INDUSTRIAL HEMP PROGRAM

Certificate of Analysis Guide

GS2103

Agriculture.Mo.Gov

Overview

- Laboratory Terminology
- Total THC
- Measurement of Uncertainty
- Additional Considerations & Examples

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LABORATORY TERMINOLOGY

Terminology: COA & MU

COA – Certificate of Analysis (test results)

MU – Measurement of Uncertainty

- Lab-calculated figure that represents a margin of error & creates a range

Terminology: LOD & LOQ

LOD – Limit of detection

Related: **ND** (Not detected) and **<LOD** (below limit of detection)

LOQ – Limit of quantitation/quantification

Related: **NR** (not reported) and **<LOQ** (below limit of quantitation)

Different figures, but both are used to generally describe the lowest amount the laboratory can reliably measure and report

Terminology: THC

Delta-9 Tetrahydrocannabinol (Delta-9 THC)

- Psychoactive compound
- Also shown as ∆9 THC, sometimes just “THC”

THCa

- Converts to Delta-9 THC when heated (decarboxylated)
- Also shown as THCA, THC-A, THC acid

Terminology: Other

- **Other COA elements***
  - Other cannabinoids: CBD, CBG, Delta-8 THC, CBN, etc.
  - Terpenes: compounds typically responsible for the smell
  - Mycotoxins: toxic molds/fungi
  - Pesticides
  - Heavy metals

*Elements that may be included on the COA but are not utilized to determine production compliance under the Industrial Hemp Program.
Please consult your lab for further questions.

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TOTAL THC

Compliance Determination 1 of 2

Compliance of Missouri production determined by two parts; the first is…

Total THC

Total THC Methods

- **Total THC may be measured in different ways:**
  - *Method 1*: Calculated by Delta-9 THC + (THCa *.877); or
  - *Method 2*: Directly measured as *decarboxylated* Delta-9 THC
    - Decarboxylation includes the conversion of THCa into Delta-9 THC
    - Less commonly used

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*CAN+ - Cannabinoid Profile Analysis

Analyzed **Oct 01, 2020** | Instrument **HPLC-VWD** | Method **SOP-001** | Measurement Uncertainty at 95% confidence **7.81 %**

Analyte	LOD %	LOQ %	Result %	Result mg/g
Cannabidivarin (CBDV)	0.0002	0.0007	<LOQ	<LOQ
Cannabidiolic Acid (CBDA)	0.0001	0.0003	4.64	46.42
Cannabigerol Acid (CBGA)	0.0001	0.0002	0.19	1.86
Cannabigerol (CBG)	0.0001	0.0004	ND	ND
Cannabidiol (CBD)	0.0001	0.0003	3.46	34.62
Tetrahydrocannabivarin (THCV)	0.0001	0.0003	ND	ND
Cannabinol (CBN)	0.0001	0.0003	ND	ND
Tetrahydrocannabinol (Δ9-THC) ★	0.0003	0.0009	0.24	2.36
Δ8-tetrahydrocannabinol (Δ8-THC)	0.0004	0.0014	ND	ND
Cannabinol (CBL)	0.0002	0.0006	ND	ND
Cannabichromene (CBC)	0.0002	0.0005	0.17	1.75
Tetrahydrocannabinolic Acid (THCA) ★	0.0001	0.0004	0.07	0.67
Total THC (THCa * 0.877 + THC)			0.29	2.95
Total CBD (CBDa * 0.877 + CBD)			7.53	75.33
Total CBG (CBGa * 0.877 + CBG)			0.16	1.63
TOTAL CANNABINOIDS			8.17	81.67

*Dry Weight %

Most COAs already have the **Total THC** calculated for you

Method 1 Calculation Example

- Delta-9 THC measured at: **0.12%**
- THCa measured at: **0.23%**

Base Formula: Delta-9 THC + (THCa *.877)

Total THC Calculation: **0.12%** + (**0.23%** * 0.877) = ***0.322%***

Non-compliant (>0.3%)

