



ADVANCED PERFORMANCE CANNABIS LABORATORIES **MICROWAVE FOR** **DIGESTION HIGH-VOLUME**

Enabling high-throughput, quality metals testing of various cannabis samples using Milestone's ETHOS UP with MAXI-24 HP

| INTRODUCTION

The medical cannabis industry is one of the fastest growing industries in the United States and is becoming more prevalent worldwide. As the industry matures, new challenges have been encountered, including the need to ensure products are safe and free from potential contaminants that are dangerous for consumers.

Like all plants, cannabis absorbs metals from its environment, a result of normal plant metabolism. Cannabis is so effective at absorbing metals from its environment that it has frequently been described as a hyperaccumulator of trace metals, such as lead, cadmium, copper, chromium, arsenic, mercury, and cobalt. State governments and private laboratories are focusing on product safety testing and place special

emphasis on As, Cd, Hg and Pb, as they are extremely hazardous to consume, even at low levels.

Today's state regulations often require testing on both cannabis flower and related products to ensure customer safety. As a result, these labs are typically faced with the need to process a large number of various cannabis samples on a daily basis.

MAXI-24 HP ROTOR FOR CANNABIS TESTING LABS

Cannabis testing labs must be able to process the wide variety of matrices they encounter. These samples can range from raw materials such as cannabis flower and concentrates, to final products such as salves, balms, edibles, tinctures, and everything in-between. These samples fall



within a wide range of reactivities, due to their varying compositions. Cannabis flower, for example is less reactive and easier to digest, whereas higher-organic samples such as salves, tinctures and concentrates are more reactive and require higher temperature and pressure capability to digest completely and safely. Given the high-throughput needs of cannabis labs, it is pivotal that the microwave system and rotor used is capable of processing these samples within the high-demand environment.

| EXPERIMENTAL

In this industry report, a recovery study on cannabis and related products was performed to prove the efficacy of the ETHOS UP with MAXI-24 HP in sample preparation for metal analysis.

INSTRUMENT



Figure 1 – Milestone's ETHOS UP

The ETHOS UP used in this study was equipped with a MAXI-24 HP rotor and Milestone's easyTEMP contactless temperature control. The superior capabilities of easyTEMP allow for the processing of different samples of similar

reactivities, thus reducing labor time and increasing overall throughput.

MAXI-24 HP ROTOR



Figure 2 – MAXI-24 HP Rotor

Milestone's ETHOS UP, equipped with the MAXI-24 High Performance (HP) rotor, delivers both high-throughput and high temperature/pressure capability in a single, easy-to-use solution. This results in high-quality data and more profitable runs, without compromising performance. The design of the MAXI-24 HP allows for up to 24 samples to be processed simultaneously, achieving temperatures and pressures not possible with traditional high-throughput rotors. To reach these enhanced capabilities, the MAXI-24 HP was designed with thicker high-purity TFM vessels and caps, and rugged PEEK shields.



PROCEDURE

SAMPLE	SAMPLE AMOUNT	ACID MIXTURE
Cannabis plant material	0.5120 g	5 mL of HNO ₃ (65%), 1 mL of H ₂ O ₂ (30%)
CBD oil	0.4983 g	5 mL of HNO ₃ (65%), 1 mL of H ₂ O ₂ (30%)
Cannabis vape cartridge	0.5025 g	5 mL of HNO ₃ (65%), 1 mL of H ₂ O ₂ (30%)
Cannabis salve	0.4991 g	5 mL of HNO ₃ (65%), 1 mL of H ₂ O ₂ (30%)
Cannabis-flavored cookie	0.5006 g	5 mL of HNO ₃ (65%), 1 mL of H ₂ O ₂ (30%)
Cannabis flavored gummy bear	0.4987 g	5 mL of HNO ₃ (65%), 1 mL of H ₂ O ₂ (30%)

Table 1 - Sample amount and acid mixture used for microwave digestion

First, approximately 0.5 g (as reported in Table 1) of each sample was weighed into separate MAXI-24 HP vessels. They were then fortified with 100 µL of a multi-elemental standard solution. The spiked final concentration resulted in 10 µg/L for Hg and 20 µg/L for all other elements, respectively. The acid mixture (trace metals grade) was added as outlined in Table 1. Next, a microwave method suitable for all cannabis samples was used as outlined in Table 2 below.

STEP	TIME	TEMP	POWER
1	00:10:00	160°C	1800 W
2	00:15:00	210°C	1800 W
3	00:10:00	210°C	1800 W

Table 2 - Microwave program used to digest samples

After microwave digestion, the samples were diluted to 50 mL with deionized (DI) water and subsequently analyzed via ICP-MS.

A parallel procedure was performed on unspiked samples in order to calculate the recovery rate in relation to the spiked levels.

