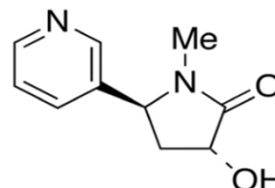


Certified Reference Material - Certificate of Analysis

trans-3'-Hydroxycotinine, Primary Standard

Cerilliant Quality
ISO GUIDE 34
ISO/IEC 17025
ISO 13485
ISO 9001
GMP/GLP

Catalog Number: H-101
Lot: FN090412-03
Retest: October 2015
Description: trans-3'-Hydroxycotinine in Methanol
Packaging: Solution in 2 mL amber USP Type I glass ampoule containing not less than 1 mL of certified solution.
Storage: Store unopened in freezer (-10 °C to -25 °C).
Shipping: Ship ambient. See Stability Section.



Intended Use: This Certified Reference Material is suitable for the *in vitro* identification, calibration, and quantification of the analyte(s) in analytical and R&D applications. Not suitable for human or animal consumption.

Instructions for Use: Users should quantitatively transfer desired volume using established good laboratory practices to spike into matrix or to dilute to the desired concentration. Each ampoule is intended for one-time use.

Safety: **Flammable, Poison. See Safety Data Sheet**

- ◆ Retest Date - stability studies ongoing. Certificate of Analysis will be updated upon completion of retest.
- ◆ Ampoules are overfilled to ensure a minimum 1 mL volume can be transferred when using a 1 mL Class A volumetric pipette.
- ◆ For quantitative applications, the minimum sample size for intended use is 1 µL.

Analyte	Certified Concentration Value
trans-3'-Hydroxycotinine	1.000 ± 0.005 mg/mL
<ul style="list-style-type: none"> ◆ Uncertainty of the concentration is expressed as an expanded uncertainty in accordance with ISO 17025 and Guide 34 at the approximate 95% confidence interval using a coverage factor of $k = 2$ and has been calculated by statistical analysis of our production system and incorporates uncertainty of the mass balance purity factor, material density, balance, and weighing technique. ◆ This standard is prepared gravimetrically and mass results are reported on the conventional basis for weighing in air. Nominal concentration is calculated based on: the actual measured mass; Mass Balance Purity Factor of the analyte(s); measured mass of the solution; and the density of the pure diluent at 20 °C. ◆ Concentration is corrected for chromatographic purity, residual water, residual solvents and residual inorganics. No adjustment required before use. ◆ Additional certification information available upon request. 	

Metrological Traceability

- ◆ This standard has been prepared and certified under the ISO Guide 34, ISO/IEC 17025, ISO 9001 and ISO 13485 standards. This standard meets the requirements of a Certified Reference Material and a Primary Standard as defined by ISO and is traceable to the SI and higher order standards through an unbroken chain of comparisons.
- ◆ 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 0.1% relative error. Balance calibration adjustments are performed weekly utilizing the balance's internal adjustment mechanism. Calibration verifications are performed pre-use. Weigh tapes from the calibration verification are included in the production batch record for this standard. Production data package available upon request.
- ◆ Fill volume is gravimetrically verified throughout the dispensing process using qualified and calibrated balances.
- ◆ Concentration is verified against an independently prepared calibration solution gravimetrically prepared.
- ◆ Each raw material utilized has been identified and thoroughly characterized through the use of multiple analytical techniques. Spectral data is provided on subsequent pages of this COA. The density and material Mass Balance Purity Factor is traceable to the SI and higher order reference standards through mass measurement and instrument qualification and calibrations.

Cerilliant certifies that this standard meets the specifications stated in this certificate and warrants this product to meet the stated acceptance criteria through the expiration/retest date when stored unopened as recommended. Product should be used shortly after opening to avoid concentration changes due to evaporation. Warranty does not apply to ampoules stored after opening.




Darron Ellsworth, Quality Assurance Manager

November 18, 2014

Date

Solution Standard Verification

Concentration accuracy and within- and between-bottle homogeneity are analytically verified against an independently prepared calibration solution.

Solution standard verification demonstrates confirmation that the specified requirements for the Primary Standard have been fulfilled and validated under ISO 13485.

