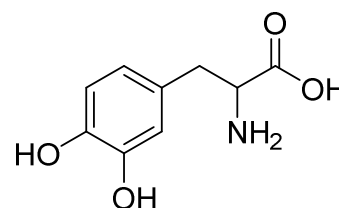


Certificate of Analysis – Certified Reference Material

3,4-Dihydroxy-L-phenylalanine

Product no.: 72816
Lot no.: BCBT4529
Description of CRM: 3,4-Dihydroxy-phenylalanine (neat)
Expiry date: FEB 2020
Storage: 20-25°C; storage under Argon
Chemical formula: C₉H₁₁NO₄
Molecular mass: 197.19 g/mol
CAS No.: 59-92-7

Produced in double accredited
laboratory fulfilling
ISO/IEC 17025 and
ISO 17034



Sample	Certified value as mass fraction (g/g) (non-stereo specific)	Associated uncertainty, $U=k \cdot u$ ($k=2$) as mass fraction (g/g) ^{[1][2]} (non-stereo specific)
3,4-Dihydroxy-phenylalanine	99.0 %	0.4 %

Metrological traceability: NIST SRM 84I (KHP) and SRM 350b (Benzoic Acid)^[3]
 Details see "Certification process details" on page 2.

Measurement method: The certified value is established by high-resolution quantitative NMR measurements (qNMR).

Intended use: Use this certified reference material (CRM) as calibrant for chromatography or any other analytical technique.

Minimum sample size: The sample is solid at room-temperature. 20 mg is recommended as the minimal sample amount. If less material is used, it is recommended to increase the certified uncertainty by a factor of two for half of sample and a factor of four for a quarter of sample.

Instructions for handling and correct use: This material does not require drying before use. The CRM should be stored in the original bottle. After use the bottle should be tightly closed and protected from excessive moisture and light.

Health and safety information: 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 Production GmbH is accredited by the Swiss accreditation authority SAS as registered reference material producer SRMS 0001 in accordance with ISO 17034 and registered testing laboratory STS 0490 according to ISO/IEC 17025.^{[4][5]}

Certificate issue date: February 21, 2018



ISO 17034
SRMS 0001



ISO/IEC 17025
STS 0490



ISO 9001
005356 QM08

Dr. A. Rück – CRM Operations

Dr. P. Zell – Approving Officer

Packaging: Brown glass bottle

Details on starting materials: Potential raw materials are checked for suitability in terms of purity. Only materials of highest available purity are accepted. 2D-NMR (H-H COSY) measurements are applied to guarantee that no impurities underlie to a peak of interest. Detection limit usually is below 0.1%.

A compatibility check guarantees that the candidate substance does not react neither with the solvent nor with the internal qNMR reference (t=0 and t=24h comparison).

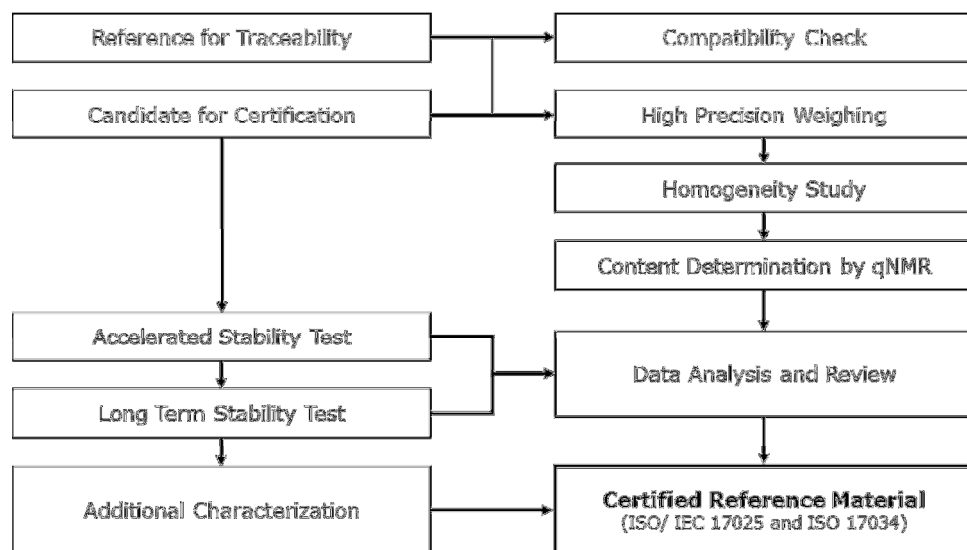
Certification process details:

