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Sampling Services & Procedures for the Hemp Industry, 2020

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New Jersey Agriculture Experiment Station in concert with the New Use Agriculture and Natural Plant Products Program and the Center for Food Systems & Sustainability
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Hemp, CBDs and Hemp Seed Oil

- **Hemp is an aromatic plant:**
  - -High in fiber
  - -Rich in a nutraceutical seed oil
  - -Rich in CBDs and other bioactive compounds
  - -Hemp usually also contains THC
    (challenge is to ensure it is <0.3% THC
  - -Hemp usually also contains other aromatic terpenes
  - -The secondary products are stress inducible
  - -Plants must be sampled to ensure it is hemp, and not marijuana
- **A few critical parameters:**
  - - Ensuring permissible limits of THC during all stages of value chain, especially at end
  - - Stability and shelf-life
  - - QC program needs to be in place at outset
  - - Proper packaging, security and tracking

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Hemp in NJ

The 2018 Farm Bill:

- Further defined Industrial Hemp
- Removed from Controlled Substances Act (CSA)
  - Considered as an agricultural product
  - States and tribes can submit plans for primary regulatory authority over hemp production in their state/tribal territory

Alaska, Arizona, Kansas, Missouri, New Jersey, and Oklahoma enacted legislation for research and pilot programs

New Jersey	AB 1330 / SB 3145 (2018)	▪ Directs the New Jersey Department of Agriculture to create a pilot program to research industrial hemp cultivation. ▪ Exempts anyone participating in the agricultural pilot program from crimes and penalties relating to the purchase, sale, or cultivation of marijuana.

http://www.ncsl.org/research/agriculture-and-rural-development/state-industrial-hemp-statutes.aspx#nj

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Hemp in NJ

https://d2azl42aua8mom.cloudfront.net/wp-content/uploads/2019/11/01171142/USDA-Hemp_fullwidth.jpg

NJ's Hemp Program was among the first three states approved by the USDA on December 27th, 2019

- NJ's Hemp Program complies to the 2018 Farm Bill
- License applications for the 2020 growing season are currently open and can be found on the NJDA website under the New Jersey Hemp Farming Act

From New Jersey Hemp Program N.J.A.C. 2:25-1 et seq.

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Required Procedures

By the NJDA, NJ Hemp Grower License:

- Can be issued to an individual, or a business
- Handling In-Program, or unprocessed, material

NJ Hemp Processor/Handler License:

- Can also be issued individually or to a business, such as a third-party lab
- Handling compliance testing and production of Out-of-Program, processed, material

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DEPARTMENT OF AGRICULTURE

https://www.nj.gov/agriculture/divisions/pi/pdf/2020%20NJH%20Grower%20Application.pdf

From “Processor/Handler License Application”, NJDA, New Jersey Hemp Farming Act

From “Hemp Grower License Application” , NJDA, New Jersey Hemp Farming Act,

From “Instructions and Attachments for Participants” , NJDA, New Jersey Hemp Farming Act

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Program Materials

Table 1: In-Program Materials (Unprocessed)	
Harvestable Component	**Form of Material**
Fiber	whole stalks, including leaf and seed materials
	bales of stalks
Roots	raw
Leaves or Floral Material	fresh, unprocessed
	dried
	ground
Grain (food product)	raw, unprocessed
Seed (for planting)	whole seed, cleaned or uncleaned
Transplants	rooted plants
	cuttings

Table 2: Out-of-Program Materials (Processed)	
Harvestable Component	**Form of Material**
Fiber	whole stalk stripped of leaf and seed materials
	decorticated fiber (bast and/or hurd)
Roots	dried
	ground
Leaves or Floral Material	cannabinoid extract
	All products derived from extracts
Grain (food product)	crushed, ground, etc.
	dehulled
	seed cake / meal
	roasted or toasted AND proven nonviable
	Seed Oil
Out-of-program transfers of these materials are compliant with NJDA policy; other state and federal laws may apply. Transfers are at your own RISK.	

From “Instructions and Attachments for Participants” , NJDA, New Jersey Hemp Farming Act, https://www.nj.gov/agriculture/divisions/pi/prog/nj_hemp.html

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Program Materials

”NJDA is not responsible for ensuring product quality or product compliance with other regulating authorities, such as the Federal Food and Drug Administration (FDA) and the New Jersey Health Department. **Licenses issued by the NJDA do NOT offer any legal protections from these governing bodies and do not provide waivers from their regulations**.”*

https://www.fda.gov/media/99788/download

https://www.nj.gov/health/assets/img/NJDOH_logo_spotlight.jpg

From “Instructions and Attachments for Participants” , NJDA, New Jersey Hemp Farming Act, https://www.nj.gov/agriculture/divisions/pi/prog/nj_hemp.html

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Required Procedures

- License agreements must be signed before taking possession of any viable hemp seeds or in-program harvested hemp materials

- When applying, a colored map and GPS coordinates for all processing, handling, and growing locations are required:

  "You are required to provide to NJDA a photographic aerial map of all growing, handling, and storage locations. This requirement applies to all applicants and License Holders, and will assist with the NJDA's required reporting to law enforcement."

https://cdn.britannica.com/89/211689-050-628DD5DF/hemp-plantation.jpg

From "Instructions and Attachments for Participants" , NJDA, New Jersey Hemp Farming Act, https://www.nj.gov/agriculture/divisions/pi/prog/nj_hemp.html

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Fees for Growers

License Fee – GROWER	**$300 plus $15 per acre**	@ time of application
	NOTE: GPS coordinates for all growing locations (fields and greenhouses/indoor growing sites) and storage locations are submitted on the application. Changes to growing locations will incur a Site Modification Fee (see below).	

Important to note regarding GPS coordinates:

- Include GPS coordinates for each field or building
- GPS coordinates should be provided in DEGREES DECIMAL MINUTES (dd° mm.mmm' ; example: lat: 38° 9.919'N, long: 84° 49.267'W)
    - This can be done through:
        - Web based mapping such as Google Earth
        - GPS coordinates from a smartphone
        - https://www.geoplaner.com/

From "Instructions and Attachments for Participants" , NJDA, New Jersey Hemp Farming Act, https://www.nj.gov/agriculture/divisions/pi/prog/nj_hemp.html

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Mapping

Google Earth is NJDA's preferred method for mapping, and they provide a free code within **"Instructions for creating maps for submissions to NJDA"**

- Farm Service Agency (FSA) maps are generally not sufficient as they typically are not in color and do not identify the roadway
- Maps must include:
    - Outline of each separate field to be used for contiguous planting
    - Greenhouses, indoor growing structures, storage buildings, or handling facilities and the location ID/name of each structure

Refer to "Instructions for creating maps for submissions to NJDA" in Instructions and Attachments for Participants for all details

From "Instructions and Attachments for Participants" , NJDA, New Jersey Hemp Farming Act, https://www.nj.gov/agriculture/divisions/pi/prog/nj_hemp.html

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NJDA Mapping Example

From “Instructions and Attachments for Participants” , NJDA, New Jersey Hemp Farming Act, https://www.nj.gov/agriculture/divisions/pi/prog/nj_hemp.html