Standard Solution Assay Parameters				Calibration Curve	
Analysis Method:	GC/FID			Calibration Curve:	Linear Regression
Column:	DB-5ms 30 m x 0.53 mm ID, 1.5 µm film thickness			Number of Points:	4
Temp Program:	60°C to 200°C at 40°C/min 200°C to 260°C at 15°C/min, hold 1.5 min			Linearity (r):	1.000
Injector Temp:	Cool-on-Column				
Detector Temp:	325°C				

Standard Solution	Lot Number	Verified Concentration (mg/mL)		%RSD - Homogeneity	
		Actual Results	Acceptance Criteria	Actual Results	Acceptance Criteria
New Lot	FN090412-03	1.002	± 3%	0.6	≤ 3%

- Concentration is verified through multiple analyses and is calculated as the average of multiple analyses compared to an independently prepared calibration solution.
- Within-sample and between-sample homogeneity of the New Lot is ensured through rigorous production process controls statistically analyzed to evaluate risk and verified by analysis. Multiple samples pulled from across the lot using a random stratified sampling plan were analyzed to verify homogeneity. % RSD results shown above for the New Lot demonstrate ampoule-to-ampoule homogeneity.

Analyte Certification - Mass Balance Purity Factor

Each analyte is thoroughly identified and characterized using an orthogonal approach. A mass balance purity factor is assigned incorporating chromatographic purity and residual impurities. The mass balance purity factor is utilized to calculate the weighing adjustment necessary to ensure accuracy of the solution standard concentration.

Material Name:	trans-3'-Hydroxycotinine	Chemical Formula:	C ₁₀ H ₁₂ N ₂ O ₂
Material Lot:	PN051512-02	CAS Number:	34834-67-8
		Molecular Weight:	192.21

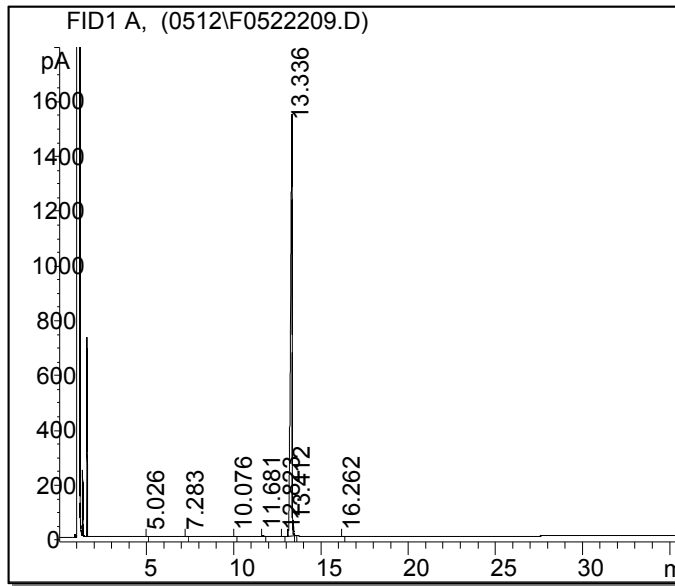
Material Characterization Summary		
Analytical Test	Method	Results
Primary Chromatographic Purity by GC/FID Analysis	SP10-0101	98.8%
Secondary Chromatographic Purity by HPLC/UV Analysis	SP10-0102	98.8%
Identity by LC/MS Analysis	SP10-0107	Consistent with Structure
Identity by ¹ H-NMR Analysis	USP <761>, SP10-0116	Consistent with Structure
Residual Solvent Analysis by GC/FID Headspace	AM1087 ¹	0.34%
Residual Water Analysis by Karl Fischer Coulometry	USP <921>, SP10-0103	0.09%
Inorganic Content by Microash Analysis	USP <281>	< 0.2%
Mass Balance Purity Factor		98.36%

- Chromatographic purity is calculated as the average of two independently performed analyses utilizing two different methods. Acceptance criteria requires the purity values to be within 0.5% of each other.
- The chromatographic purity value is used to calculate the Mass Balance Purity Factor.
- Mass Balance Purity Factor = [(100 - wt% residual solvent - wt% residual water - wt% residual inorganics) x Chromatographic Purity/100].
- Mass Balance Purity Factor does not include adjustment for chiral and/or isotopic purity.

