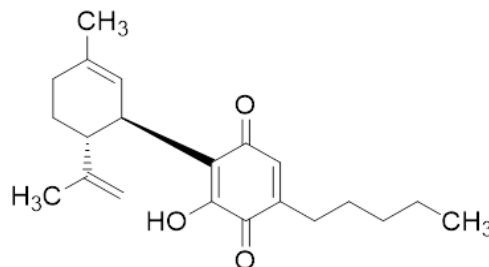


# Certified Reference Material - Certificate of Analysis

## Cannabidiol Hydroxyquinone (HU-331)

3-Hydroxy-2-[(1R,6R)-3-methyl-6-isoprenyl-2-cyclohexen-1-yl]-5-pentyl-2,5-cyclohexadiene-1,4-dione

<b>Catalog Number:</b>	C-228-5MG
<b>CRM Lot Number:</b>	FN09302208
<b>Retest Date:</b>	October 2024
<b>CAS Number:</b>	137252-25-6
<b>Chemical Formula:</b>	C <sub>21</sub> H <sub>28</sub> O <sub>3</sub>
<b>Molecular Weight:</b>	328.45
<b>Storage:</b>	Sub-Freezer
<b>Shipping:</b>	Ship Cold. See Stability Section.
<b>Country of Origin:</b>	United States of America
<b>Handling:</b>	Warning. See Safety Data Sheet.
<b>Intended Use:</b>	For R&D/ analytical purposes only.



**Chromatographic Purity: 97 ± 1%**

**Certified Property Value: 0.97 ± 0.01 mg/mg**

- ◆ The Certified Property Value is the mass balance purity factor and is corrected for chromatographic purity, residual water, residual solvents and residual inorganics.
- ◆ Uncertainty is expressed as an expanded uncertainty in accordance with ISO 17025 and ISO 17034 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 balance and weighing technique, purity factor, between bottle homogeneity and stability.
- ◆ Between-bottle homogeneity of the lot was assessed using purity of the material based on random sampling.

### Traceability

- ◆ The Certified Property Value is traceable to NIST through calibration verification using NIST traceable weights.
- ◆ Weigh tapes provide traceability to SI units of measure.
- ◆ Balances and NIST traceable weights calibrated by ISO 17025 accredited vendors.
- ◆ Material has been identified and thoroughly characterized through the use of multiple analytical techniques. Spectral data is provided on subsequent pages of the COA.

Cerilliant certifies that this material meets or exceeds the purity value stated in this data sheet. Purity and identity are established using a variety of chromatographic and spectroscopic methods. The results of these analyses are included in this data package.



Darron Ellsworth, Quality Assurance Manager

**October 06, 2023**

Date

Cerilliant Corporation, 811 Paloma Drive, Suite A Round Rock,  
TX 78665, USA, Tel: 800-848-7837 / 512-238-9974; www.cerilliant.com  
Sigma-Aldrich Production GmbH is a subsidiary of Merck KGaA, Darmstadt, Germany.



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**Spectral and Physical Data****Neat Material Lot Number: FN08062101**

<b>Analytical Test</b>	<b>Method</b>	<b>Results</b>
Chromatographic Purity by HPLC/UV Analysis	20384348	97.4% <sup>1</sup>
Identity by LC/MS Analysis	20384217	Consistent with Structure
Identity by <sup>1</sup> H-NMR Analysis	20384224	Consistent with Structure
Residual Solvent Analysis by GC/FID Headspace	20397799 <sup>2</sup>	None Detected
Residual Water Analysis by Karl Fischer Coulometry	20384212 <sup>2</sup>	Below Quantitation Limit
Inorganic Content by Microash Analysis	20384350	Below Quantitation Limit
Mass Balance Purity Factor		97.38%