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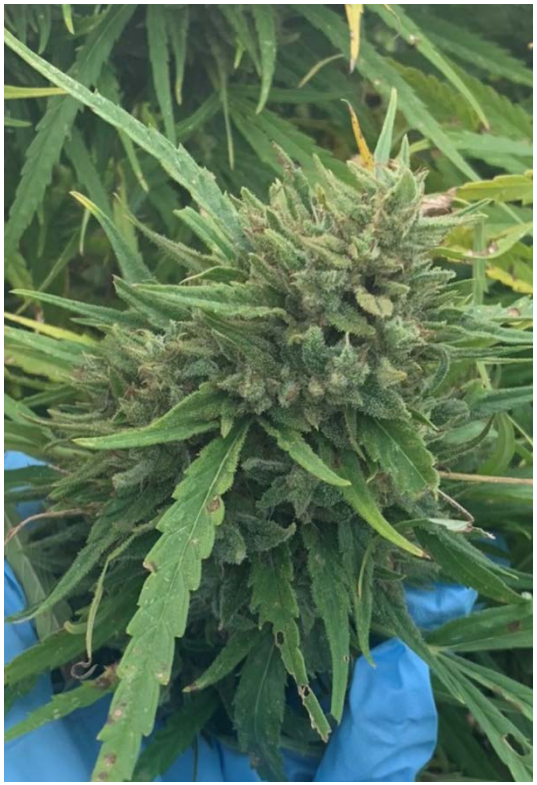
Hemp Grower Documents



Katharine Jaworski

- If applying as a business, only one signing authority can represent
  - Can be changed later through a new *Signing Authority for Corporate Entities* form

- Reports are required throughout the growing season, including pre-planting reports, planting reports, pre-harvest reports, and one annual production report

From New Jersey Hemp Program N.J.A.C. 2:25-1 et seq.

From “Hemp Grower License Application” , NJDA, New Jersey Hemp Farming Act, https://www.nj.gov/agriculture/divisions/pi/pdf/2020%20NJH%20Grower%20Application.pdf

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Hemp Grower Documents

Examples of reports:

- 2020 Planting report(s) are due:
  - For each address in your Licensing Agreement and each field and or every indoor growing address that was identified prior
  - **Within 10 days following the first day of each planting**

- 2020 Harvest/Destruction Report(s) are due:
  - For every field or indoor area planted
  - **At least 30 days prior to harvest or destruction**
    - An NJDA inspector will schedule an appointment to collect sample(s) *unless* you indicate your intent to hire a third party lab
      - Written approval required before harvest or disposal

From “Instructions and Attachments for Participants” , NJDA, New Jersey Hemp Farming Act, https://www.nj.gov/agriculture/divisions/pi/prog/nj_hemp.html

From “Hemp Grower License Application” , NJDA, New Jersey Hemp Farming Act, https://www.nj.gov/agriculture/divisions/pi/pdf/2020%20NJH%20Grower%20Application.pdf

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Fees for Processing/Handling

License Fee – PROCESSOR / HANDLER (Due annually)	**Fees per Processing Type** • **Handlers - $450 annual fee** ○ An example of a "handler" includes any private lab or service provider, such as a seed cleaner. • **Grain Processor - $450 annual fee** • **Fiber Processor - $450 annual fee** • **Floral, Oil or CBD Processor - $1,000 annual fee**	@ time of application
	NOTE 1: Processors working with multiple harvestable components will be required to pay an annual fee for EACH component. Ex. Grain ($450) + CBD ($1,000) = $1,450 Production* Fee	
	NOTE 2: GPS coordinates for all processing, handling, and storage locations must be submitted with the application submission. Changes to processing sites following execution of the *Processor Licensing Agreement* will incur a Site Modification Fee (see below).	
Site Modification Fee (SMF)	**$300 plus $15 per acre each change or addition of GPS coordinates** Defined as any change to the GPS coordinates for processing or growing locations at an existing address on the *Licensing* form *Agreement*, or for the addition of a GPS coordinate not already on the *Licensing Agreement*). Storage location changes or additions will not incur the SMS.	@ submission of site modification request form

From "Instructions and Attachments for Participants" , NJDA, New Jersey Hemp Farming Act, https://www.nj.gov/agriculture/divisions/pi/prog/nj_hemp.html

From Field to Lab to Public

In-Program material, must remain in the Hemp Program

Only to be handled by:

1. An individual or business with a NJDA licensing agreement as a handler or processor
2. or legally operating within another program authorized by federal law

Once processed, finished products can be transferred or sold to the general public, those with or without licenses

Source: Botanacor.com
(not recommending but using only
As an illustrative example

From “Instructions and Attachments for Participants” , NJDA, New Jersey Hemp Farming Act, https://www.nj.gov/agriculture/divisions/pi/prog/nj_hemp.html

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Transferring Samples to Labs

- Transfers of hemp material for phytocannabinoid level analysis are not to exceed 1 lb (0.45 kg) per sample
- Samples must be labeled properly and directly sent to the company address of the chosen lab

https://ritterspencer.com/wp-content/uploads/2019/11/USDA-Hemp-Production-Plan-Part-II-Sampling-Testing-of-Hemp.jpg

From “2020 New Jersey Hemp Testing Guidelines” , NJDA, New Jersey Hemp Farming Act,https://www.nj.gov/agriculture/divisions/pi/pdf/HempTestingGuidelines.pdf

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Transferring Samples to Labs

- For all samples being transferred/delivered to labs for testing, program participants (growers and handlers) must be prepared to produce a copy of the Licensing Agreement upon request by:
  - NJDA Hemp Staff,
  - The New Jersey State Police,
  - Or, to any law enforcement agency

- Additionally, a copy of the Licensing Agreement, along with the address of origin, must accompany any hemp material in transit

From “2020 New Jersey Hemp Testing Guidelines” , NJDA, New Jersey Hemp Farming Act,https://www.nj.gov/agriculture/divisions/pi/pdf/HempTestingGuidelines.pdf

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Inspection, Sampling and Testing Protocol

- **Inspection and Compliance:**
  - Sampling carried out by the DEA or a DEA registered third-party lab shall occur **within 15 days prior to the anticipated harvest date**
  - Additionally, an annual inspection, at minimum, will be carried out to randomly sample and this inspections may be random and withour advance notification to grower and/or processor
  - A minimum of two samples from each variety planted during the growing season and before harvest to ensure compliance with the federally defined THC level
  - Hemp producers must agree to grant entry to the DEA into premises where hemp is grown, processed or handled for inspections and may be required to be present

From New Jersey Hemp Program N.J.A.C. 2:25-1 et seq.

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Inspection, Sampling and Testing Protocol

- **Testing of In-Program Material:**
  - Quantitative determination of delta-9 THC levels
  - THC testing procedures must use decarboxylation or other reliable methods such as High performance liquid chromatography (HPLC) or Ultra-Performance Liquid Chromatography (UPLC)
  - The method used for sampling from the flower material of the cannabis plant must obtain a confidence level of 95 percent to ensure no more than one percent (1%) of the plants in the lot would exceed the federally defined THC level for hemp

From New Jersey Hemp Program N.J.A.C. 2:25-1 et seq.