¹ Validated analytical method

Spectral and Physical Data

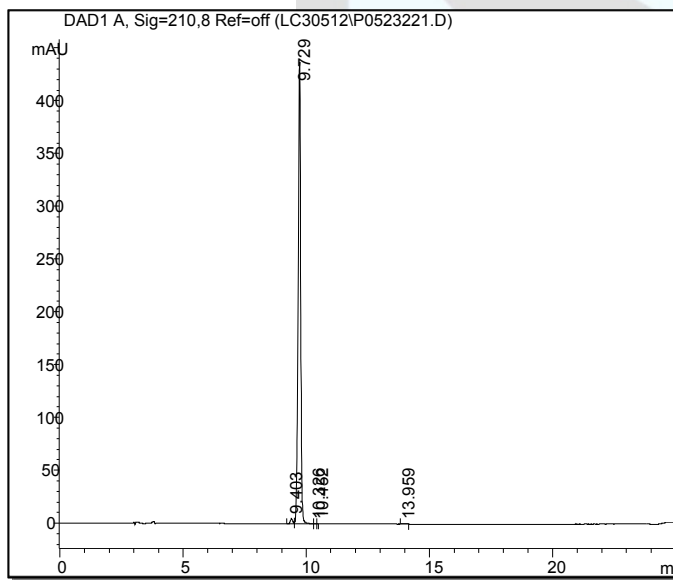
GC/FID



Column: DB-5ms, 30 m x 0.53 mm ID, 1.5 µm film thickness
Temp Program: 40°C to 140°C at 40°C/min
 140°C to 280°C at 5°C/min (hold 5 min)
Injector Temp: Cool-on-Column
Detector Temp: 325°C
Data File Name: S:\GC\GC6\2012\0512\F0522209.D
Instrument: GC#6
Sample Name: PN051512-02
Acquired: May 22, 2012

Peak #	Ret Time	Area	Height	Area %
1	5.03	1.15	0.38	0.01
2	7.28	0.62	0.15	0.01
3	10.08	0.26	0.07	0.00
4	11.68	18.13	4.37	0.18
5	12.82	1.42	0.32	0.01
6	13.34	10152.70	1543.34	98.95
7	13.41	85.71	28.77	0.84
8	16.26	0.58	0.11	0.01

HPLC/UV



Column: Prodigy ODS 3 5µ, 4.6 x 250 mm
Mobile Phase: A: Acetonitrile
 B: 10 mM Potassium phosphate buffer
Gradient Program:

Time (mins)	%A	%B
0.0	5	95
20.0	20	80
20.1	5	95

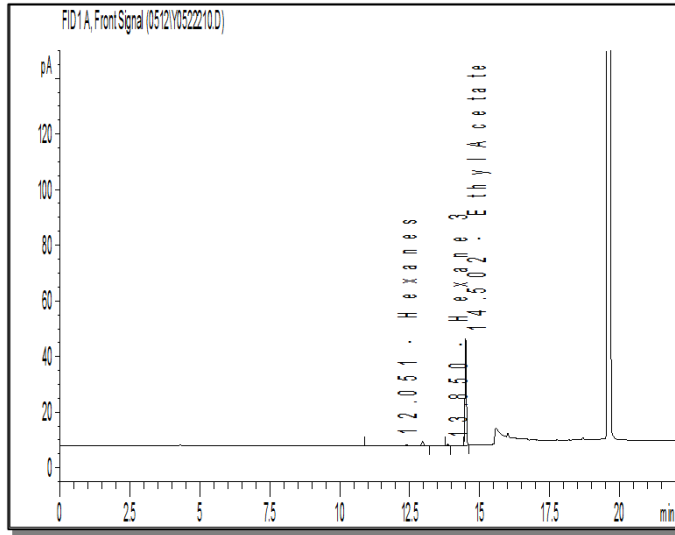
Flow Rate: 1.0 mL/min
Wavelength: 210 nm

Data File Name: S:\HPLC\HPLC3\2012\LC30512\P0523221.D
Instrument: LC#3
Sample Name: PN051512-02
Acquired: May 23, 2012

Peak #	Ret Time	Area	Height	Area %
1	9.40	33.94	4.87	1.06
2	9.73	3157.27	438.10	98.76
3	10.33	1.01	0.17	0.03
4	10.45	0.25	0.09	0.01
5	13.96	4.46	0.57	0.14

Spectral and Physical Data (cont.)

Residual Solvent Analysis by GC/FID Headspace



Column: DB-ALC1 30 m x 0.53 mm, 3 µm film thickness
Temp Program: 40°C (12 min) to 220°C at 40°C/min (5.5 min)
Carrier Gas: Helium
Flow Rate: 2.0 mL/min
Detector Heater Temp: 250°C
Injector: Headspace Sampler
HS Oven Temp: 60°C
Vial Equilibration: 10 minutes