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MEASUREMENT OF UNCERTAINTY

Compliance Determination 2 of 2

Compliance of Missouri production determined by two parts; the first is *Total THC*, and the second is the…

Measurement of Uncertainty

- Also known as the “MU”
- Lab-calculated figure; varies by lab
- Similar to margin of error
- **Creates a range**

MU Presentation Types

- **Measurement of Uncertainty may be presented in different ways:**
  - *MU Presentation Type 1*: same unit as the total THC measurement
    - Plus-or-minus figure; usually small
    - Example: **±0.07%**
  - *MU Presentation Type 2*: a percentage of the measurement itself
    - Percentage figure; usually larger (2-12% common)
    - Producer may have to do additional calculations
    - Example: **8.4%**

MU Presentation *Type 1*: Example

- Total THC: **0.322%**
- Measurement of Uncertainty "MU": **±0.07%**

Upper End of Range Calculation: 0.322% + 0.07% = 0.392%

Lower End of Range Calculation: 0.322% - 0.07% = 0.252%

Range Created by MU: 0.252% - 0.392%

Compliant (≤0.3%)

MU Presentation *Type 2*: Example

- Total THC: **0.322%**
- Measurement of Uncertainty "MU": **8.4%**

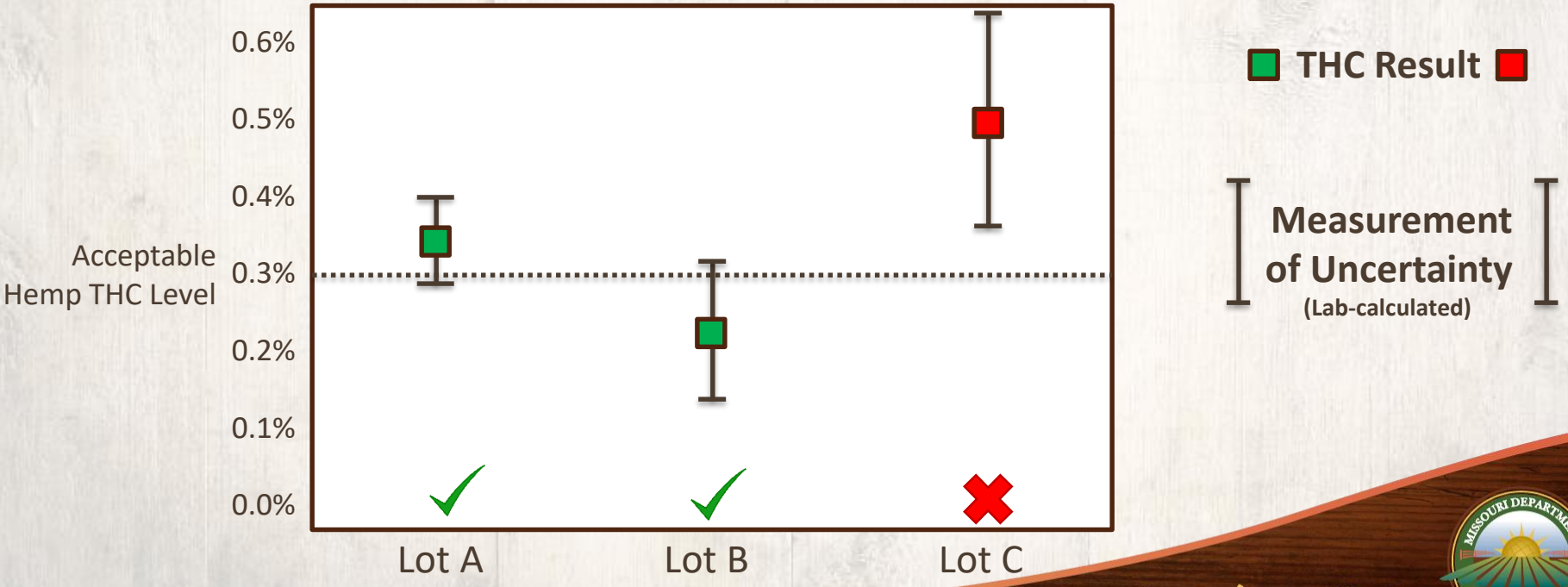
MU Calculation of Total THC: 0.322% x **0.084** = **0.027**