From “2020 New Jersey Hemp Testing Guidelines” , NJDA, New Jersey Hemp Farming Act,https://www.nj.gov/agriculture/divisions/pi/pdf/HempTestingGuidelines.pdf

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Inspection, Sampling and Testing Protocol

- **Required Testing Results for In-Program Material:**
  - Ensure that all hemp grown and processed maintains the federal delta-9 THC concentration limit of 0.3 percent on a dry weight basis*
  - "All hemp with a delta-9 THC concentration of more than 0.3% must be destroyed, but it will only be considered a negligent violation pursuant to these rules if the hemp has a delta-9 THC concentration of more than 0.5% on a dry weight basis." A hemp producer who violates these rules with a culpable mental state greater than negligence may be subject to criminal law enforcement actions.
  - Results are subject for review by the DEA, who are authorized to re-test and collect samples
  - **A $150 fee shall be assessed for all Departmental testing, including but not limited to, retests and pesticide residue quantification tests**, unless inconsistent, then it may be waived

From New Jersey Hemp Program N.J.A.C. 2:25-1 et seq.

*Seed lots may not be genetically homogenous- don't assume fixed THC levels!

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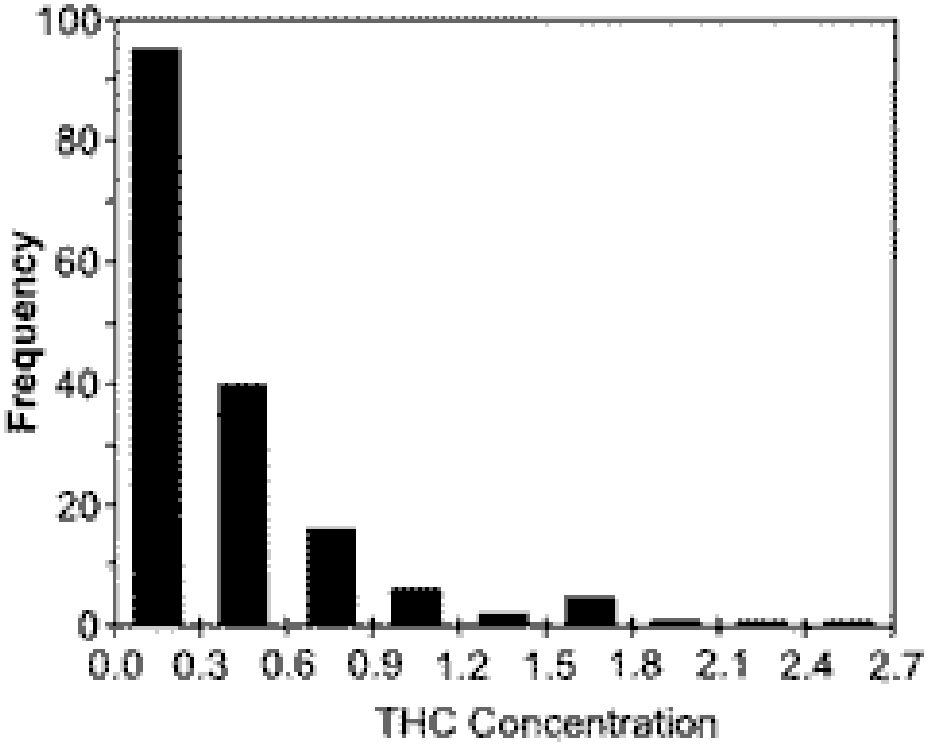
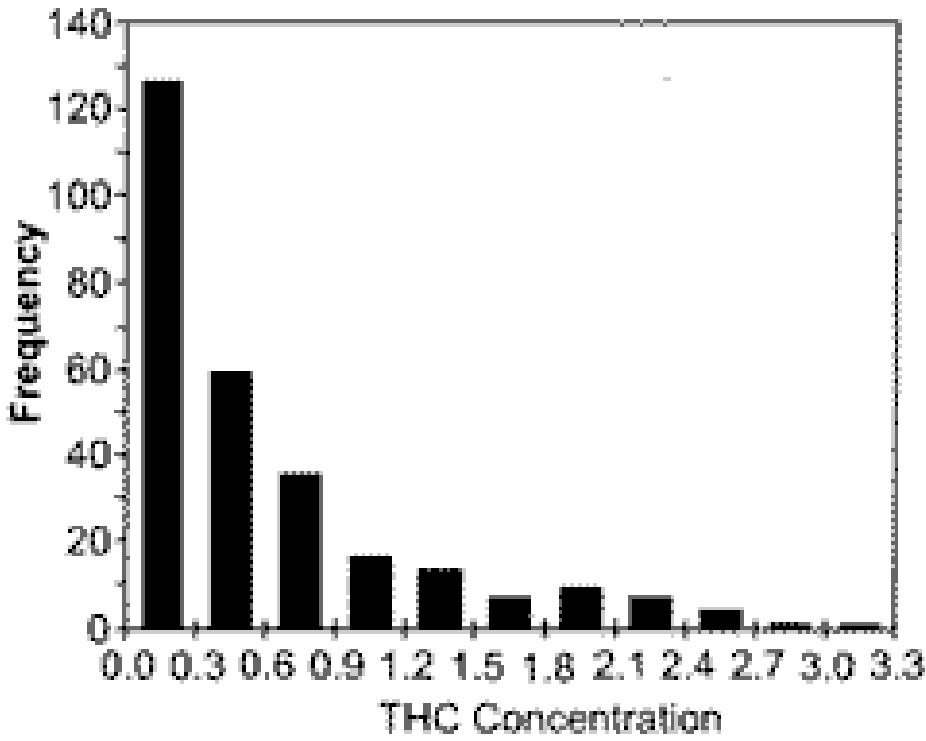
Why is there a concern about THC with Hemp?





Frequency histograms of THC concentration in germplasm collections.
Left, collection of E. Small and D. Marcus; 43% of the 167 accessions had THC levels >0.3%.
Right, Vavilov Institute, St. Petersburg;
of the 278 accessions about 55% had THC levels >0.3%.
(Small & Marcus, 2002)

