https://www.nist.gov/programs-projects/nist-tools-cannabis-laboratory-quality-assurance

National Institute of Standards and Technology
U.S. Department of Commerce

PROJECTS/PROGRAMS (https://www.nist.gov/laboratories/projects-programs)

NIST Tools for Cannabis Laboratory Quality Assurance

Summary

The Chemical Sciences Division (CSD) at NIST is developing an integrated measurement services program for Cannabis (hemp and marijuana) to help ensure the quality of routine analysis throughout the Cannabis industry as illustrated below. NIST is uniquely positioned to support commerce in the Cannabis community through the improvement of the analytical measurement comparability. The tools developed by this NIST Cannabis program will support measurements establishing legal, commerce, and safety claims through the development of fit-for-purpose analytical methodologies, production of Reference Materials (RMs), and implementation of a Cannabis Quality Assurance Program (CannaQAP). Additional information can be found throughout this website and if you have additional questions please contact NIST at cannabis@nist.gov (https://www.nist.govmailto:cannabis@nist.gov).

Description

Since the 1970s, *Cannabis* (marijuana and hemp) and its psychoactive constituent, Δ^9-tetrahydrocannabinol or THC, have been classified as Schedule I controlled substances. Seized evidence is tested by forensic laboratories, who verify the identity of the plant through macro- and microscopic evaluation and the presence of THC through presumptive and confirmatory chemical testing. Drug scheduling has directed the testing approaches, as qualitative confirmation of the presence of THC was sufficient to demonstrate possession of a controlled substance. Currently, marijuana and THC remain on the controlled substances list, although medical marijuana is legal in 33 states and recreational marijuana is legal in 11 states as well as the District of Columbia. The 2018 Farm Bill defined hemp as *Cannabis* containing less than 0.3 % THC and removed hemp from the controlled substances list. These legal changes have required forensic laboratories throughout the United States the need to implement quantitative analytical methods to distinguish Cannabis seizures as marijuana or hemp. However, the majority of these laboratories have little to no experience in or are accredited to perform quantitative drug analysis. The Chemical Sciences Division at NIST is developing an integrated measurement services program for *Cannabis* to ensure the quality of routine analysis in forensic laboratories to confidently distinguish between hemp and marijuana in seized *Cannabis* samples with a three-pronged approach: (1) robust analytical methods for a variety of technologies (GC-MS, LC-UV, LC-MS/MS); (2) *Cannabis* Reference Materials; and (3) *Cannabis* Quality Assurance Program (CannaQAP). For

additional technical information please contact us at cannabis@nist.gov (https://www.nist.govmailto:cannabis@nist.gov).

Measurement Services

Cannabis Quality Assurance Program (CannaQAP)

CannaQAP will help Cannabis (hemp and marijuana) testing laboratories demonstrate and improve measurement comparability and/or competence. Participation in CannaQAP will also inform NIST about the measurement capabilities within the hemp and Cannabis communities and assist in the design and characterization of Cannabis reference materials. A QAP can be viewed as a perpetual interlaboratory study mechanism that is akin to a proficiency testing (PT) scheme but with a focus on education.

NIST has provided QAPs (https://www.nist.gov/mml/csd/products-and-services/quality-assurance-programs/current-programs) to various analytical laboratory communities for over 3 decades as a trusted tool to evaluate an individual laboratory's performance and assist in validation of their measurement capabilities. All results from QAP studies are evaluated by NIST and made publicly available as published NIST Internal Reports (IRs), however the identities of individual laboratories are anonymized and known only to them and NIST. Some participants of past QAP studies have elected to have their results used as part of formal method validation studies to underpin their laboratory's purported capabilities.

Exercise 1 of CannaQAP will focus on the determination of cannabinoids in hemp oils. Participants may elect to measure up to 17 selected cannabinoids as well as total THC and total CBD. Each participant will receive two different hemp oil samples and will be asked to report triplicate results using measurement procedures and calculations normally performed in their laboratories. In addition, participants will be asked to identify the type of sample preparation and analytical methods employed in their testing to facilitate conclusions about potential method bias. For additional information regarding CannaQAP and to sign up to receive notification of new exercises, please visit https://qa.nist.gov/cannaqap/ (https://qa.nist.gov/cannaqap/).