Upper End of Range Calculation: 0.322% + 0.027 = 0.349%
Lower End of Range Calculation: 0.322% - 0.027 = 0.295%

Range Created by MU: 0.295% - 0.349%

Compliant (≤0.3%)

*Results that <u>contain or are below</u> the **0.3% Total THC** threshold are a "pass".*



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001 | Measurement Uncertainty at 95% confidence 7.81 %

	LOD %	LOQ %	Result %	Result mg/g
	0.0002	0.0007	<LOQ	<LOQ
	0.0001	0.0003	4.64	46.42
	0.0001	0.0002	0.19	1.86
	0.0001	0.0004	ND	ND
	0.0001	0.0003	3.46	34.62
	0.0001	0.0003	ND	ND
	0.0001	0.0003	ND	ND
	0.0003	0.0009	0.24	2.36
	0.0004	0.0014	ND	ND
	0.0002	0.0006	ND	ND
	0.0002	0.0005	0.17	1.75
	0.0001	0.0004	0.07	0.67
			0.29	2.95

The MU is not always easy to find (if it is listed at all!)

Look in the notes section, the footer, or other fine print

No MU?

- **If no MU is listed on your COA, it is deemed ZERO for compliance determinations**
  - Total THC is then *read as-is*; no range is calculated
  - Some labs have an MU, but will only include it upon request, & some labs do not calculate MU at all

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ADDITIONAL CONSIDERATIONS & EXAMPLES

All Results Not Equal

- Some COAs have a “pass” or “fail” – but not all are created equal or accurate to YOUR state regulations

Overall Batch Results	
Pesticide N/A	Moisture Content N/A
Potency PASS	Water Activity N/A
Mycotoxins N/A	Heavy Metals N/A
Microbial Screen N/A	Residual Solvents N/A
Terpenoids N/A	

PASSED AS CALIFORNIA INDUSTRIAL HEMP

I 0.04% / Pass
10/21/20

PASSED

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USDA Pass/Fail

Pass

Know YOUR STATE

States may have different rules
This COA showed “pass”;
It was a “pass” in the lab’s state,
but NOT in Missouri

Overall Batch Results	
Pesticide N/A	Moisture Content N/A
Potency PASS	Water Activity N/A
Mycotoxins N/A	Heavy Metals N/A
Microbial Screen N/A	Residual Solvents N/A
Terpenoids N/A	

Potency (mg/g)

Date Tested: 10/27/2020 Method:

Instrument:

0.343 %	8.874 %	10.58 %	105.8 mg/g
Total THC	Total CBD	Total Cannabinoids	Total Cannabinoids

"Pass" or "Fail" Category

- Also be sure the "pass" is related to THC potency

Potency not even tested here!

Overall Batch Results PASS	
Pesticide N/A	Moisture Content N/A
Potency N/A	Water Activity N/A
Mycotoxins N/A	Heavy Metals N/A
Microbial Screen N/A	Residual Solvents N/A
Terpenoids PASS	

VISUAL INSPECTION	**PASS**	Analysis Date: 09/10/2020

Analysis Information	
Analysis Date/Time:	Tuesday, July 21, 2020 4:57:50 PM CDT
Uncertainty range:	+/- 0.0309 (% by dry weight)
Sample Weight (mg):	100.20
Instrumentation Used:	Gas Chromatography with Flame Ionization Detector (GC-FID)
Testing Performed:	Total % Delta-9-THC by Dry Weight (Post-decarboxylation)

Measurement of Uncertainty "MU"

Test Results

Compound Name	Concentration (% by dry weight)
Delta9-Tetrahydrocannabinol	0.0848

Delta-9-Tetrahydrocannabinol Compliance: PASS

This lab uses decarboxylation (heating process), therefore this COA **will not list THCa** as it has converted over to Delta-9