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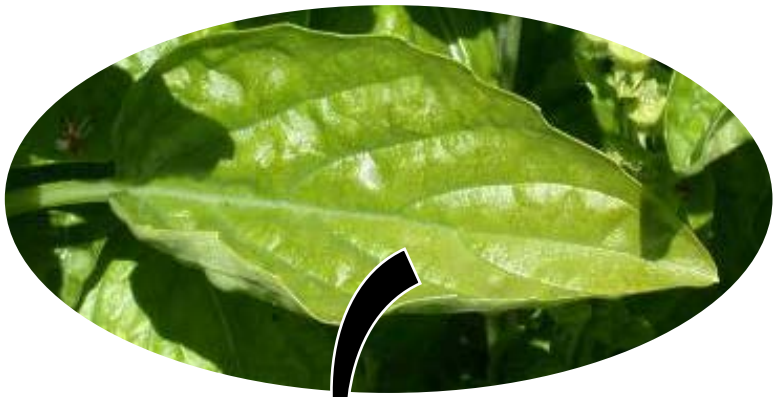
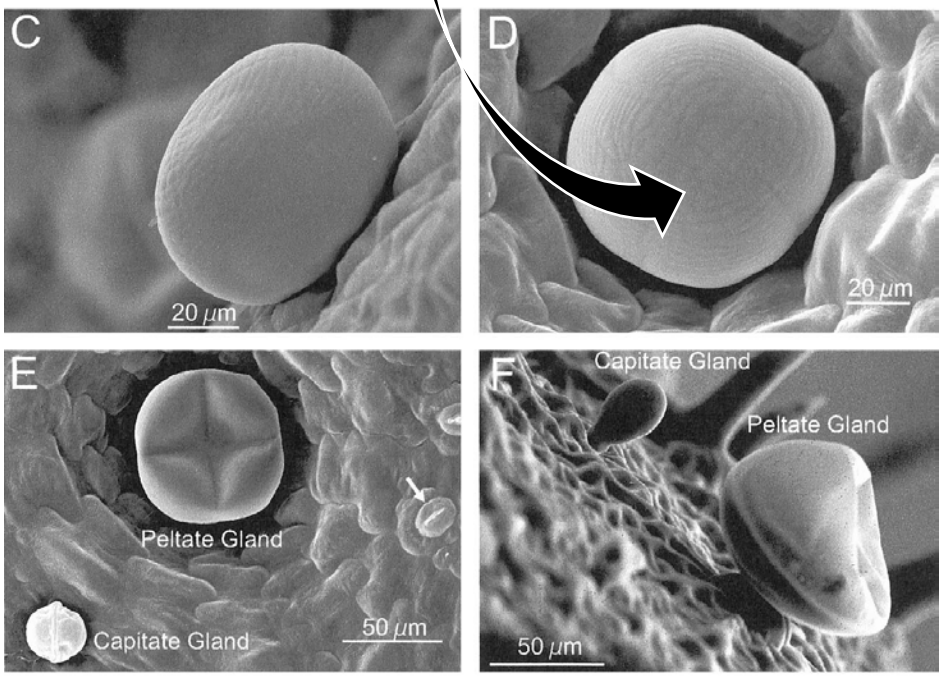
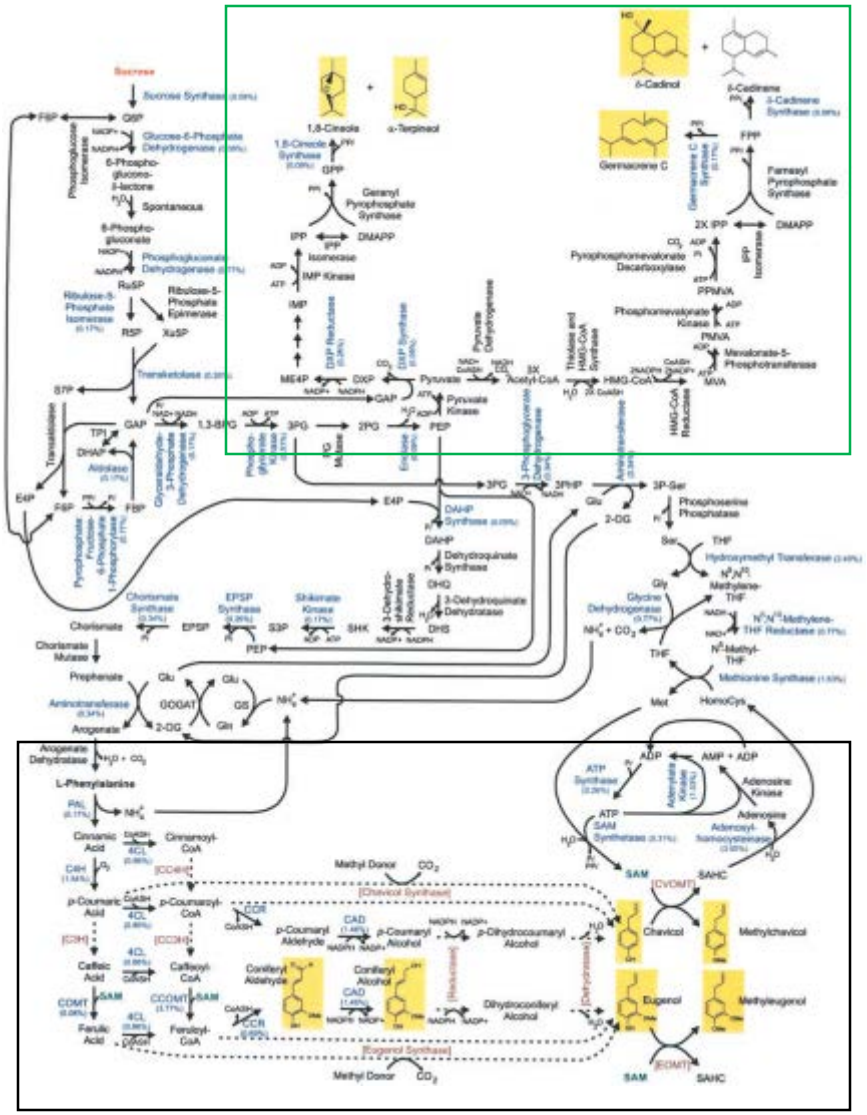
Our Rutgers lab studies and profiles plant volatiles and bioactive terpenes



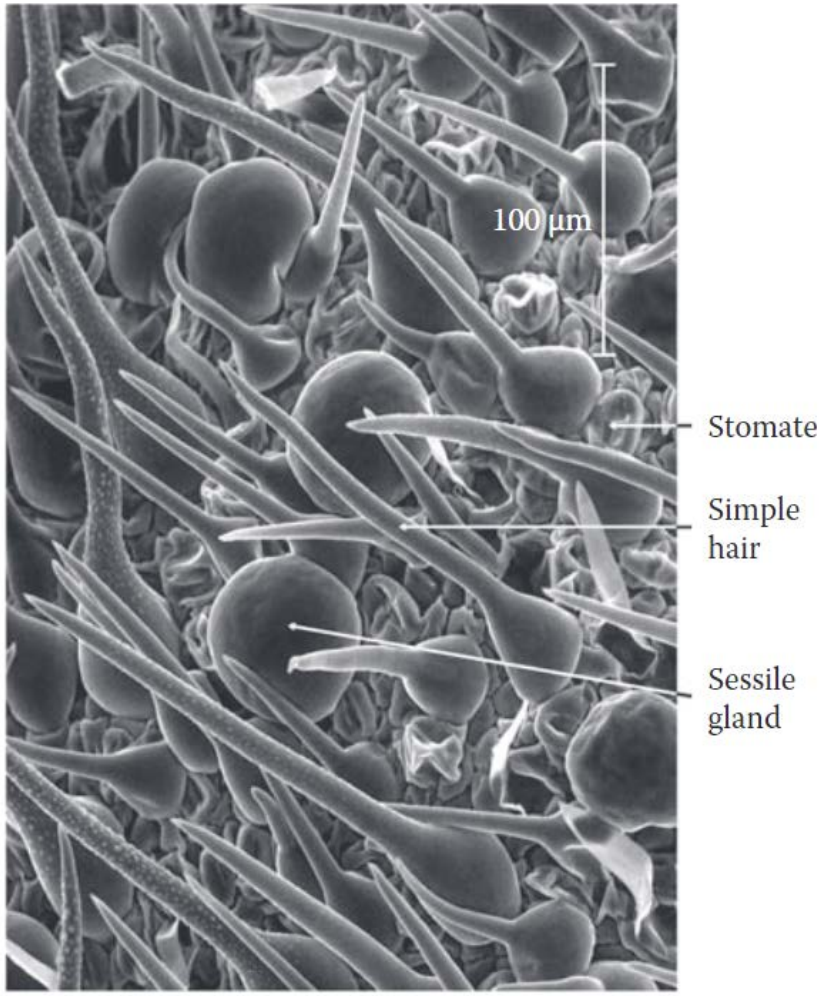




Gang & Simon 2001. Plant Physiol.125 (2): 539-555.

