

## Overview

- A solvent free headspace extraction approach – **vacuum assisted sorbent extraction (VASE)** – is applied in combination with thermal desorption (TD)-gas chromatography-mass spectrometry (GC-MS) to examine the **chemical composition of cannabis and cannabis infused consumer products**.
- Application of VASE for qualitative profiling of cannabis infused edibles (e.g., gummies, chocolates) reveals the presence of **residual solvents, flavor additives** (e.g., vanillin), and **active cannabinoids**.
- VASE profiling of cannabis flower demonstrates strain-to-strain differences in **monoterpenes, sesquiterpenes, and cannabinoids**.
- Cannabinoids are efficiently extracted only when **both heat and vacuum** are applied.



## Sorbent Pen™ Technology



**Sorbent Pen (SP)** schematic, showing the Micro-QT vacuum seal and the internal sorbent bed. The SPs come in four different configurations and can be packed with a variety of sorbents, including multi-component beds of varying physical properties.

### Step 1 Sample Preparation & Vial Evacuation

The cannabis product is homogenized and an aliquot is transferred to a glass vial in the presence of a Headspace Sorbent Pen (HSP). The vial is evacuated using a 2-stage diaphragm pump, helping to promote less-volatile compounds (e.g. THC) into the headspace for capture on the sorbent bed.



### Step 2 Diffusive Headspace Extraction

The samples are heated and agitated while under vacuum. Diffusive headspace extraction conditions promote analyte adherence to the front of the sorbent bed, prevents volatile compound breakthrough, enables flash desorption, and promotes tight chromatography. Typical extractions occur in less than 24 h.



### Step 3 Water Management

The sample vials are placed onto a chilled block to remove moisture from the sorbent bed and HSP body.



### Step 6 Clean Pen Storage

Desorbed Sorbent Pens are placed in isolation sleeves for storage or stored for up to 1 month before reconditioning, the Sorbent Pens can be immediately re-used.



### Step 5 Direct Thermal Desorption GC-MS

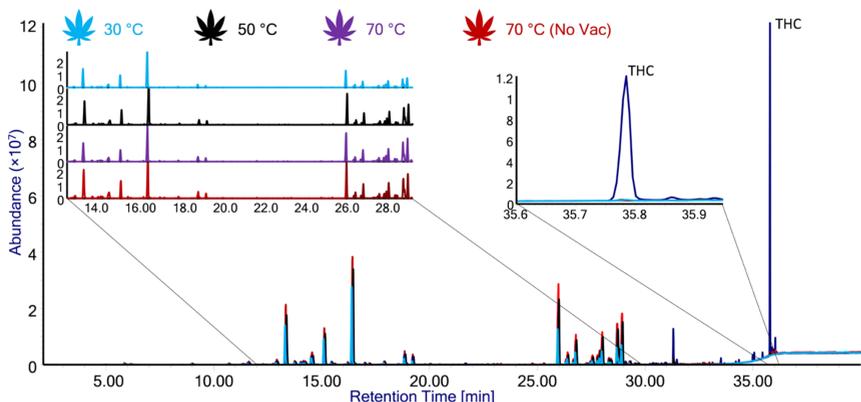
Sorbent Pen Thermal Desorption Unit (SPDU), Sorbent Pen Thermal Conditioner (SPTC) and Sample Preparation Rail (SPR) positioned on top of a GC-MS. The SPR transfers Sorbent Pens between the SPDU, the SPTC, and air-tight isolation sleeves. The SPDU is connected directly to a capillary column held within the GC-oven, which helps to minimize the flow path and mitigate analyte loss and carryover. Important optimization parameters for desorption include the temperature and duration of the preheat, desorption, and bakeout.

### Step 4 Storage

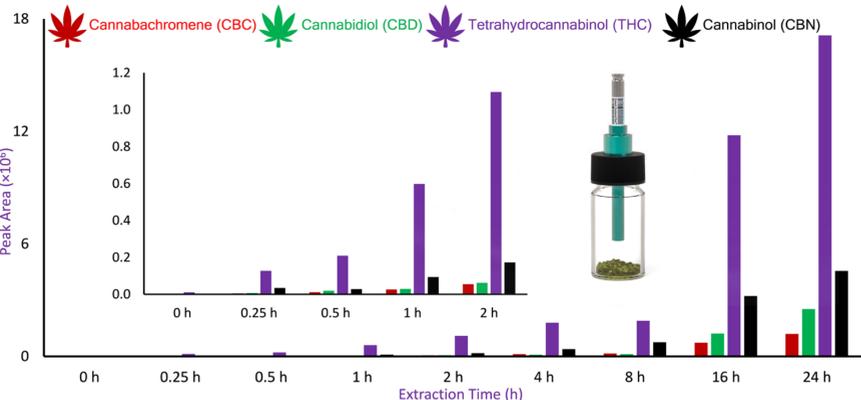
Sorbent Pens containing extracted sample are placed into isolation sleeves, where they can be stored for more than 2 weeks prior to TD-GC-MS.