QUANTIFICATION

ICP-MS Parameters	
RF power (W)	1600
Sampling depth (min)	10
Carrier gas (L/min)	0.8
Sweeps/reading	20
Readings/replicate	1
Number of replicates	3
Integration time (ms)	1000
Dwell time per AMU (ms)	50
Mode	KED
Scan mode	Peak hopping
Cell gas A	0.6
RP a	0

Table 3 - ICP-MS Instrument parameters

RESULTS AND DISCUSSION

The performance of the Milestone ETHOS UP equipped with MAXI-24 HP rotor was evaluated through a recovery study on samples of interest for the cannabis industry, from plant material to edibles and concentrates. The spike levels and acceptance criteria were chosen according to the action levels reported by California state regulations and in consideration of USP and ICH guidelines. All samples were completely digested, and final solutions clear and colorless upon dilution. The analytical results are shown in Table 4, with good recoveries of all elements of interest and RSDs below 3%. This demonstrates the robustness and reproducibility of microwave digestion using the ETHOS UP equipped with MAXI-24 HP technology. Figure 3 shows the temperature profile of the digestion, the multiple temperature

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visualization, and a record of all samples in the run.

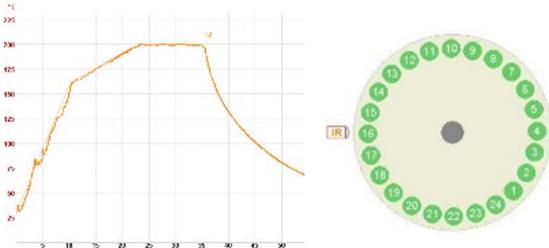


Figure 3 – MAXI-24 HP Microwave Run Report and Multiple temperature traceability

This study was performed using approximately 0.5 g of sample, which meets the minimum sample mass permitted by several states, including California. Even when working below the required limits (generally 0.2 ppm for Cd, Pb and As and below 0.1 ppm for Hg), all recoveries were within the required range of 80-120%.

		As	Cd	Hg	Pb	Ag	Ba	Co	Cr	Cu	Mn	Ni	Se	V	Zn
Cannabis plant material	Recovery (n=3) (%)	90.3	93.4	93.8	96.7	91.3	90.5	89.7	92.8	-*	-*	95.2	90.7	104.1	-*
	RSD (%)	1.8	0.9	2.1	1.4	2.3	1.6	0.6	0.4	-*	-*	0.6	2.2	0.3	-*
CBD oil	Recovery (n=3) (%)	91.8	88.9	101.2	94.2	86.9	89.8	99.5	102.3	94.3	90.9	84.6	93.9	105.4	92.8
	RSD (%)	2.8	2.7	1.6	2.9	2.3	2.7	1.4	2.5	2.2	2.6	2.0	2.7	1.5	2.9
Cannabis vape cartridge	Recovery (n=3) (%)	92.7	90.8	94.4	106.5	96.3	88.4	106.1	94.2	101.9	94.8	97.6	101.3	90.4	95.3
	RSD (%)	1.5	2.1	1.1	1.4	1.8	1.3	1.7	1.1	1.3	1.7	1.9	2.2	1.2	1.7
Cannabis salve	Recovery (n=3) (%)	94.2	94.8	103.5	90.2	87.3	89.2	88.8	94.5	93.2	99.1	94.3	90.7	94.9	89.9
	RSD (%)	2.5	1.4	1.3	2.1	2.3	1.6	1.8	2.0	1.4	1.0	1.8	1.5	1.7	1.4
Cannabis cookie	Recovery (n=3) (%)	91.6	94.3	93.8	97.5	91.4	96.4	92.6	91.6	96.7	94.3	90.1	94.6	94.1	-*
	RSD (%)	2.8	1.0	1.3	1.4	1.1	1.3	2.1	2.3	0.7	1.7	1.4	2.4	1.1	-*
Cannabis gummy bear	Recovery (n=3) (%)	98.1	97.1	97.7	96.9	97.8	92.9	94.8	94.1	90.8	96.2	90.6	91.4	94.9	92.6
	RSD (%)	2.1	0.6	0.9	1.9	2.4	0.6	0.8	0.7	0.5	1.2	1.5	2.4	0.3	1.6

Table 4- Data of the recovery study. * The ratio between spiked/unspiked concentration was too low.

CONCLUSION

The data shown in this industry report demonstrate full recovery was achieved for the most frequently tested elements that occur in cannabis plants and related products. Highly reactive samples such as gummy bears, cookies and CBD oils have been completely digested, even in large sample amounts, ensuring reliable analysis. In addition, microwave digestion using Milestone's ETHOS UP with MAXI-24 HP rotor provides the highest level of

reproducibility, even for volatile elements such as As and Hg. The MAXI-24 HP with ETHOS UP is able to successfully process a wide variety of cannabis samples at 0.5 g, delivering the performance and throughput that cannabis testing labs require.

ABOUT MILESTONE

At Milestone we help chemists by providing the most innovative technology for metals analysis, direct mercury analysis and the application of microwave technology to extraction, ashing and synthesis. Since 1988 Milestone has helped chemists in their work to enhance food, pharmaceutical and consumer product safety, and to improve our world by controlling pollutants in the environment.