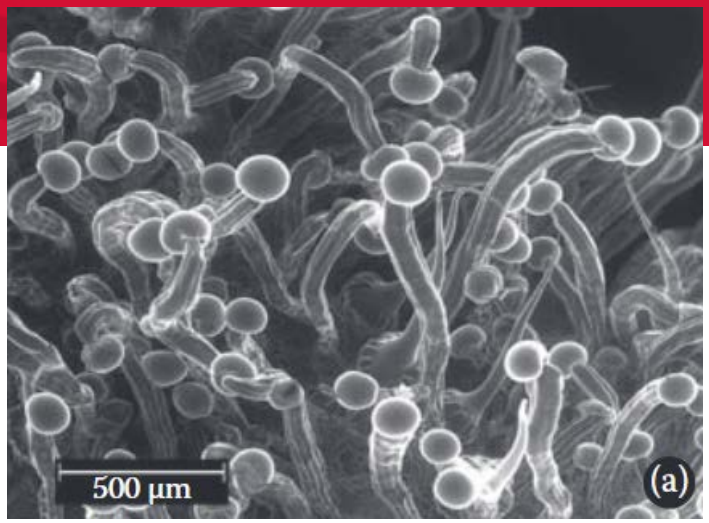
Revisiting hemp glandular trichomes

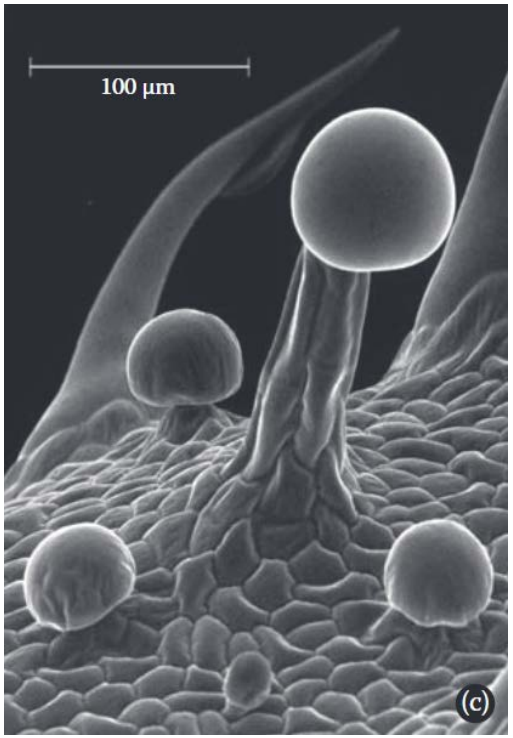
- Genetic and environmental factors affect the distribution of trichomes and biosynthesis of cannabinoids
- Manipulating this factor is one approach with selection and breeding that can have impact on breeding for high or low levels of cannabinoids
- Glandular trichomes, plant's drug factories
- 30% of flowering plants possess glandular trichomes
- Produce secondary, bioactive, metabolites
- Three classes of epidermal secretory glandular trichomes



Type of epidermal structures

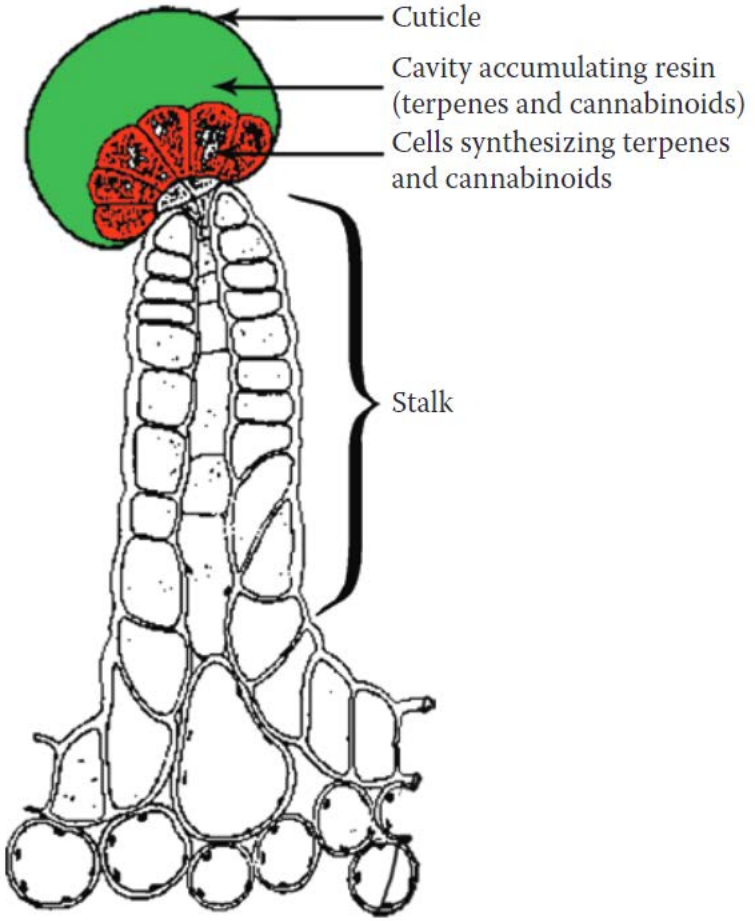
- Scanning electron micrographs from a high THC variety of *C. sativa*
- Stalkless or sessile type, may have a very short stalk (c)
- Long-stalked glands (a) and (c), at the center of the image (c)
- Non-glandular hair, on the background of (c)