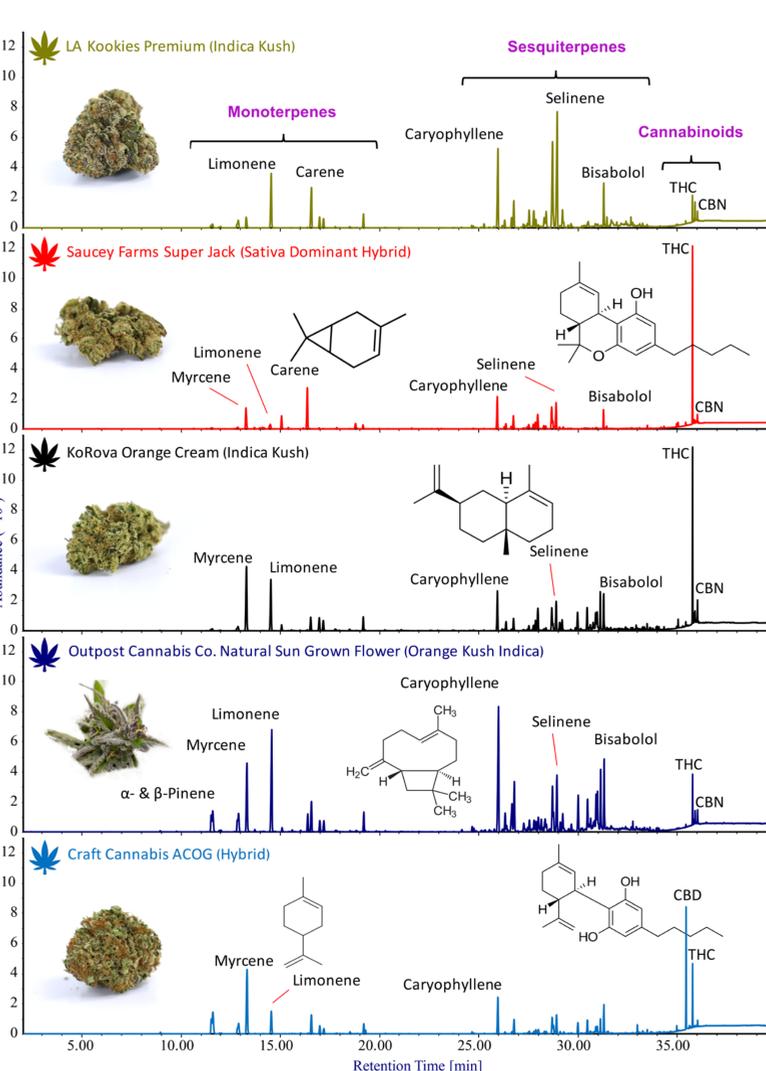
## Effects of Temperature & Vacuum on THC Extraction (~5 mg Flower)



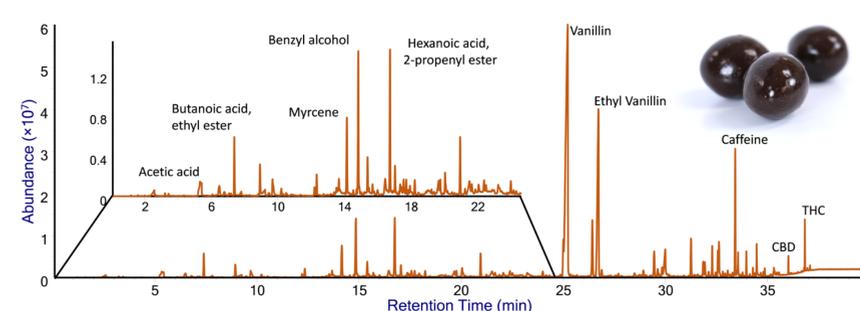
## Effects of Time on Cannabinoid Extraction (6-8 mg Flower)



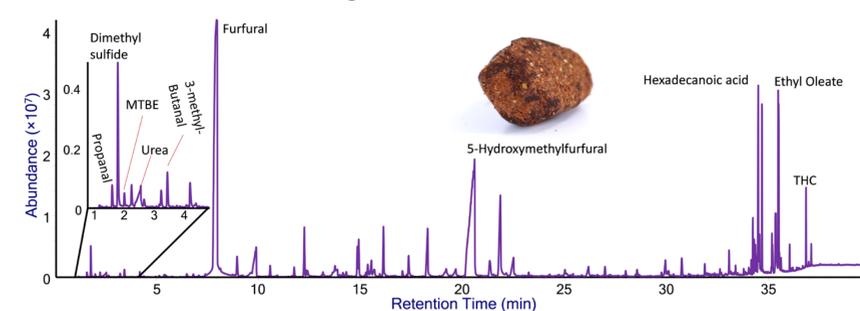
## VASE-TD-GC-MS Profile of Five Cannabis Strains (~5 mg Flower)



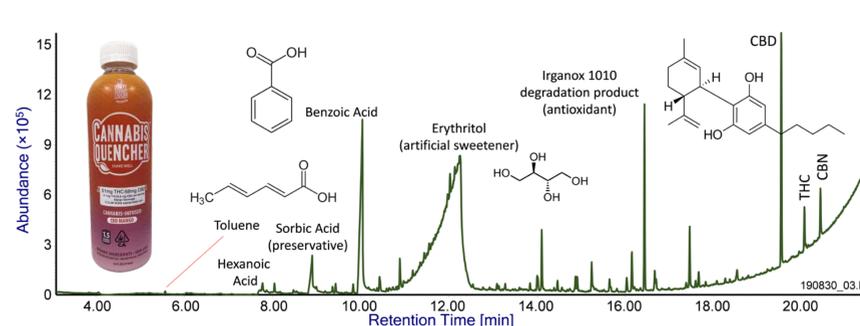
## VASE-TD-GC-MS of 130 mg Espresso Crunch



## VASE-TD-GC-MS of 140 mg SoDaze Fruit Bites



## VASE-TD-GC-MS of 2 µL Cannabis Quencher CBD Mango



**Conclusions:** The technology and methods underlying a solvent-free headspace extraction technique – vacuum assisted sorbent extraction (VASE) – are presented. When applied in conjunction with thermal desorption GC-MS, VASE is shown to be ideal for analyzing cannabinoids, terpenes, and flavor additives in raw cannabis plant material and cannabis infused consumer products.

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