Cannabis Reference Materials (RMs)

Natural-matrix RMs are intended for use as laboratory quality control materials, in the validation of established methods and in the development of new analytical methods. RMs are a critical measurement service that is presently lacking in the Cannabis community. The use of RMs play an important role in Cannabis product measurement community to promote compliance with current and future legislation, labeling accuracy, and good manufacturing processes. The development of RMs at NIST will initially focus on hemp plant and oil materials. Both will be homogenized, packaged, and analyzed at NIST and/or trusted third-party Cannabis laboratories for a variety of chemical species such as cannabinoids, total THC, moisture, toxic elements, mycotoxins, and pesticides, as well as microbiological contaminants. For additional information on currently available NIST RMs please visit https://www.nist.gov/srm (https://www.nist.gov/srm).

NIST Cannabis Projects Outside CSD

Objective Image Analysis for Color Test Evaluation

Objective: To rapidly (1) develop an objective image analysis method for interpreting colorimetric test results, (2) perform an interlaboratory study using the image analysis method to evaluate the reliability and accuracy of a new Cannabis typification colorimetric test, and (3) provide standard operating procedures to forensic laboratories for THC determination. For additional information for this project please contact Marcela Najarro (marcela.najarro@nist.gov (https://www.nist.govmailto:marcela.najarro@nist.gov)).

Marijuana Breathalyzer

For additional information for this project please contact Tara Lovestead (tara.lovestead@nist.gov (https://www.nist.govmailto:tara.lovestead@nist.gov)).

Stakeholders

NIST's mission is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life. Stakeholder engagement is critical for development of impactful measurement services, and some long-standing partnerships are described below. To share your measurement services needs or suggest new or upgraded solutions, please contact Walter Brent Wilson (walter.wilson@nist.gov (https://www.nist.govmailto:walter.wilson@nist.gov)).

AOAC International

AOAC INTERNATIONAL (https://www.aoac.org/) is a 501©(3), independent, third party not-for-profit association and voluntary consensus standards developing organization that brings together government, industry, and academia to establish standard methods of analysis that ensure the safety and integrity of foods and other products that impact public health around the world. NIST staff are actively involved in the Cannabis Analytical Science Program (CASP) (https://www.aoac.org/scientific-solutions/casp/) and associated AOAC standards development activities, engaging with CASP stakeholders to inform development of NIST measurement services .

ASTM International

ASTM INTERNATIONAL (https://www.astm.org/) is a globally recognized leader in the development and delivery of voluntary consensus standards with over 12,000 ASTM standards used worldwide to improve product quality, enhance health and safety, strengthen market access and trade, and build consumer confidence. NIST staff are actively involved in the D37 Cannabis committee (https://www.astm.org/COMMITTEE/D37.htm) and associated ASTM standards development activities, and engaging with Cannabis stakeholders to inform development of NIST measurement services.

The Organization of Scientific Area Committees for Forensic Science (OSAC)

OSAC (https://www.nist.gov/topics/organization-scientific-area-committees-forensic-science) is a collaborative body of more than 550 forensic scientists, administered by NIST, that consists of experts from all levels of the government, academia, and industry. OSAC strengthens the forensic

practice by facilitating the development of technically sound, science-based standards through a formal standards development organization process, evaluating existing standards, and promoting the use of approved OSAC standards throughout the forensic science community.

Cannabis Meetings at NIST

Future Meetings

Forensic Cannabis Workshop – November 6, 2020 (https://www.nist.gov/news-events/events/2020/11/forensicsnist-2020)

This workshop will include presentations from NIST researchers and outside collaborators from County and State forensic laboratories in the United States. NIST presenters will provide an overview of the newly developed sample preparation protocols, qualitative colorimetric test, quantitative analytical methods (i.e., LC-UV, LC-MS/MS, GC-MS, and portable IR detectors), interlaboratory study results, and updates on Cannabis RMs. NIST collaborators will present on their in-house Cannabis protocols, analytical methods, validation schemes, and involvements with NIST through interlaboratory studies. The workshop will include a round table discussion for the presenters to answer questions and exchange ideas with the audience.