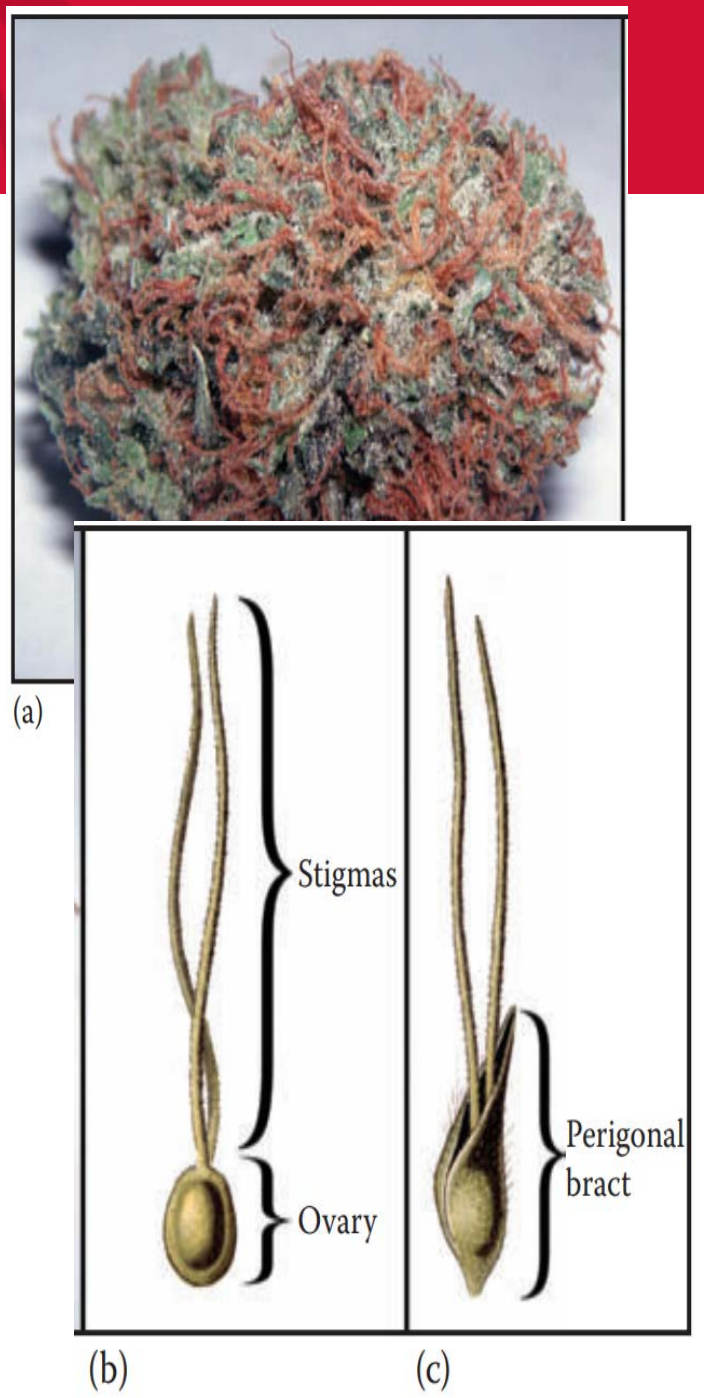
Site of Cannabinoid synthesis

- Anatomy of a long-stalked secretory gland
- Glandular head and stalk
- The cells of the glandular head produce the resins (red), that contains terpenes and cannabinoids
- Resin is excreted and accumulated in the cavity (green)
- That resin is what you touch and feel with the ‘buds’



Site of THC accumulation

- a. Buds
- b. Actual female flower, devoid of THC, so defining or characterizing marijuana as the flowers not quite botanically correct.
- c. The bracts (modified specialized leaves associated with flowers) are the structures that accumulates most of the THC.
- Female flowers of cannabis lack sepals and stamens lack typical petals.
- A female flower is inside a surrounding perigonal bract.
- The perigonal bracts contain the majority of the bud's THC but are not visible in (a) as they are nestled deeply amidst tiny leaves. The reddish-brown threads in (a) are dried, overmature stigmas, shown in the fresh, green stage in (b).



THC content in the plant

- Absolute cannabinoid content varies in different parts of the plant
- 10–12% in pistillate flowers
- 1–2% in leaves
- 0.1–0.3% in stalks
- < 0.03% in the roots
- None in actual seed

[Actual procedure in sampling rather critical]

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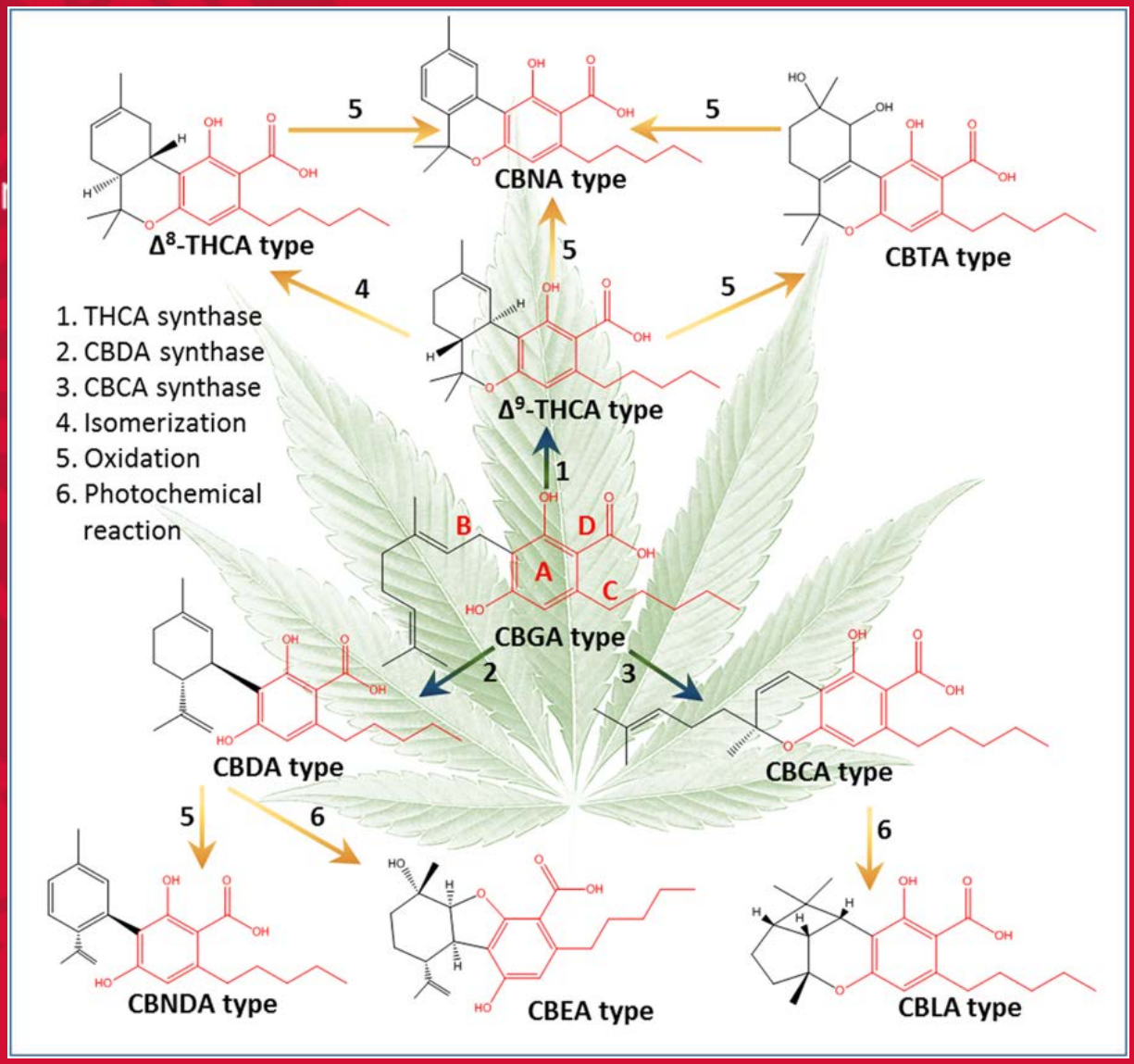

Phytocannabinoid biosynthesis and degradation routes and products. The most prevalent acid components are presented for each type of phytocannabinoid. In general, CBG, Δ9-THC, CBD and CBC phytocannabinoid subclasses are biosynthesized in *Cannabis* plants, while the other subclasses are probably the result of decomposition either in the plant or due to poor storage conditions following harvest.