CANNABINOID PROFILE

Compound	Limit of Quantitation (%)	Dry Weight Result (%)	Uncertainty Interval (%)
Delta 9-Tetrahydrocannabinolic acid (THCA-A)	0.06	0.1030	0.0951 - 0.1110
Delta 9-Tetrahydrocannabinol (Delta 9THC)	0.03	0.0451	0.0416 - 0.0486
Cannabidiolic acid (CBDA)	0.01	2.5803	2.3808 - 2.7797
Cannabidiol (CBD)	0.03	0.5726	0.5284 - 0.6169
Delta 8-Tetrahydrocannabinol (Delta 8THC)	0.03	ND	ND
Cannabinolic Acid (CBNA)	0.09	ND	ND
Cannabinol (CBN)	0.04	ND	ND
Cannabigerolic acid (CBGA)	0.06	ND	ND
Cannabigerol (CBG)	0.03	ND	ND
Tetrahydrocannabivarinic Acid (THCVA)	0.05	ND	ND
Tetrahydrocannabivarin (THCV)	0.03	ND	ND
Cannabidivarinic Acid (CBDVA)	0.01	ND	ND
Cannabidivarin (CBDV)	0.01	ND	ND
Cannabichromenic Acid (CBCA)	0.05	0.2267	0.2092 - 0.2443
Cannabichromene (CBC)	0.06	0.0922	0.0851 - 0.0993
Total Cannabinoids		3.6199	3.3401 - 3.8998
Total Potential THC**		0.1354	0.1250 - 0.1459
Total Potential CBD**		2.8355	2.6163 - 3.0547

NOTES:
Dried Sample Moisture Content = 5.75%
Measurement Uncertainty = 7.73%

MU shown here

And also calculated here

% = % (w/w) =
Percent (Weight of Analyte / Weight of Product)
* Total Cannabinoids result reflects the absolute sum of all cannabinoids detected.
** Total Potential THC/CBD is calculated using the following formulas to take into account the loss of a carboxyl group during decarboxylation step.
Total THC = THC + (THCa *(0.877)) and
Total CBD = CBD + (CBDa *(0.877))
ND = None Detected (Defined by Dynamic Range of the method)
Percentage of THC on a dry weight basis = The uncertainty

Percentage of THC dry weight
≤0.3%
USDA Pass/Fail
Pass

USDA Pass = Missouri Pass (Total THC)

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ANALYTE	WEIGHT %	CONCENTRATION (mg/g)
CBD	<0.10%	<1.00
CBG	0.35%	3.50
CBD-A	<0.10%	<1.00
CBN	<0.10%	<1.00
CBGA	13.16%	131.60
Delta 9 THC **(THC)**	<0.10%	<1.00
Delta 8 THC	<0.10%	<1.00
CBC	<0.10%	<1.00
THC-A	<0.10%	<1.00
THC-V	<0.10%	<1.00
TOTAL	13.51%	135.10

Make sure you're reading the **% by weight** column

This is another way of showing **<LOQ** or **<LOD**

GENERAL EXAMPLE:

Certificate of Analysis

Powered by Confident Cannabis
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Producer's Contact Information

Sample: **Lab's Sample/Analysis ID**

Strain **Variety Name**

Sample Received: 09/25/2020; Report Created: 09/28/2020; Expires: 09/28/2021

29_R0[redacted]A3 09222020

Your State Sample ID: (Registration # - Lot ID – Sample Date)

QR Code for Verification

[redacted]

0.141% Total THC	ND Δ9 THC
5.428% Total Cannabinoids	4.261% Total CBD

QUESTIONS?

hempprogram@mda.mo.gov

573-522-0351

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THANK YOU!

Dr. Babu Valliyodan, Lincoln University

https://bluetigerportal.lincolnu.edu/web/hemp-institute/home

For your support of the Missouri Industrial Hemp Program & review of this presentation.

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