In order to guarantee highest reliability of this TraceCERT CRM a multi-component approach was applied whereby the certified value is determined by high-resolution quantitative NMR measurements (qNMR on a Bruker 600 MHz Avance III NMR spectrometer).^[6] This certified value is determined under double accreditation in accordance with ISO/IEC 17025 and also ISO 17034. The certificate is designed in accordance with ISO Guide 31.^[7]

The certified values are confirmed by extended analytical data including impurity determination. These data are not covered by the scope of accreditation but determined following best practices in analytical measurements. See "Indicative Values" for more details.

High precision weighing is performed under ISO/IEC 17025 accreditation with ultra-micro balances certified by DKD and calibrated with OIML Class E2 weights.

Absolute content determination by qNMR is performed using 5-10 separate samples of the candidate substance which are each spiked with an adequate amount of internal reference and then immediately dissolved in deuterated solvent. In most cases 16-32 scans are recorded for every sample with a ¹H relaxation time of d1= 60 seconds. Quantification of the candidate content is directly calculated from the ¹H-NMR peak areas and the initial weights of the candidate and reference substance. After ANOVA the resulting standard deviation is included into the uncertainty calculation of the certified value. Extensive stability and homogeneity tests are considered for certification.^[8]



Homogeneity assessment: Homogeneity of the material is tested by qNMR measurements using 5-10 subsamples which are taken from different positions in the entire bulk material. The recommended minimal sample size is taken for all the homogeneity test samples. Analysis of variance (ANOVA) results are included into the calculation of content uncertainty of this CRM.

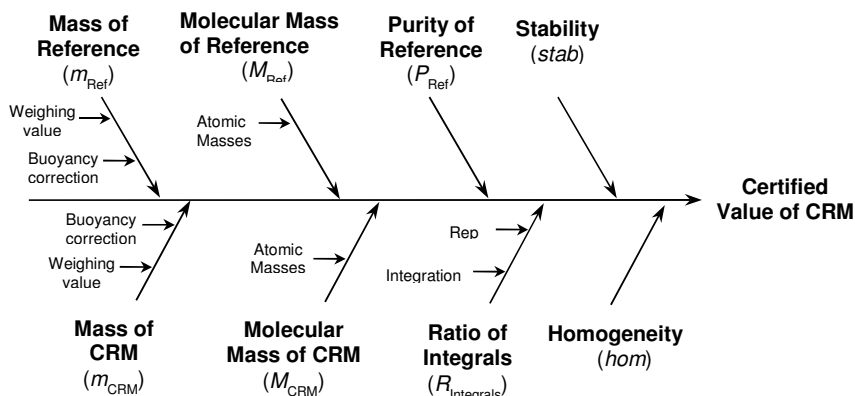
Stability assessment: An accelerated stability test is performed with samples which are stored above the recommended storage temperature. The material is tested by qNMR after 1, 3, 9 and 18 months. The long term stability test is performed with samples which are stored at the recommended storage temperature and applying qNMR double determination at appropriate time intervals, e.g. 24 months.

Associated uncertainty:

All uncertainties are calculated according to Eurachem/CITAC Guide and reported as combined expanded uncertainties. The uncertainty contributions are illustrated by the following cause-effect diagram.

Typical relative contributions are:

$u(P_{\text{Ref}})$	< 0.15 %
$u(m_{\text{Ref}})$	< 0.05 %
$u(m_{\text{CRM}})$	< 0.05 %
$u(M_{\text{Ref}})$	< 0.003 %
$u(M_{\text{CRM}})$	< 0.003 %
$u(R_{\text{Integrals}})$	< 0.20 %
u_{hom}	< 0.10 %
u_{stab}	< 0.10 %