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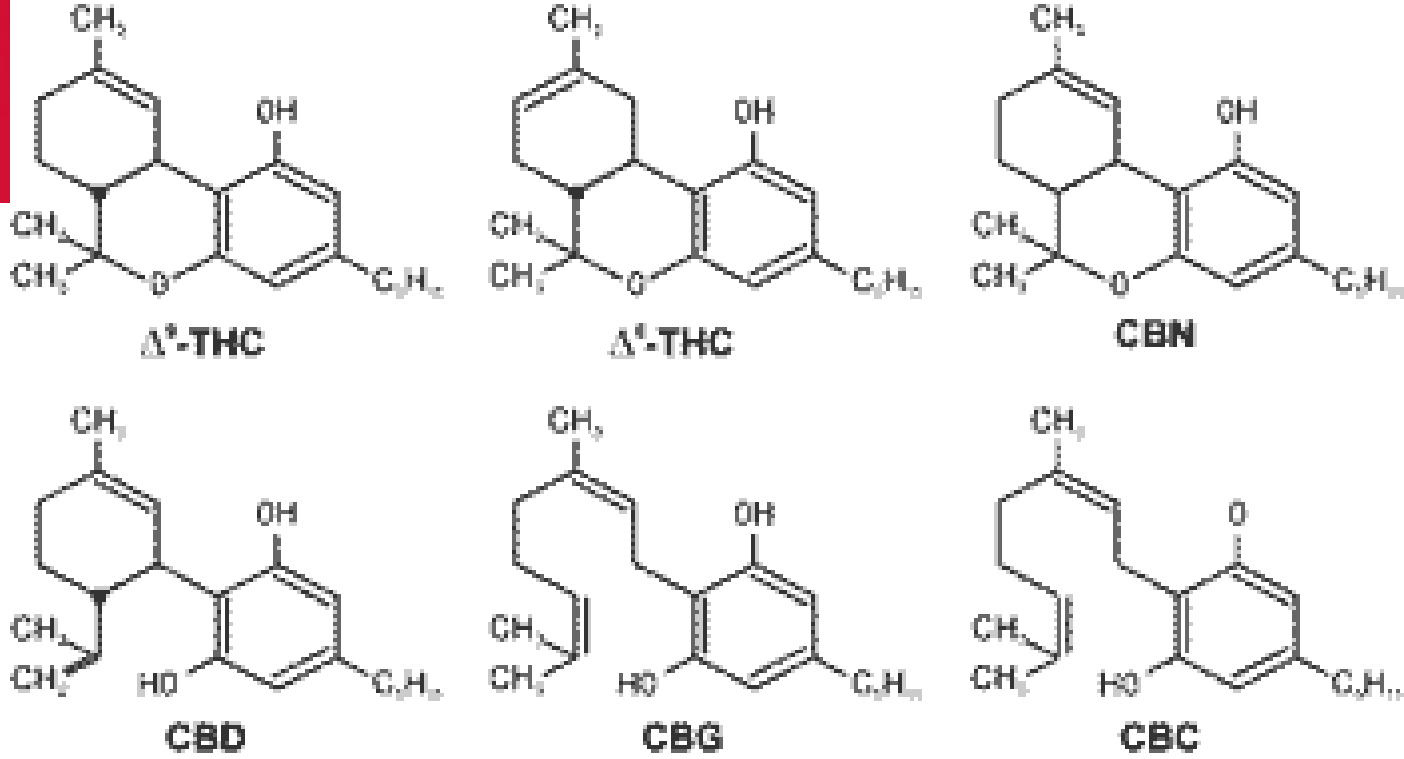

Of the >550 metabolic constituents in hemp, >140 cannabinoids of cannabis have been identified- with many more likely to be identified. Key ones include D9-THC (delta-9 tetrahydrocannabinol), the chief intoxicant chemical and predominates in intoxicant strains; the isomer D8-THC was previously considered to be found in trace amounts. CBD (cannabidiol) is the chief non-intoxicant chemical, and predominates in non-intoxicant strains- or in hemp.The non-intoxicant CBN (cannabinol) is a degradation/oxidation product. Non-intoxicant cannabichromene (CBC) is a trace compound in intoxicant strains. Non-intoxicant cannabigerol (CBG) is considered

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- The principal phytocannabinoids appear to be delta-9-tetrahydrocannabinol (i.e. Δ9-THC, THC), CBN, and cannabidiol (CBD)

- Other phytocannabinoids found in cannabis include cannabigerol (CBG), cannabichromene (CBC), tetrahydrocannabivarin (THCV) and many others

- In the living plant, these phytocannabinoids exist as both inactive monocarboxylic acids (e.g. tetrahydrocannabinolic acid, THCA) and as active decarboxylated forms (e.g. THC); however, heating (at temperatures above 120 ° C) promotes decarboxylation (e.g. THCA to THC)

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Inspection, Sampling and Testing Protocol

- **Required Testing Results for Out-of-Program Material:**
  - Ensure that the final product batch of any processed hemp, such as floral extracts, maintains the federal delta-9 THC concentration limit of 0.3 percent
  - Seeds must have third-party germination study carried out, and render 0% germination level using roasting or toasting methods
  - Processors need to label hemp products with the amount of oil or extract, the percentage of THC, and the percentage of CBD extract
  - Additionally, labeling must distinguish between hemp extract, CBD, or hemp oil

From New Jersey Hemp Program N.J.A.C. 2:25-1 et seq.

From "2020 New Jersey Hemp Testing Guidelines" , NJDA, New Jersey Hemp Farming Act,https://www.nj.gov/agriculture/divisions/pi/pdf/HempTestingGuidelines.pdf

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Hemp Seeds

- Hemp seeds are a product of commerce
- Hemp seeds contain virtually no THC, but THC contamination results from contact of the seeds with the resin secreted by the epidermal glands on the leaves and floral parts, and also by the failure to sift away all of the bracts (which have the highest concentration of THC of any parts of the plant) that cover the seeds
- Hemp seeds can be cleaned, processed, ground and/or pressed for hempseed oil used in foods and beverages

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Fatty Acid Composition of Hempseed oil

	Fatty acid composition (%)						
Fatty acid	**Felina 34**	**Beniko**	**Fedora 19**	**Futura 77**	**Zolotonosha 11(LR)**	**Zolotonosha 13(LR)**	**Typical canola**
Palmitic (16:0)	**5.4**	**5.5**	**5.5**	**5.6**	**5.4**	**5.6**	**3.2**
Palmitoleic (16:1)	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**
Stearic (18:0)	**2.8**	**2.8**	**2.8**	**3.1**	**2.9**	**2.9**	**1.2**
Oleic (18:1)	**11.8**	**12.2**	**12.0**	**12.8**	**12.1**	**12.2**	**55.6**
Linoleic (18:2)	**56.1**	**56.4**	**56.1**	**54.6**	**55.6**	**55.6**	**21.7**
Gamma linolenic (γ18:3)	**2.1**	**2.1**	**2.0**	**1.5**	**2.2**	**2.2**	**--**
Linolenic (α18:3)	**18.5**	**17.8**	**18.1**	**19.2**	**18.4**	**18.1**	**12.9**
Arachidic (20:0)	**0.8**	**0.8**	**0.8**	**0.8**	**0.4**	**0.8**	**0.6**
Eicosenic (20:1)	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**2.2**
Behenic (22:0)	**0.3**	**0.3**	**0.3**	**0.6**	**0.3**	**0.3**	**0.3**
Lignoceric (24:0)	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.4**
Others	**1.4**	**1.3**	**1.6**	**1.3**	**1.5**	**1.5**	**--**
Erucic	**--**	**--**	**--**	**--**	**--**	**--**	**1.5**

The fatty acid of the seeds compare favorable to that of canola, and also contain low amounts of GLA. The oils also contain various anti-oxidants, including tocopherols and sterols (Blade et al., 1999).

