DRAFT AOAC SMPR 2021.XXX; v5

Method Name: **Quantitation of cannabinoids in beverages**

Intended Use: Consensus-based Reference method.

1. **Purpose:** AOAC SMPRs describe the minimum recommended performance characteristics to be used during the evaluation of a method. The evaluation may be an on-site verification, a single-laboratory validation, or a multi-site collaborative study. SMPRs are written and adopted by AOAC stakeholders composed of representatives from the industry, regulatory organizations, contract laboratories, test kit manufacturers, and academic institutions. AOAC SMPRs are used by AOAC Expert Review Panels in their evaluation of validation study data for methods being considered for *Performance Tested Methods* certification or AOAC *Official Methods of Analysis* adoption and can be used as acceptance criteria for verification at user laboratories.

2. **Applicability**:
The method will be able to identify and quantify individual cannabinoids (as listed in Table 1a and Table 1b) in at least 4 beverage matrices (as listed in table 4). The method must include detailed sample preparation for each individual matrix evaluated.

3. **Analytical Technique**:
Any analytical technique(s) that measures the analytes of interest and meets the following method performance requirements is/are acceptable.

4. **Definitions**:

Limit of Quantitation (LOQ)
The minimum concentration or mass of analyte in a given matrix that can be reported as a quantitative result.

Quantitative method
Method of analysis which response is the amount of the analyte measured either directly (enumeration in a mass or a volume), or indirectly (color, absorbance, impedance, etc.) in a certain amount of sample.

Repeatability
Variation arising when all efforts are made to keep conditions constant by using the same instrument and operator and repeating during a short time period. Expressed as the repeatability standard deviation (SD_r); or % repeatability relative standard deviation ($\%RSD_r$).

Reproducibility
The standard deviation or relative standard deviation calculated from among-laboratory data. Expressed as the reproducibility standard deviation (SD_R); or % reproducibility relative standard deviation (% RSD_R).

Recovery
The fraction or percentage of spiked analyte that is recovered when the test sample is analyzed using the entire method.

5. Method Performance Requirements:

See tables 2 and 3.

6. System suitability tests and/or analytical quality control:
Suitable methods will include blank check samples, and check standards at the lowest point and midrange point of the analytical range.

7. Reference Material(s):

See tables 1A and 1B for sources of reference materials.

Refer to Annex F: *Development and Use of In-House Reference Materials* in Appendix F: *Guidelines for Standard Method Performance Requirements*, 19th Edition of the AOAC INTERNATIONAL Official Methods of Analysis (2012). Available at: http://www.eoma.aoac.org/app_f.pdf

8. Validation Guidance:

Detailed and complete procedures for reproducible preparation of test samples of each beverage matrix must be addressed during method validation and those data must be included in the method validation submission. Required matrix categories are listed in table 4; method developers must include validation data and detailed sample preparation procedures for at least one sample from each matrix category.

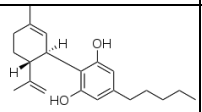
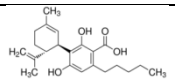
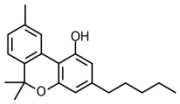
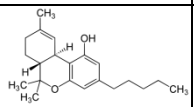
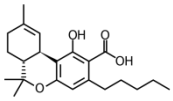
Appendix D: Guidelines for Collaborative Study Procedures To Validate Characteristics of a Method of Analysis; 19th Edition of the AOAC INTERNATIONAL Official Methods of Analysis (2012). Available at: http://www.eoma.aoac.org/app_d.pdf

Appendix F: Guidelines for Standard Method Performance Requirements; 19th Edition of the AOAC INTERNATIONAL Official Methods of Analysis (2012). Available at: http://www.eoma.aoac.org/app_f.pdf

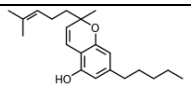
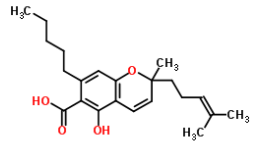
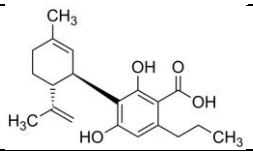
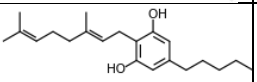
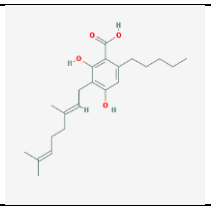
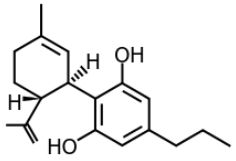
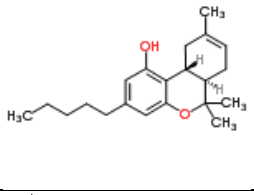
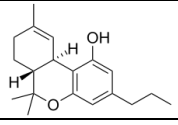
Appendix K: Guidelines for Dietary Supplements and Botanicals; 19th Edition of the AOAC INTERNATIONAL Official Methods of Analysis (2012). Available on line at: http://www.eoma.aoac.org/app_k.pdf

