

Certificate of analysis

Certified reference material code: CRM-00-NEO

Name: Certified Reference Material of Neosaxitoxin dihydrochloride.

Batch: 21-001

Description: This Certified Reference Material (CRM) is a solution of Neosaxitoxin dihydrochloride (CAS Number: 64296-20-4, free base) in aqueous [HCl] = 0.003 M, pH = 2.49.

Intended use: Calibration of equipment or a measurement procedure. Establishing metrological traceability. Method validation. Quality control of a measurement or measurement procedure. For laboratory use only.

Certified values and uncertainties: The certified concentration given below is based on results obtained from the gravimetric preparation of this solution previous quantity determination by ^1H -qNMR in Varian WB 500 MHz equipment (Universidad de Santiago de Compostela).

Concentration of Neosaxitoxin dihydrochloride (NEO·2HCl) (95% Confidence Interval)	$(52.2 \pm 3.7) \mu\text{mol} / \text{kg}$
	$(20.3 \pm 1.4) \mu\text{g} / \text{g}$

The starting material is measured by ^1H -qNMR against a Sucrose certified reference material followed by gravimetric preparation using high precision balances calibrated with SI-traceable weights. Consequently, the quantified values are traceable to the International System of Units (SI) via an unbroken chain of comparisons through validated methodology.

Homogeneity was evaluated by analysis of variance on 2% of stratified randomly selected ampoules over the entire batch (6 replicate analyses per ampoule). A possible heterogeneity is hidden by the method repeatability. Therefore, a maximum possible heterogeneity was calculated as u_{bb} , 1.78%. The Stability studies after storage of selected units were performed at -20°C for an expected storage time of 12 months. Using the data from the long-term study, the uncertainty due to possible degradation was calculated as u_{lts} , 0.68%. Both studies were verified against an independently prepared calibration solution.

The components of Standard Uncertainty include related uncertainties due to characterization, heterogeneity, long term instability, short term instability (dispatch), and bulk assay, Table 1. The results are expressed as the certified value $\pm$ the expanded uncertainty (calculated by combination of the squared contribution values). Estimated expanded uncertainty with a coverage factor $k = 2$, corresponding to a level of confidence of about 95 %, as defined in the Guide to the expression of uncertainty in measurement, ISO33405.

The certificate is a summary of an extensive program of work involving selection and purification of the material, assessing its suitability and measuring the properties to be certified.

Expiration of Certification: *This certificate of CRM-00-NEO, 21-001 batch is valid 12 months after purchase date within the measurement uncertainties specified, provided the CRM is handled and stored in accordance with the instructions given in this certificate. This validity may be extended if further evidence of stability becomes available.*



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Maintenance of Certification: The material will be subjected to regular Laboratorio CIFGA stability monitoring programme to control its further stability over the period of its certification. If substantive changes occur that affect the certification before the expiration date, Laboratorio CIFGA will notify the purchaser.

Instructions for proper handling use: This material has been classified as non-hazardous, but it should still be handled with care. Read MSDS before using. Material Safety Data sheet for information regarding CRM-00-NEO is enclosed in the package. Use proper disposal methods.

Before opening an ampoule, it must be guaranteed that the content is a liquid and properly mixed to ensure homogeneity. Sample aliquots for analysis should be handled at 15°C to 25°C immediately after opening the ampoules and should be processed without delay for the certified value to be valid within the stated uncertainty. Ampoule should not remain open longer than five minutes due to solvent volatility and air contamination.

Storage conditions: The original sealed ampoules should be stored at temperatures below/at -20 °C (freezer) until use. Unopened ampoules should be stored upright under normal laboratory conditions inside the original container supplied.

Source and Preparation of Material: The raw material used in the preparation of this CRM was obtained from large-scale culture of *Alexandrium tamarense*. After purification, identity of the material was confirmed by ¹H-NMR and LC-MS/MS. Finally, 0.5 mL aliquots of toxin solution were dispensed into 1.5 mL amber argon-filled glass ampoules, which were then flame sealed.

Non-certified and non-accredited data:

Taking into account the density of water at 20 °C ($\rho^{20} = 0.9982 \text{ g/mL}$), non-certified volumetric concentration values are:

Concentration of Neosaxitoxin dihydrochloride (NEO·2HCl) (95% Confidence Interval)	(51.1 ± 3.7) µM
	(20.2 ± 1.4) µg / mL

Concentration of NEO·2HCl, HCl and impurities are neglected in order to apply solution density value.

Purity analysis was performed by UPLC-MS/MS and qNMR. Results of nuclear magnetic resonance (NMR) analysis were consistent with structure. Both analyses indicated that there was no significant contribution from other analogues. Mayor impurities are doSTX (0.15%) and tentative didodcSTX (0.12%), Figure 1.

