

Reference Material 8210

Hemp Plant

REFERENCE MATERIAL INFORMATION SHEET

Purpose: The non-certified values delivered by this Reference Material (RM) are intended for harmonizing measurements of cannabinoids and toxic elements in hemp plant and similar materials.

Description: A unit of RM 8210 consists of three packets of hemp plant each sealed inside an aluminized pouch with a desiccant packet. Each packet contains approximately 1.5 g of material.

Non-Certified Values: Non-certified values are suitable for use in method development, method harmonization, and process control but do not provide metrological traceability to the International System of Units (SI) or other higher-order reference system [1]. The non-certified mass fraction values provided below are on a dry-mass basis (see section on determination of moisture) [2].

Table 1: Non-Certified Values for Cannabinoids and Toxic Elements in RM 8210

Cannabinoid	Mass Fraction ^(a) (%)		
Cannabichromene (CBC)	0.0943	±	0.0062
Cannabidiol (CBD)	0.972	±	0.067
Cannabidiolic Acid (CBDA)	7.33	±	0.70
Total Cannabidiol (Total CBD)	7.38	±	0.64
Cannabigerol (CBG)	0.0349	±	0.0042
Cannabigerolic Acid (CBGA)	0.145	±	0.018
Cannabinol (CBN)	0.00348	±	0.00025
Delta-9-tetrahydrocannabinol (Δ^9 -THC)	0.1152	±	0.0068
Delta-9-tetrahydrocannabinolic Acid (THCA)	0.159	±	0.014
Total Delta-9-tetrahydrocannabinol (Total Δ^9 -THC)	0.254	±	0.016

Element	Mass Fraction ^(a) ($\mu\text{g}/\text{kg}$)			Element	Mass Fraction ^(a) ($\mu\text{g}/\text{kg}$)		
Arsenic (As)	43	±	12	Mercury (Hg)	7.5	±	1.6
Beryllium (Be)	2.3	±	1.9	Molybdenum (Mo)	319	±	29
Cadmium (Cd)	83	±	14	Nickel (Ni)	3980	±	730
Chromium (Cr)	552	±	170	Selenium (Se)	81	±	17
Cobalt (Co)	196	±	35	Uranium (U)	4.4	±	1.3
Lead (Pb)	211	±	60	Vanadium (V)	238	±	87
Manganese (Mn)	137600	±	20000				

^(a) Values are expressed as $x \pm U_{95\%}(x)$, where x is the non-certified value and $U_{95\%}(x)$ is the expanded uncertainty of the non-certified value [3,4].

Additional Information: Methods used for the analysis of RM 8210 and additional information are provided in Appendix A.

Period of Validity: The non-certified values are valid within the measurement uncertainty specified until **31 December 2028**. The value assignments are nullified if the material is stored or used improperly, damaged, contaminated, or otherwise modified.

Maintenance of Non-Certified Value: NIST will monitor this material to the end of its period of validity. If substantive technical changes occur that affect the non-certified values during this period, NIST will update this Reference Material Information Sheet and notify registered users. RM users can register online from a link available on the NIST SRM website or fill out the user registration form that is supplied with the RM. Registration will facilitate notification. Before making use of any of the values delivered by this material, users should verify they have the most recent version of this documentation, available through the NIST SRM website (<https://www.nist.gov/srm>).

Safety: RM 8210 is intended for research use; not for human consumption.

Storage: Packets of RM 8210 should be stored unopened at freezer temperature $-20\text{ }^{\circ}\text{C}$ or below until required for use. Packets can be opened at room temperature for removal of test portions and resealed with a heat sealer for up to four months after initial opening of the packet if stored at freezer temperature $-20\text{ }^{\circ}\text{C}$ or below between use.

Use: Before use, the packet should come to room temperature and the contents of the unopened packet should be mixed thoroughly. To relate analytical determinations to the non-certified values in this Reference Material Information Sheet, test portions of the powder equal to or greater than 0.5 g for cannabinoids, As, Be, Cd, Cr, Co, Pb, Mn, Mo, Ni, Se, U, and V; and equal to or greater than 0.12 g for Hg should be used. There is some elemental heterogeneity present and measuring replicate samples can mitigate spurious elevated measurements from microscale heterogeneity. Test portions should be analyzed as-received, and results converted to a dry-mass basis by determining moisture content (described below) on separate test portions.

