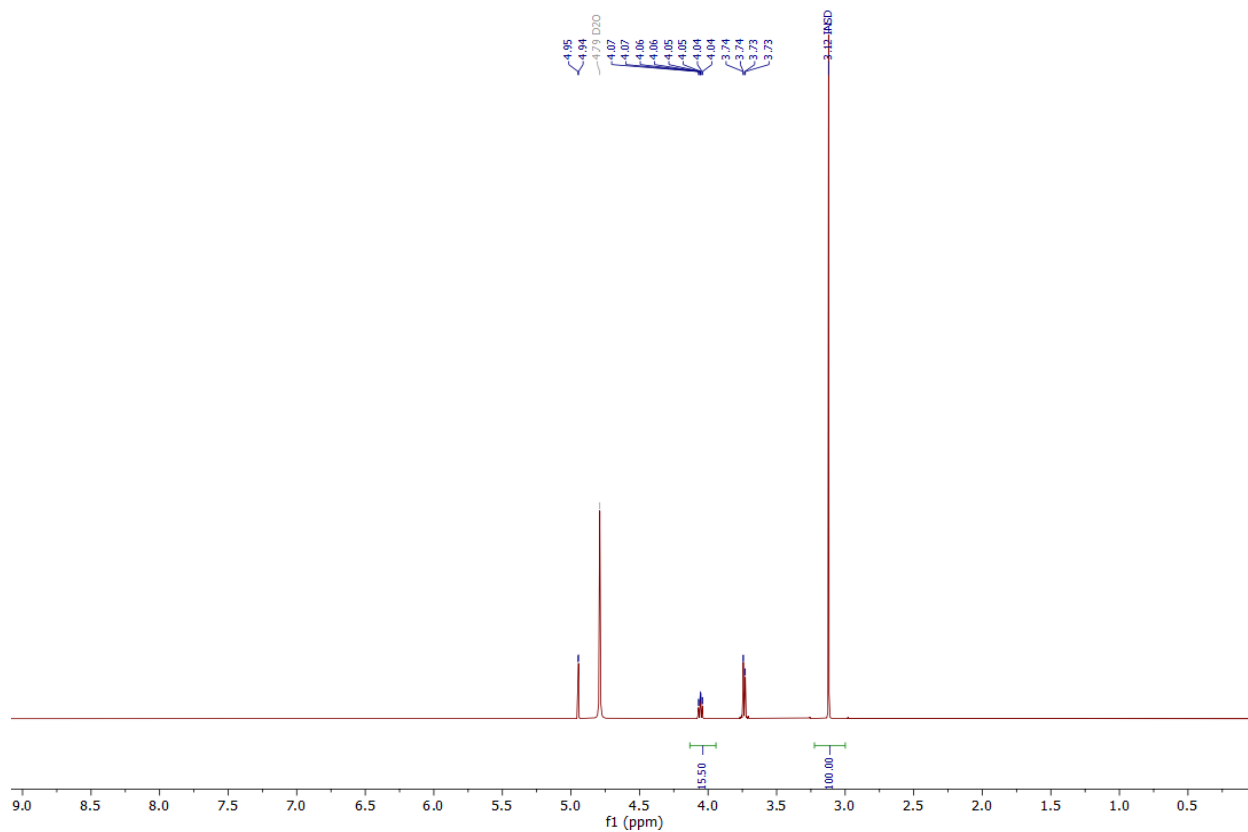
The signal of the MS spectrum is consistent with the theoretical value and its interpretation is consistent with the structural formula.

## 1H NMR Qualitative Spectrum



Consistent with structure

## Quantitative NMR Spectrum



**OPTICAL ROTATION**

Specification: +20.5° to +21.5°

Perkin Elmer Polarimeter 343

Wavelength: 589 nm

Concentration: 100mg/mL in Water

Cell Path: 100 mm

Mean of three measurements = **+21.124°*****Certificate of analysis revision history:***

| Certificate version | Date        | Reason for version    |
|---------------------|-------------|-----------------------|
| LRAE0663.01         | 27 JUN 2025 | Original release date |

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