Purity determination was performed by impurities quantification and subtracting the sum from 100%, the final molar ratio purity is ≥ 99%. *No purity correction over certified concentration should be done.*

Additional lectures:

1. UNE-EN ISO 17034 *General Requirements for the competence of reference material producers.*
2. ISO 33405 *Reference materials - Approaches for characterization and assessment of homogeneity and stability.*



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The marked activities (#) are not covered by ENAC accreditation

Figures

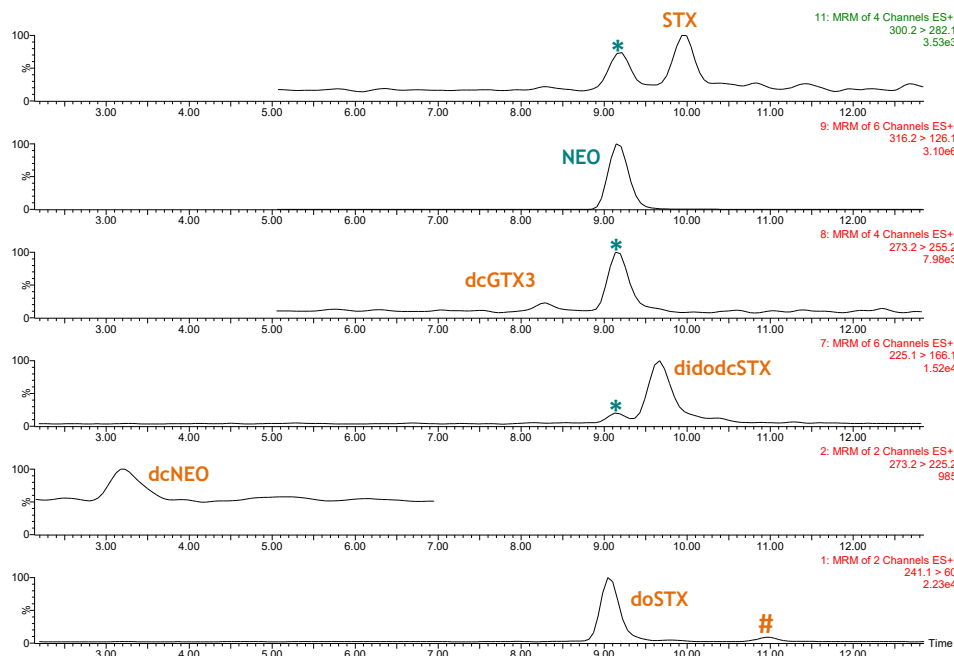


Figure 1. Analysis of the CRM-00-NEO (21-001) by HPLC-MS/MS. Conditions: Thermo Hypercarb 3 μ m, 100 x 2.1 mm, LC column. Elution conditions, gradient mode with mobile phases: (A) Water0.1% TFA (V/V), (B) acetonitrile and (C) Water; Gradient: 0 min [100% A]; 0.5 min [100% A]; 1.0 min [96% A, 4% B]; 8.0 min [96% A, 4% B]; 13 min [30% A, 8% B, 62% C]; 15.0 min [40% A, 13% B, 47% C]; 17.5 min [40% A, 25% B, 35% C]; 18.0 min [40% A, 40% B, 20% C]; 21.5 min [40% A, 40% B, 20% C]; 22 min [100% A]; 30 min [100% A]; flow rate: 0.25 mL/min. Temperature: 25°C. MS detector: Waters Quattro micro using MRM transitions for most common PSPs analogues, as well as M and GCs toxins. MRM with the most important transitions for Neosaxitoxin and impurities detected are shown. (*) residual signals from high Neosaxitoxin concentration. (#) no identified impurities with fragmentation pattern similar to doSTX.

Table 1. Uncertainties contribution for the certification of CRM-00-NEO (21-001). *Char*: qNMR quantification; *ba*: bulk assay; *bb*: homogeneity test; *lts*: long term stability test; *sts*: short term stability test.

Uncertainty contribution parameter	Uncertainty values	
	Neosaxitoxin·2HCl	
$u_{char}/\%$	2.11	
$u_{ba}/\%$	0.08	
$u_{bb}/\%$	1.78	
$u_{lts}/\%$	0.68	
$u_{sts}/\%$	2.14	
Expanded uncertainty ($k=2$) / %	7.13	

Short-term stability study. The uncertainty due to transport instability was estimated from the test for slope significance at 40°C. The results indicated continued stability, no change is expected in the property values of the CRM. The combined uncertainty budget of the assigned value was upgraded to incorporate short-term stability at 40°C for 9 days.



Table 2. Molecular information.

Name	Neosaxitoxin-2HCl
CAS NUMBER	64296-20-4
Molecular formula	C ₁₀ H ₁₉ N ₇ O ₅ Cl ₂
Molecular Weight	387.21 g·mol ⁻¹
Monoisotopic molecular weight	316.14 [Neosaxitoxin free base + H ⁺] g·mol ⁻¹
2D structure	

Inquiries concerning this Reference Material should be directed to:

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RM PRODUCER'S APPROVING OFFICER:

Certification Manager: Álvaro Antelo

This Certificate is only valid if the product was obtained directly from Laboratorio CIFGA S.A. or one of our authorized distributors.

Certificate Revision History:

May, 13th 2021 (Original certificate issue date, revision 1).

January, 12th 2026. Revised and added associated uncertainties following additional testing. Minor typographical errors. Address update (*certificate rev. 2*).

NOTE: This certificate of analysis shall not be reproduced, except in full, without written approval of Laboratorio CIFGA S.A.



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