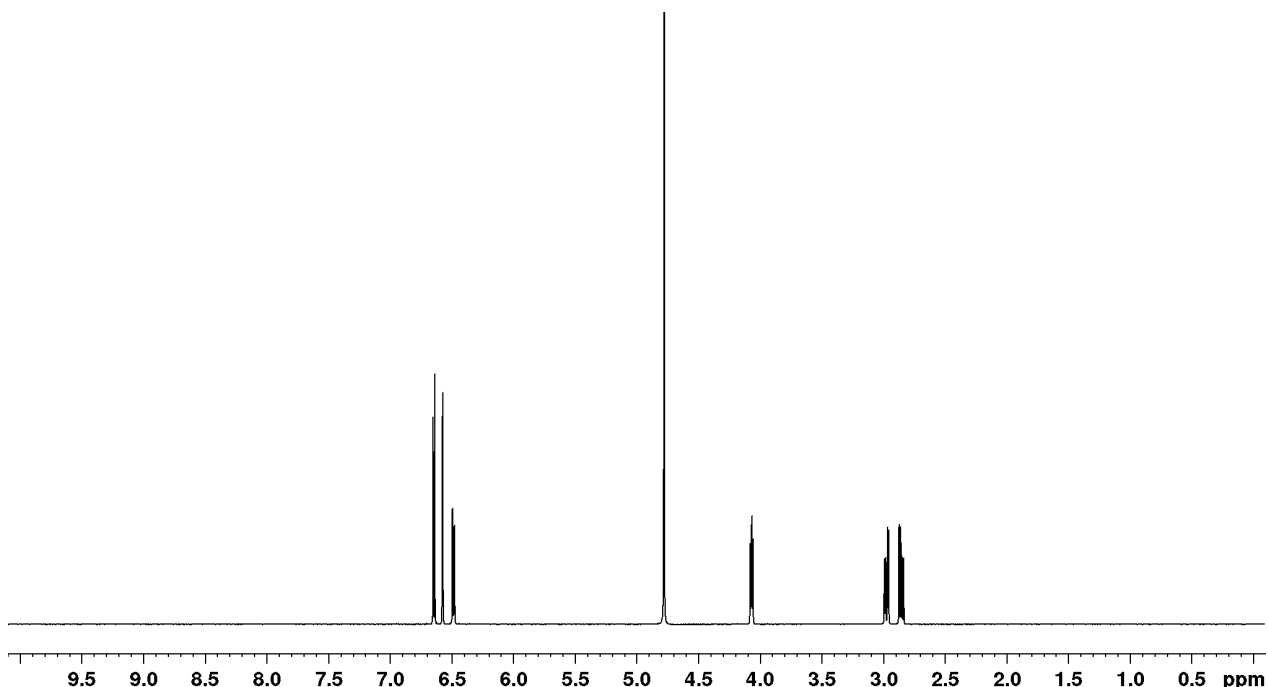
The combined uncertainty is calculated by combination of the squared contribution values.

Expanded uncertainty is then calculated to a confidence level of 95%, typically by multiplying with a confidence level factor of $k=2$.

Indicative Values:

mp	276-278 °C (lit.)
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$^1\text{H-NMR}$ Spectrum (600 MHz, 3,4-Dihydroxy-phenylalanine in $\text{D}_2\text{O}/\text{DCI}$)



References:

- [1] ISO Guide 35:2017, "Reference materials - Guidance for characterization and assessment of homogeneity and stability"
- [2] Eurachem/CITAC Guide, 3rd Ed. (2012), "Quantifying uncertainty in analytical measurement"
- [3] Eurachem/CITAC Guide, 1st Ed. (2003), "Traceability in chemical measurement"
- [4] ISO 17034:2016, "General requirements for the competence of reference material producers"
- [5] ISO/IEC 17025:2005, "General requirements for the competence of testing and calibration laboratories"
- [6] Weber M, Hellriegel C, Rueck A, Sauer Moser R, Wuethrich J, Accred. Qual. Assur. 18 (2013) 91-98
- [7] ISO Guide 31:2015, "Reference materials - Contents of certificates, labels and accompanying documentation"
- [8] Weber M, Hellriegel C, Rueck A, Wuethrich J, Jenks P, JPBA 93 (2014) 102-110

Certificate of analysis revision history:

Certificate version	Date	Reason for version
01	February 21, 2018	Initial version

Disclaimer:

The purchaser must determine the suitability of this product for its particular use. Sigma-Aldrich Production GmbH makes no warranty of any kind, express or implied, other than its products meet all quality control standards set by Sigma-Aldrich Production GmbH. We do not guarantee that the product can be used for a special application.