9. Maximum Time-To-Result: None

Table 1A: Required Cannabinoids

Common Name	Abbrev-iation	IUPAC Name	CAS Number	Molecular Structure	Reference Material
Cannabidiol	CBD	2-[(1*R*,6*R*)-6-isopropenyl-3-methylcyclohex-2-en-1-yl]-5-pentylbenzene-1,3-diol	13956-29-1		Restek Cerilliant Sigma-Aldrich API Standards Echo Pharm Lipomed AG
Cannabidiolic Acid	CBDA	2,4-dihydroxy-3-[(1R,6R)-3-methyl-6-prop-1-en-2-ylcyclohex-2-en-1-yl]-6-pentylbenzoic acid [SGC: name corrected]	1244-58-2		Cerilliant USP Restek Lipomed AG Echo Pharmaceutical
Cannabinol	CBN	6,6,9-Trimethyl-3-pentyl-benzo[c]chromen-1-ol	521-35-7		Cerilliant Restek
Tetrahydro-cannabinol	THC	(−)-(6aR,10aR)-6,6,9-Trimethyl-3-pentyl-6a,7,8,10a-tetrahydro-6H-benzo[c]chromen-1-ol	1972-08-3		Cerilliant USP Echo Pharmaceuticals
Tetrahydro-cannabinolic acid	THCA	(6aR,10aR)-1-hydroxy-6,6,9-trimethyl-3-pentyl-6a,7,8,10a-tetrahydro-6h-benzo[c]chromene-2-carboxylic acid	23978-85-0		Cerilliant USP Echo Pharmaceuticals

118 **Table 1B: Additional, Desirable Cannabinoids (to be reviewed)**

Name	Abbreviation	IUPAC Name	CAS Number	Molecular Structure	Reference Material
Cannabichromene	CBC	2-Methyl-2-(4-methylpent-3-enyl)-7-pentyl-5-chromenol	20675-51-8		Cerilliant Sigma Aldrich Echo Pharmaceuticals
Cannabichromenic acid	CBCA	5-Hydroxy-2-methyl-2-(4-methyl-3-penten-1-yl)-7-pentyl-2H-chromene-6-carboxylic acid	20408-52-0		Cerilliant
Cannabidivarinic acid	CBDVA	2,4-dihydroxy-3-[(1R,6R)-3-methyl-6-prop-1-en-2-ylcyclohex-2-en-1-yl]-6-propylbenzoic acid	31932-13-5		Cerilliant
Cannabigerol	CBG	2-[(2E)-3,7-dimethylocta-2,6-dienyl]-5-pentyl-benzene-1,3-diol **NIST: 1,3-Benzenediol, 2-(3,7-dimethyl-2,6-octadienyl)-5-pentyl-**	25654-31-3 NIST: 2808-33-5		Cerilliant Lipomed AG Echo Pharmaceuticals SPEX Certiprep Tocris (UK)
Cannabigerolic - acid	CBGA	3-[(2E)-3,7-dimethylocta-2,6-dienyl]-2,4-dihydroxy-6-pentylbenzoic acid	25555-57-1		Cerilliant Echo Pharmaceuticals SPEX Certiprep
Cannabidivarin	CBDV	2-((1*S*,6*S*)-3-methyl-6-(prop-1-en-2-yl) cyclohex-2-enyl)-5-propylbenzene-1,3-diol	24274-48-4		Cerilliant SPEX Certiprep
$^{\Delta 8}$ Tetrahydro-cannabinol	$^{\Delta 8}$ THC	6,6,9-trimethyl-3-pentyl-6a,7,10,10a-tetrahydrobenzo[c]chromen-1-ol	5957-75-5		Cerilliant SPEX Certiprep
Tetrahydro-cannabivarin	THCV	6,6,9-Trimethyl-3-propyl-6a,7,8,10a-tetrahydro-6*H*-benzo[c]chromen-1-ol	28172-17-0		Cerilliant USP

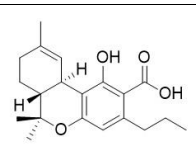
Tetrahydrocannabivaric - acid	THCVA		39986-26-0		Cerilliant

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Table 2: Method performance requirements (part 1) for cannabinoids

Parameter	**Requirement**
Limit of Quantitation (LOQ) (%)	≤ 0.002
Analytical Range(%)	0. 002 – 15

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Table 3: Method performance requirements (part 2) for cannabinoids

Parameters			Ranges (%)*		
	0.002- 0.01	0.01 – 0.05	0.05 – 0.5	0.5 - 5	5 - 15
Recovery (%)	70-130	80 – 120	85 – 118	90 - 111	95-105
% RSD_r	8	≤ 5	≤ 5	≤ 3	≤ 2
% RSD_R	12	≤ 10	≤ 10	≤ 8	≤ 6

Table 4: Matrix Categories

1. Carbonated beverages:
Sodas, sparkling water
2. Coffees:
with & without dairy/fats
3. Teas & multi-herb blends:
Kombucha, green tea, ginger-turmeric

4. Other:
Fruit juices, smoothies/shakes, sports drinks, dry powder mixes, wine, beer,