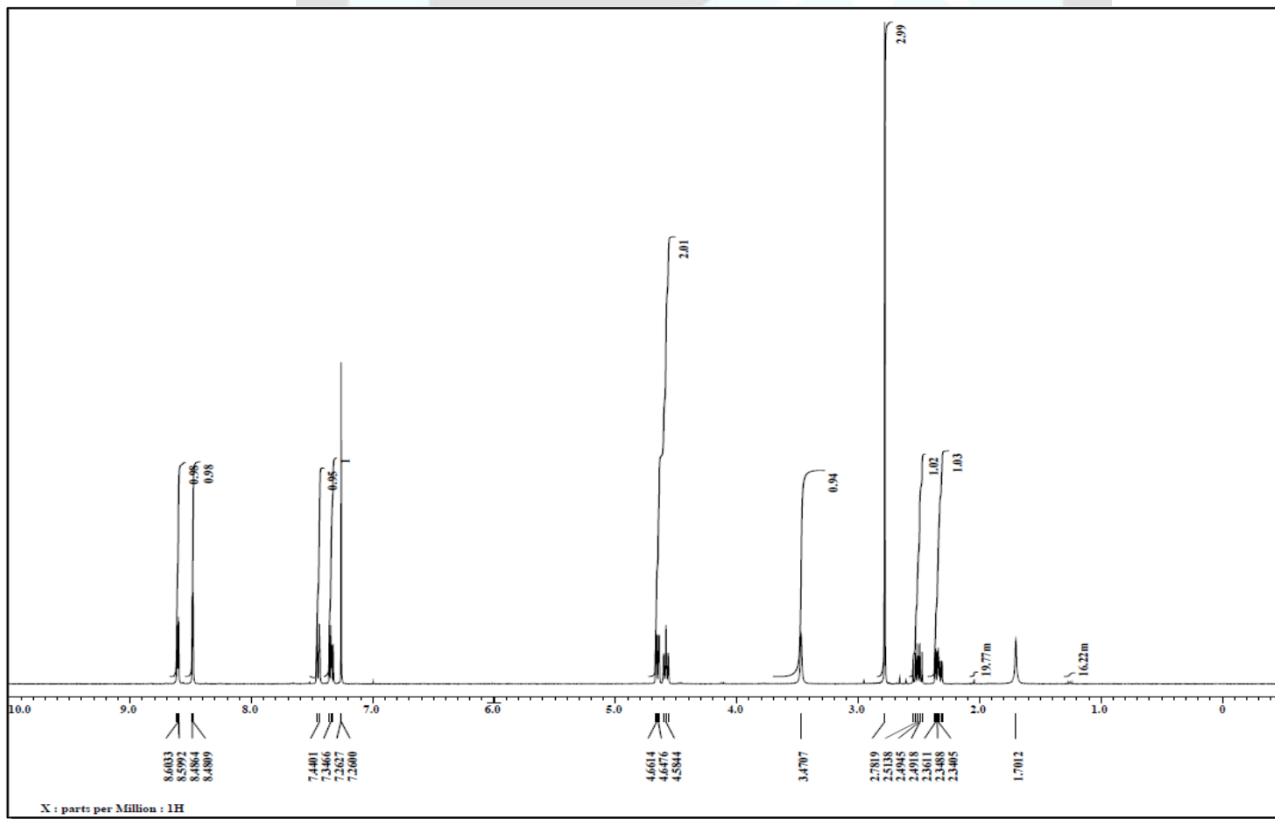
Data File Name: S:\GC\GC-HS11\2012\0512\Y0522210.D
Instrument: GC#11
Sample Name: PN051512-02
Acquired: May 23, 2012

Peak	Compound	Area	Weight %
1	Hexanes	13.929	BQL
2	Ethyl acetate	133.742	0.34
Total			0.34