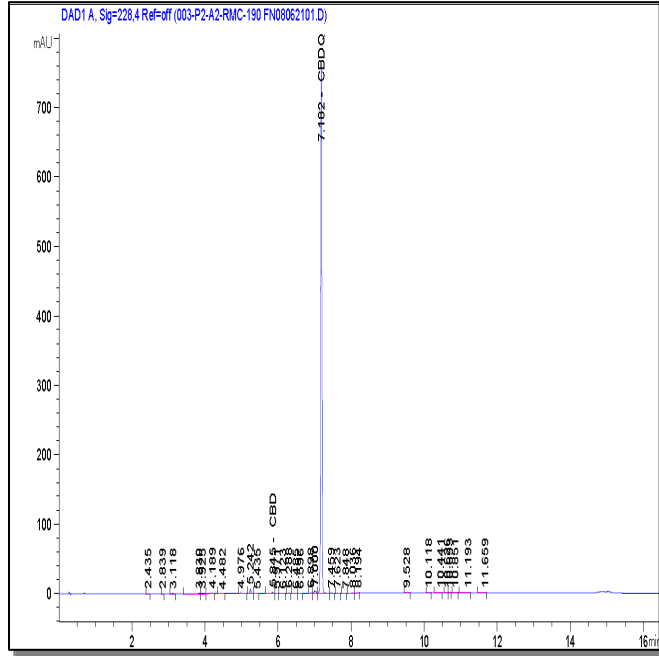
<sup>1</sup> 0.21% Cannabidiol (CBD) detected by HPLC/UV analysis.

<sup>2</sup> Validated analytical method

- ♦ Mass Balance Purity Factor = [(100 - wt% residual solvent - wt% residual water - wt% residual inorganics) x Chromatographic Purity/100].

## Spectral and Physical Data (cont.)

### HPLC/UV



**Column:** Ascentis Express C18, 2.7  $\mu$ m,  
3.0 x 100 mm

**Mobile Phase:** A: Acetonitrile  
B: 0.1% Phosphoric acid in Water

**Gradient:**

Time (min)	% A	% B
0.0	40	60
5.0	70	30
8.0	90	10
12.0	98	2
14.0	98	2
14.1	40	60

**Flow Rate:** 1.2 mL/min

**Wavelength:** 228 nm

**Sample Name:** FN08062101

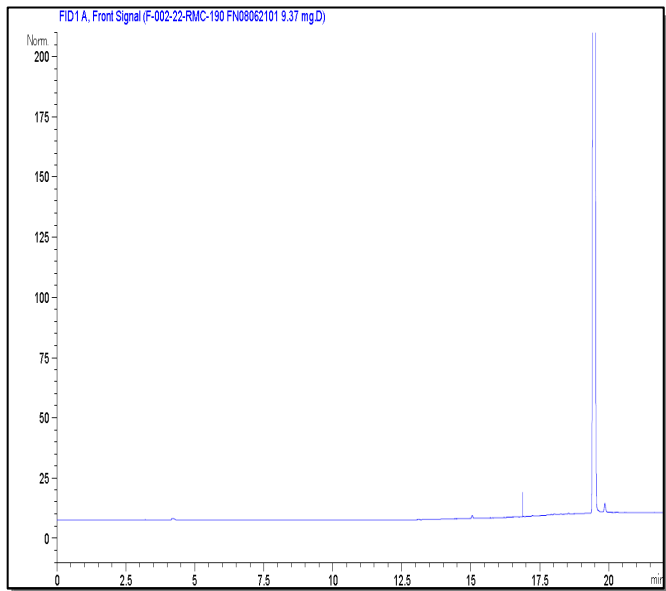
**Acquired:** May 17, 2022

Peak #	Ret Time	Area %
1	2.44	0.01
2	2.84	0.00
3	3.12	0.03
4	3.83	0.04
5	3.93	0.05
6	4.19	0.14
7	4.48	0.05
8	4.98	0.17
9	5.24	0.70
10	5.44	0.02
11	5.85	0.21
12	5.97	0.01
13	6.12	0.03
14	6.29	0.07
15	6.49	0.04
16	6.60	0.02
17	6.90	0.08
18	7.00	0.69
19	7.18	97.31
20	7.46	0.11
21	7.62	0.03
22	7.85	0.02
23	8.04	0.03
24	8.19	0.01
25	9.53	0.02
26	10.12	0.02
27	10.44	0.02
28	10.63	0.01
29	10.69	0.01
30	10.85	0.01
31	11.19	0.03
32	11.66	0.02