Determination of Moisture for Correction to a Dry-Mass Basis: Moisture content of RM 8210 was determined at NIST by drying approximately 1 g test portions over fresh anhydrous magnesium perchlorate in a desiccator at room temperature for 28 d (the sample depth should not exceed 1 cm). The percent moisture ($5.46\% \pm 0.32\%$) was calculated by combining two independent measurement sets at NIST using desiccator drying. The consensus value of the percent moisture measurements ($n = 22$), and the standard and expanded uncertainties, were obtained with a Bayesian Linear Pool model [5] using OpenBUGS software [6].

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- [2] Bryan Sallee, C.E.; Wilson, W.B.; Barber, C.A.; Johnson, M.E.; Klingsick, J.R.; Mulloor, J.; Wood, E.S.C.; Wood, L.J.; Yarberr, A.J.; Toman, B.; *Characterization of Reference Material 8210: Hemp Plant*; NIST Special Publication 260-246; National Institute of Standards and Technology, Gaithersburg, MD (2024); available at <https://doi.org/10.6028/NIST.SP.260.248> (accessed June 2024).
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If you use this RM in published work, please reference:

Bryan Sallee CE, Wilson WB, Barber CA, Johnson ME, Klingsick JR, Mulloor J, Wood ESC, Wood LJ, Yarberry AJ, Toman B (2024) Characterization of Reference Material 8210 Hemp Plant. (National Institute of Standards and Technology, Gaithersburg, MD), NIST Special Publication (SP) NIST SP 260-248. <https://doi.org/10.6028/NIST.SP.260-248>

Certain commercial equipment, instruments, or materials may be identified in this Reference Material Information Sheet to adequately specify the experimental procedure. Such identification does not imply recommendation or endorsement by the National Institute of Standards and Technology, nor does it imply that the materials or equipment identified are necessarily the best available for the purpose.

Users of this RM should ensure that the Reference Material Information Sheet in their possession is current. This can be accomplished by contacting the Office of Reference Materials 100 Bureau Drive, Stop 2300, Gaithersburg, MD 20899-2300; telephone (301) 975-2200; e-mail srminfo@nist.gov; or the Internet at <https://www.nist.gov/srm>.

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APPENDIX A

Source and Preparation: The RM is dried hemp plant materials, *Cannabis sativa L.*, obtained from two sources. The level of cannabinoids and toxic elements in the RM was targeted to represent typical levels found in hemp plant from conventional agriculture practices. NIST prepared the RM by grinding the hemp plant materials and sieving the resulting materials to ensure a particle size between 250 μm and 710 μm . The materials were blended for 30 min and immediately stored in the dark at $-80\text{ }^{\circ}\text{C}$. The hemp plant was packaged into 1.5 g portions in 2" x 2" anti-static polyethylene bags by the Office of Reference Materials at NIST (Gaithersburg, MD). The packaged material was stored in the dark at $-80\text{ }^{\circ}\text{C}$ until final packaging of RM units described on page 1. Full details of material source and preparation can be found in reference 2.

Analysis: Value assignment of the mass fractions of cannabinoids and toxic elements in RM 8210 were conducted at NIST based on a single method or the combination of two methods described below and in full detail in reference 2.

Cannabinoids: Mass fractions (percent, dry-mass) for cannabinoids were measured at NIST by liquid chromatography with absorbance detection using a photodiode array detector [2]. All samples were prepared for analysis following a previously published procedure [7,8].

Toxic Elements: Mass fractions (micrograms per kilogram, dry-mass) for toxic elements were measured at NIST using the analytical methods outlined in Table A1 [2]. All samples were prepared for analytical analysis by closed vessel acid-assisted microwave digestion.

Table A1. NIST Methods Used for Elemental Determinations

Element	NIST Analytical Methods ^(a)
Arsenic (As)	ICP-MS
Beryllium (Be)	ICP-MS/MS
Cadmium (Cd)	ICP-MS
Chromium (Cr)	ICP-MS/MS
Cobalt (Co)	ICP-MS
Lead (Pb)	ICP-MS
Manganese (Mn)	ICP-OES
Mercury (Hg)	DC AAS
Molybdenum (Mo)	ICP-MS
Nickel (Ni)	ICP-MS
Selenium (Se)	ICP-MS
Uranium (U)	ICP-MS
Vanadium (V)	ICP-MS/MS

^(a) DC AAS: Direct combustion atomic absorption spectrometry
ICP-MS: Inductively coupled plasma mass spectrometry
ICP-MS/MS: Inductively coupled plasma tandem mass spectrometry
ICP-OES: Inductively coupled plasma optical emission spectrometry

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***** End of Appendix A *****