Past Meetings

NIST Food Safety Workshop – October 28 – 31, 2019 (https://www.nist.gov/news-events/events/2019/10/nist-food-safety-workshop)

This workshop brought experts from the food industry, government, academia, and support organizations (e.g., trade and standards organizations, instrument manufacturers) together with metrology experts to discuss challenges and possible solutions facing laboratories charged with ensuring the safety of the US and global food supply. Food safety is a broad topic, and this workshop covered challenges with analysis of heavy metals, toxins, and residue contamination resulting from growth conditions to allergens, bacteria, or other contamination occurring during processing and/or packaging. The full report from the workshop is available for download.

NIST Hemp RM and QAP Meeting at NIST – May 30, 2019

The CSD held an informal meeting at NIST with multiple stakeholders to discuss the needs of the hemp community for reliable measurements and product quality control. The meeting consisted of two NIST presentations and an open discussion between the 39 meeting attendees. The stakeholder provided NIST with necessary information to start developing analytical tools to improve measurement comparability and product quality in the Cannabis community. CSD has started developing an integrated measurement services program to accomplish these goals through developing Cannabis Reference Materials and starting a Cannabis Quality Assurance Program (CannaQAP) (https://qa.nist.gov/cannaqap/index.php).

Presentations/Publications

1. Wilson, W.B., Phillips, M.M., and Lieberman, R.A. "NIST Tools for Confidently Distinguishing Between Hemp and Marijuana (https://event.on24.com/eventRegistration/EventLobbyServlet?target=reg20.jsp&partnerref=NIST&eventid=2356765&sessionid=1&key=01E655B8000B17D7D8B25B7E6C8F3C50&regTag=&sourcepage=register)." ASMS 2020 Shimadzu Webinar Series, Virtual, June 2, 2020. Oral Presentation.
2. Harries, M.E., Friss, A., Jeerage, K.M., Lovestead, T.M., Suiter, C.L., and Widegren, J.A.

"Considerations for Field Portable Vapor Sampling in Forensic Science," PITTCOM, Chicago, IL, March 1, 2020. Oral Presentation.