Peak #11 is identified as CBD

**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 hold 12 min to 220°C at 40°C/min hold 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

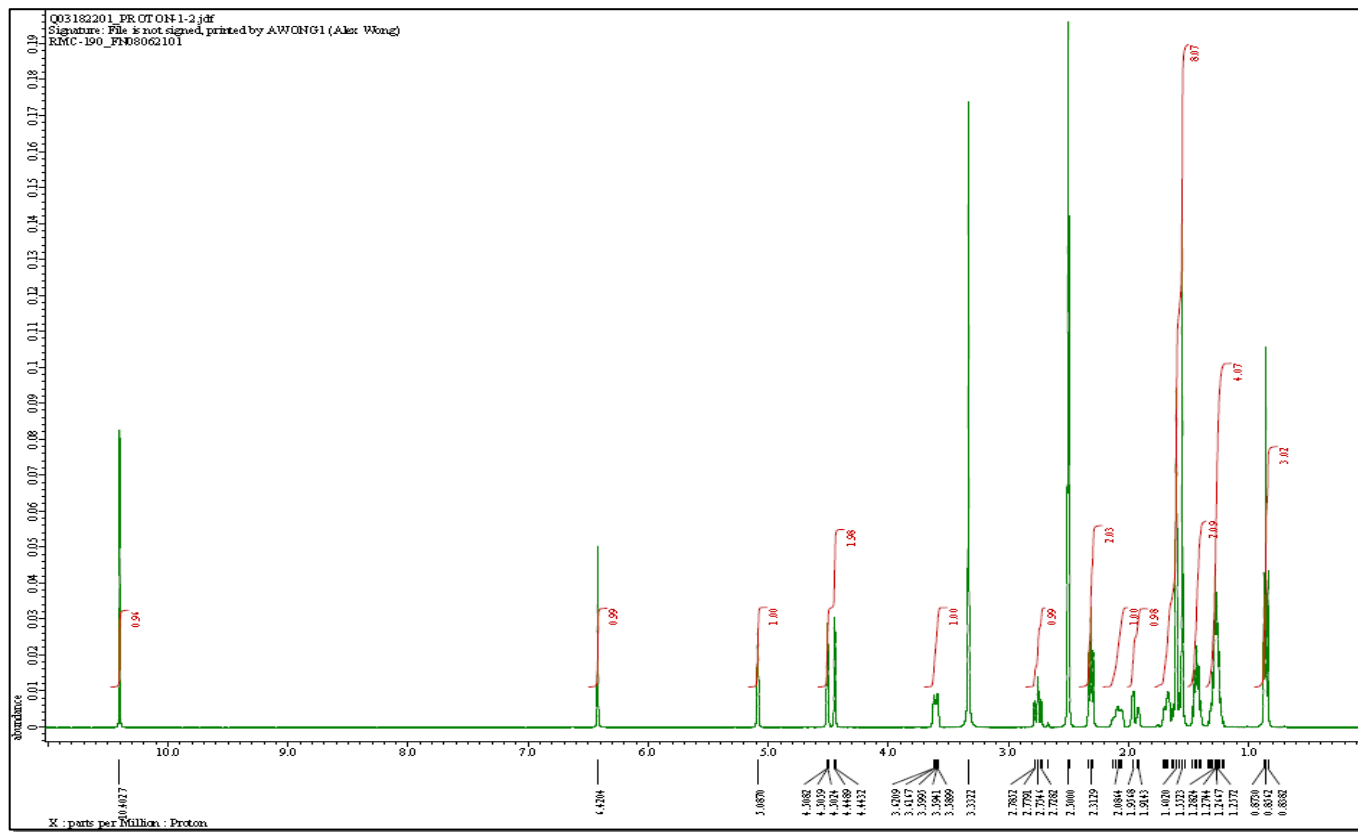
**Sample Name:** FN08062101  
**Acquired:** April 21, 2022