BQL - Below Quantitation Limit

¹H NMR

Instrument: JEOL ECS 400
Solvent: Chloroform-D

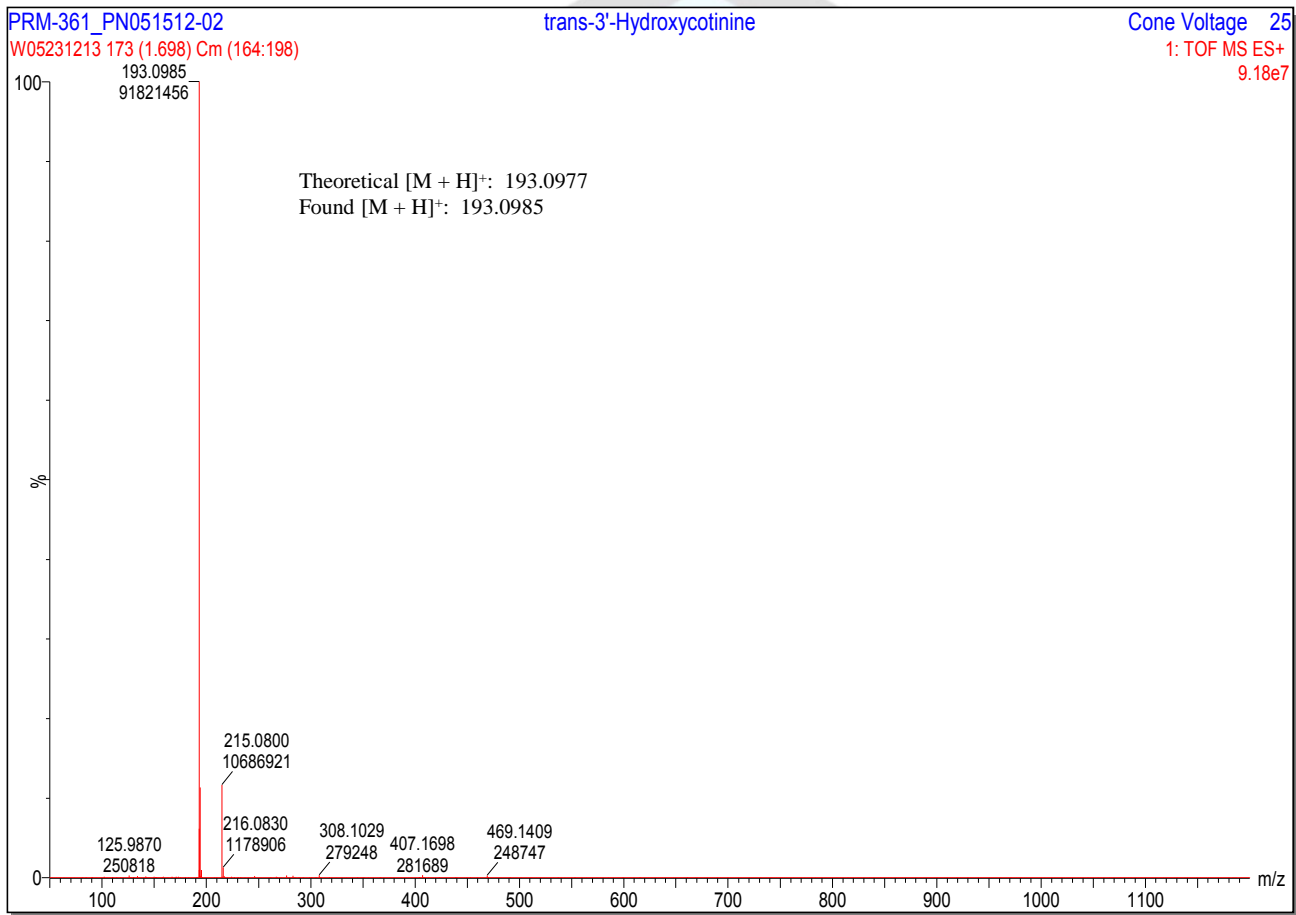


Spectral and Physical Data (cont.)

LC/MS

Column: Supelco Discovery HS F5, 3 μ m, 2.1 x 100 mm
Mobile Phase: 0.1% Formic acid in Water::Acetonitrile
(100::0 to 90::10 at 2 mins, to 100::0 at 2.1 mins,
hold 2.9 mins)
Flow Rate: 0.4 mL/min
Scan Range: 50-1200 amu
Ionization: Electrospray, Positive Ion

Data File Name: W05231213
Instrument: Waters XEVO G2 QTOF
Sample Name: PN051512-02
Acquired: May 24, 2012



Stability

Short term stability studies have been performed under accelerated conditions for a period of up to four weeks. Short term data is utilized to predict long term stability and to support transport conditions and normal laboratory use. Real-time stability studies are performed at the recommended storage conditions over the life of the product.

Short Term Stability: A summary of accelerated stability findings for this product is listed below.		
Storage Condition	Mean Kinetic Temperature (MKT)	Time Period/Result
Freezer	-15°C	No decrease in purity was noted after four weeks.
Refrigerator	4°C	
Room Temperature	21°C	
40°C	40°C	
Transport/Shipping : Stability data supports transport of this product at ambient conditions.		
Short Term Storage: Stability data supports short term storage for no more than 3 months at Refrigerate conditions.		
Long Term Stability: Long term stability has been assessed for Freezer storage (-10 °C to -25 °C) conditions. Stability of a minimum of 25 months has been established through real-time stability studies.		

COA Revision History

Revision No.	Date	Reason for Revision
00	September 25, 2012	Initial version
01	December 06, 2012	Revised Stability Section to reflect four-week study.
02	July 14, 2013	General rewrite.
03	November 05, 2013	Revised Retest Date from November 2013 to December 2014.
04	November 18, 2014	Revised Retest Date from December 2014 to October 2015.
		Added minimum sample size statement to first page.