3. Wilson, W.B. "The Role of Reference Materials for Improving the Quality of Analytical Measurements Throughout the Cannabis Community (https://www.dropbox.com/sh/ob20jpqfwxbdsyc/AADMGkLO3eiBximY35jXBtIXa?dl=0&preview=Wilson_Walter_The+Role+of+Reference+Materials+for+Improving+the+Quality+of+Analytical+Measurements+Throughout+the+Cannabis+Community.pdf)." 6th Annual Emerald Conference, San Diego, CA, February 29, 2020. Oral Presentation.
4. Wilson, W.B., Phillips, M.M., and Rimmer, C.A. "Method Development for the Separation of 15 Cannabinoids by Reverse Phase Liquid Chromatography and Photodiode Array Detection." 2019 Eastern Analytical Symposium and Exposition, Princeton, NJ, November 18-20, 2019. Poster.
5. Wilson, W.B., Barber, C.A., Phillips, M.M., Rimmer, C.A., and Wood, L.J. "Future Plans at the National Institute of Standards and Technology for a Hemp Quality Assurance Program and Reference Materials (https://www.nist.gov/system/files)." NIST Food Safety Workshop, Gaithersburg, MD, October 28 – 31, 2019. Poster.
6. Phillips, M.M., Melanson, J.E. "Overcoming Challenges in Development of Cannabis Reference Materials." Maryland Medical Cannabis Commission Workshop on Optimizing Performance and Maximizing Productivity When Measuring Heavy Metals in Cannabis and Hemp by Inductively Coupled Plasma Mass Spectrometry, Columbia, MD, October 3, 2019. Oral Presentation.
7. Phillips, M.M., Konschnik, J., Melanson, J.E. "Overcoming Challenges in Development of Cannabis Reference Materials." 133rd Annual AOAC Meeting & Expositions, Denver, CO, September 6 – 12, 2019. Oral Presentation.
8. Wilson, W.B., Barber, C.A., Phillips, M.M., Rimmer, C.A., and Wood, L.J. "Future Plans at the National Institute of Standards and Technology for a Hemp Quality Assurance Program and Reference Materials." 133rd Annual AOAC Meeting & Expositions, Denver, CO, September 6 – 12, 2019. Poster.
9. Wilson, W.B. "Recent Developments for Tobacco and Hemp Reference Materials." 2019 Cannabis & Tobacco Science Summit, Durham, NC, July 29 – July 31, 2019. Oral Presentation.
10. Jeerage, K.M., Suiter, C.L., Holland, E.N. Harries, M.E., Widegren, J.A., and Lovestead, T.M. "Fundamental partitioning relationships of compounds indicative of cannabis plants or cannabis exposure," 29th Annual International Cannabinoid Research Society Symposium on the Cannabinoids, Bethesda, MD, June 2019. Oral Presentation.
11. Lovestead, T. M., Lamplugh, A., Harries, M.E., Jeerage, K.M., Suiter, C.L., Montoya, L., and Widegren, J.A., "Air quality as it relates to worker safety," ASTM International D37 workshop on Advancing the Field of Cannabis/hemp through Standardization, Rome, Italy, Feb 18-19, 2019. Oral Presentation.
12. Jeerage, K.M, Harries, M.E., Suiter, C.L., Holland, E.N., Widegren, J.A., Lovestead, T.M. "Building the Chemical Foundation for Intelligent Breath Analysis," Forensics@NIST (https://www.nist.govmailto:Forensics@NIST) 2018, Gaithersburg, MD, November 7 – 8, 2018. Oral Presentation.
13. Jeerage, K.M., Holland, E.N., Bruno, T.J. "Partitioning of Drug Analogs in Adsorbent Phases." 20th Symposium on Thermophysical Properties, Boulder, CO, June 24 – 29, 2018. Oral Presentation.
14. Widegren, J. A., Lovestead, T.M., Holland, E.N., and Bruno, T.J. "Concatenated gas saturation method for vapor pressure measurements: A new design that minimizes measurement uncertainty," 20th Symposium on Thermophysical Properties, Boulder, CO, June 29, 2018. Poster Presentation.
15. Rupert, K., Harries, M.E., and Lovestead, T.M. "Characterization of Vapor Pods by PLOT-

Cryoadsorption" SURF / SHIP Colloquium, Boulder, CO, August 2018. Oral Presentation.

16. Lovestead, T.M. and Bruno, T.J. "Vapor Pressure Measurements of Cannabinoids," 20th Symposium on Thermophysical Properties, Boulder, CO, June 29, 2018. Oral Presentation.
17. Lovestead, T.M. and Bruno, T.J. "Cannabinoid Vapor Pressure Measurements and Predictions by PLOT-Cryo," American Chemical Society, New Orleans, LA, March 22, 2018. Oral Presentation.
18. Lovestead, T.M. and Bruno, T.J. "Cannabinoid Vapor Pressure Measurements and Predictions by PLOT-Cryo," American Academy of Forensic Science, Seattle, WA, February 24, 2018. Oral Presentation.
19. Lovestead, T.M. and Bruno, T.J. "Determination of Cannabinoid Vapor Pressures to Aid in Vapor Phase Detection of Intoxication," Forensic Chemistry, 2017, 5, 79-85 https://doi.org/10.1016/j.forc.2017.06.003 (https://doi.org/10.1016/j.forc.2017.06.003)
20. Lovestead, T.M., Burger, J.L., and Bruno, T.J. "A Better Understanding of Cannabis Chemistry to Aid in Vapor Phase Detection of Intoxication," 69th Annual Scientific Meeting of the American Academy of Forensic Sciences, February 13-18, 2017, New Orleans, Louisiana. Oral Presentation.
21. Lovestead, T.M., Burger, J.L., and Bruno, T.J. "A Better Understanding of Cannabis Chemistry to Aid in Vapor Phase Detection of Intoxication," 69th Annual Scientific Meeting of the American Academy of Forensic Sciences, February 13-18, 2017, New Orleans, Louisiana. Poster Presentation.
22. Lovestead, T. M., Burger, J.L., and Bruno, T.J. "A Better Understanding of Cannabis Chemistry to Aid in Vapor Phase Detection of Intoxication," National Academy of Sciences, 2016 Japanese-American Kavli Frontiers of Science Symposium, December 2-4, 2016, Irvine, California. Poster Presentation.
23. Lovestead, T. M., "A Better Understanding of Cannabis Chemistry to Aid in Vapor Phase Detection of Cannabis Intoxication," Forensics@NIST (https://www.nist.govmailto:Forensics@NIST) 2016, November 9, 2016, Gaithersburg, MD. Oral Presentation.