Peak	Compound	Area	Weight %
1	NMP	NA	NA
<b>Total</b>			<b>ND</b>

ND- None Detected

**<sup>1</sup>H NMR**

**Instrument:** JEOL ECZ400S  
**Solvent:** DMSO-D<sub>6</sub>



**Spectral and Physical Data (cont.)**

**LC/MS**

**Column:** Ascentis Express C18, 2.7 µm, 3.0 x 50 mm

**Mobile Phase:** A: 0.1% Formic acid in Water  
B: Acetonitrile

Gradient:	Time (min)	% A	% B
	0.0	50	50
	0.5	50	50
	4.0	2	98
	5.8	2	98
	6.0	50	50
	8.0	50	50

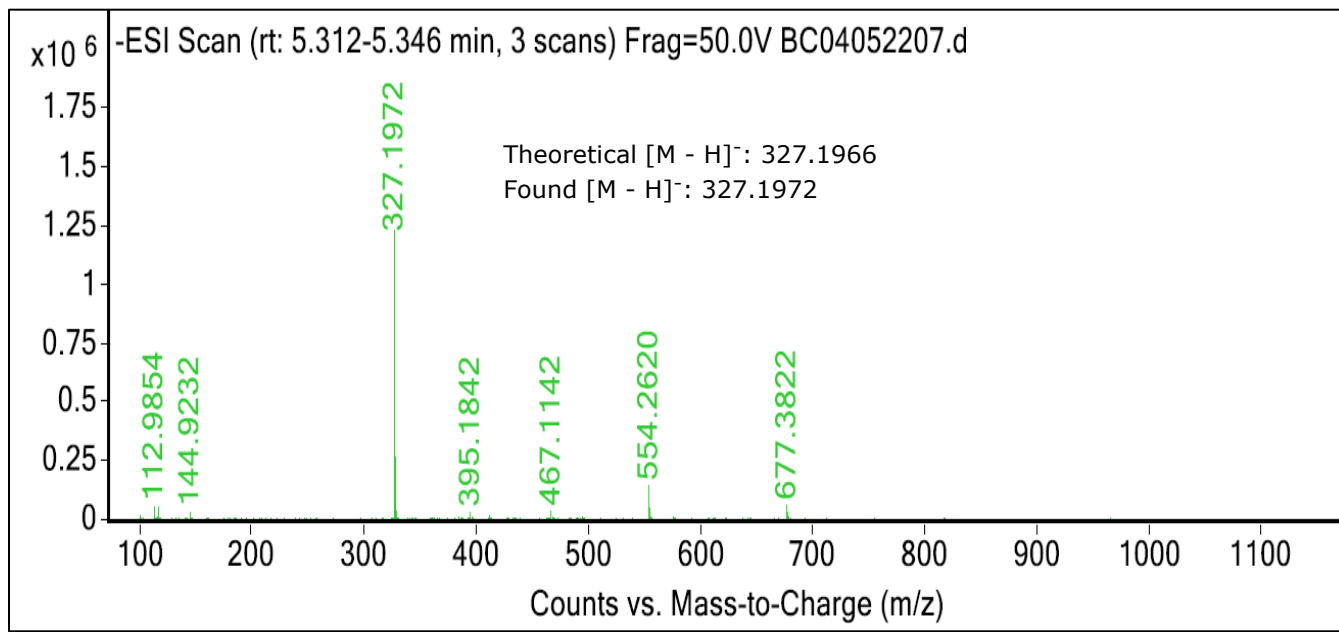
**Flow Rate:** 0.4 mL/min

**Scan Range:** 100-1200 amu

**Ionization:** Electrospray, Negative Ion

**Instrument:** Agilent 6545XT QTOF

**Acquired:** April 05, 2022



### Stability

Short term stability studies have been performed in multiple storage conditions for a period of up to two weeks. Short term data is utilized 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 stability findings for this product is listed below.

Storage Condition	Mean Kinetic Temperature (MKT)	Time Period/Result
Freezer	-20°C	No decrease in purity was noted after two weeks.
Refrigerate	5°C	

**Transport/Shipping:** Ship cold.

### COA Revision History

Revision No.	Date	Reason for Revision
00	January 04, 2023	Initial version.
01	October 06, 2023	Revised Retest Date of November 2023 to October 2024.

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