Opportunities

Cannabis Postdoctoral Opportunities at NIST are available in cooperation with the National Academies/National Research Council.

- Catching Crooks with Chemistry (http://nrc58.nas.edu/RAPLab10/Opportunity/Opportunity.aspx?LabCode=50&ROPCD=506461&RONum=B8168)
- Separation Science Techniques for Trace Organic Analysis (http://nrc58.nas.edu/RAPLab10/Opportunity/Opportunity.aspx?LabCode=50&ROPCD=506461&RONum=B1712)
- Novel Analytical Separation Science Methodology (http://nrc58.nas.edu/RAPLab10/Opportunity/Opportunity.aspx?LabCode=50&ROPCD=506461&RONum=B1711)
- Chemical Metrology of Dietary Supplements (http://nrc58.nas.edu/RAPLab10/Opportunity/Opportunity.aspx?LabCode=50&ROPCD=506461&RONum=B6909)
- Applications of Organic Analytical Chemistry in Forensic Science (http://nrc58.nas.edu/RAPLab10/Opportunity/Opportunity.aspx?LabCode=50&ROPCD=506461&RONum=B3932)
- Advances in High Resolution Mass Spectrometry (http://nrc58.nas.edu/RAPLab10/Opportunity/Opportunity.aspx?LabCode=50&ROPCD=506461&RONum=C0054)
- Activation and Deactivation of Cannabinoid Receptors by Nuclear Magnetic Resonance (NMR) Spectroscopy Screening (http://nrc58.nas.edu/RAPLab10/Opportunity/Opportunity.aspx?LabCode=50&ROPCD=506472&RONum=C0164)
- Sampling and Characterization of Breath Metabolic Products Associated with Cannabis Use (http://nrc58.nas.edu/RAPLab10/Opportunity/Opportunity.aspx?LabCode=50&ROPCD=506472&RONum=C0234)
- Applications of Real-Time Portable Mass Spectrometry in Forensic Science (http://nrc58.nas.edu

/RAPLab10/Opportunity/Opportunity.aspx?LabCode=50&ROPCD=506472&RONum=C0214)

- Chemical Foundation for Capture and Release of Diccicult to Detect Drugs or Drug Metabolites of Abuse (http://nrc58.nas.edu/RAPLab10/Opportunity/Opportunity.aspx?LabCode=50&ROPCD=506472&RONum=B8158)
- High-Accuracy Measurements on Complex Mixtures with NMR Spectroscopy: Applications to Refrigeration, Forensic Science, Hydrogen Storage and Carbon Capture (http://nrc58.nas.edu/RAPLab10/Opportunity/Opportunity.aspx?LabCode=50&ROPCD=506472&RONum=C0163)
- Vapor Detection in Forensic Chemical Analysis (http://nrc58.nas.edu/RAPLab10/Opportunity/Opportunity.aspx?LabCode=50&ROPCD=506472&RONum=B7228)

Analytical chemistry (https://www.nist.gov/topic-terms/analytical-chemistry), Drugs and toxicology (https://www.nist.gov/topic-terms/drugs-and-toxicology), Quality assurance (https://www.nist.gov/topic-terms/quality-assurance), Law enforcement (https://www.nist.gov/topic-terms/law-enforcement) and Reference materials (https://www.nist.gov/topic-terms/reference-materials)

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Dates

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