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Inspection, Sampling and Testing Protocol

Hemp Testing Laboratories are encouraged to adhere to ISO 17025, **but are not required by the USDA**

- **Laboratories Approved for THC testing MUST**:
  - Be registered with the Drug Enforcement Administration (DEA) to handle controlled substances under the Controlled Substances Act (CSA), 21 CFR 1301.13
  - Be registered with the NJ Hemp Program as a Handler
  - Comply with the Departments testing procedures
  - Directly transmit results to the Department
  - Submit to random quality assurance testing by the Department to validate the accuracy of testing results

From New Jersey Hemp Program N.J.A.C. 2:25-1 et seq.

From “2020 New Jersey Hemp Testing Guidelines” , NJDA, New Jersey Hemp Farming Act, https://www.nj.gov/agriculture/divisions/pi/pdf/HempTestingGuidelines.pdf

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NJAES Hemp Team Can Provide Support to Growers and the State by:

- Analyzing samples for THC & CBDs

We have the state of art analytical instrumentation including High performance liquid chromatography (HPLC/MS and Q-TOF/HPLC/MS) and an Ultra-Performance Liquid Chromatography (UPLC/QQQMS) allowing us to comply with THC testing procedures that use decarboxylation

- We can screen samples for cannabinoids in hemp (THC and CBDs) from field or greenhouse through postharvest handling and processing to final product evaluation/testing.
- Ensuring all samples tracked and archived using LIMS system and even subsampled for other certified labs.
- We can analyze the fatty acid composition of hemp and seed oil using our GC/MS
- We can analyze the aromatic terpenes with our GC/MS
- Other groups at Rutgers may be able to provide analytical support for heavy metals, pesticide residues and mycotoxins.
- Other NJAES team members poised and ready to conduct supportive field studies to assist growers in evaluation of hemp production systems.

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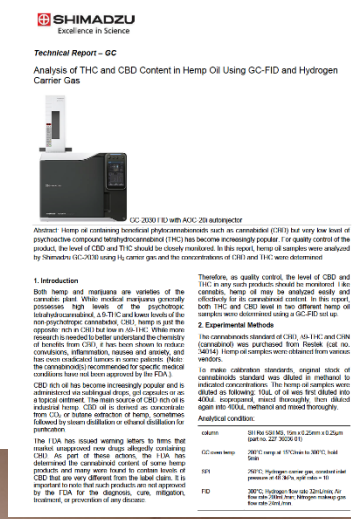
Chemically characterizing the aroma, flavor and fatty acids in Hemp: By GC/MS

- GC/MS, SPME or Headspace Volatile Capture and Analysis used to determine aroma composition and fatty acid composition in hemp and can analyze THC and CBD.
- SCFA and aromatic compounds can rapidly be analyzed using our Shimadzu GCMS-TQ8040 Triple Quadrupole MS interfeaced with a Shimadzu AOC6000 autosampler allowing us to us to detect very low concentrations.

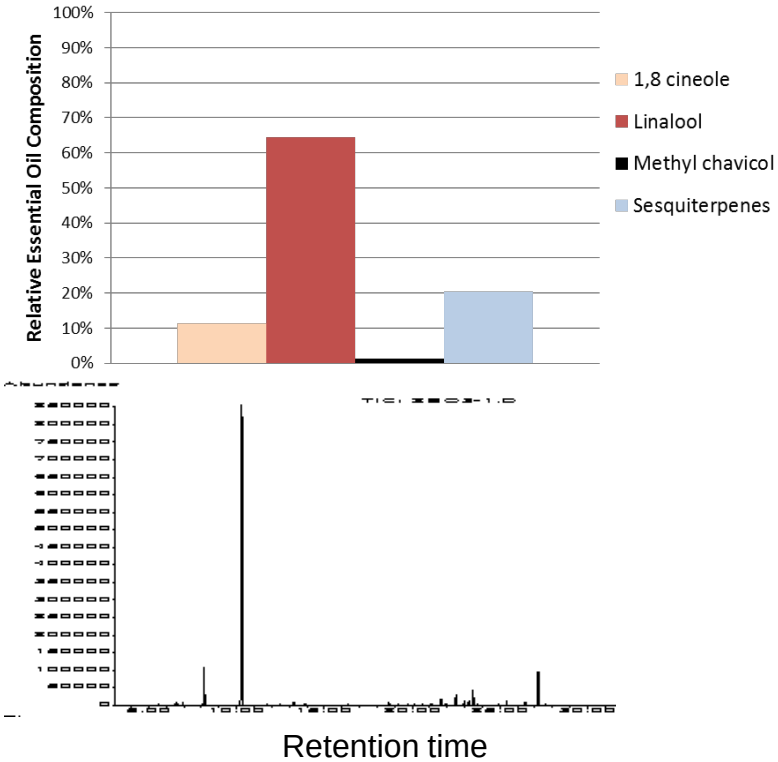


SHIMADZU
Excellence in Science

Technical Report – GC

Analysis of THC and CBD Content in Hemp Oil Using GC-FID and Hydrogen Carrier Gas

GC-2030 FID with AOC-20i autoinjector



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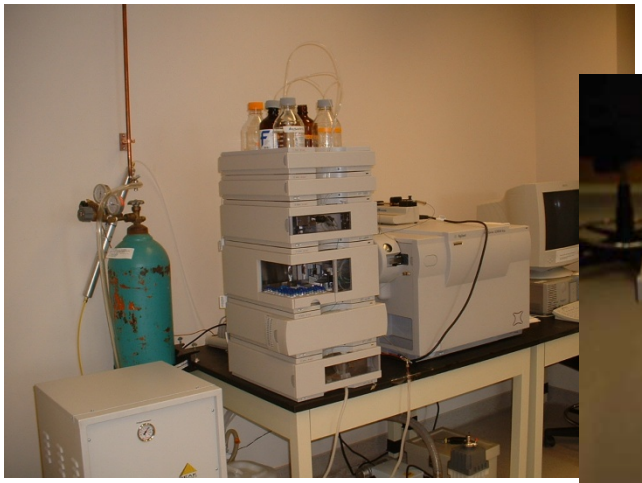
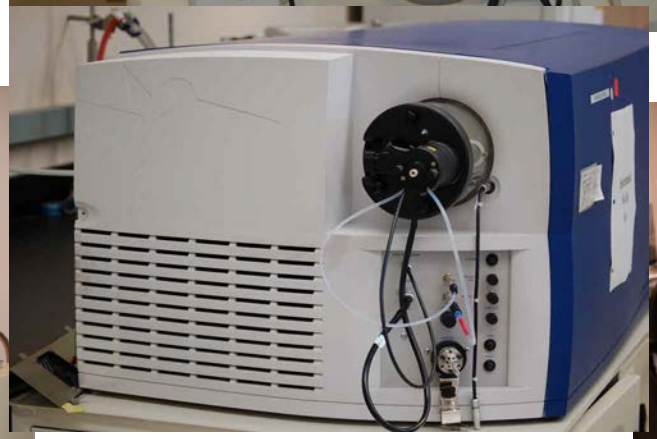
Our lab: Searches for new bioactives, then profiles and screens





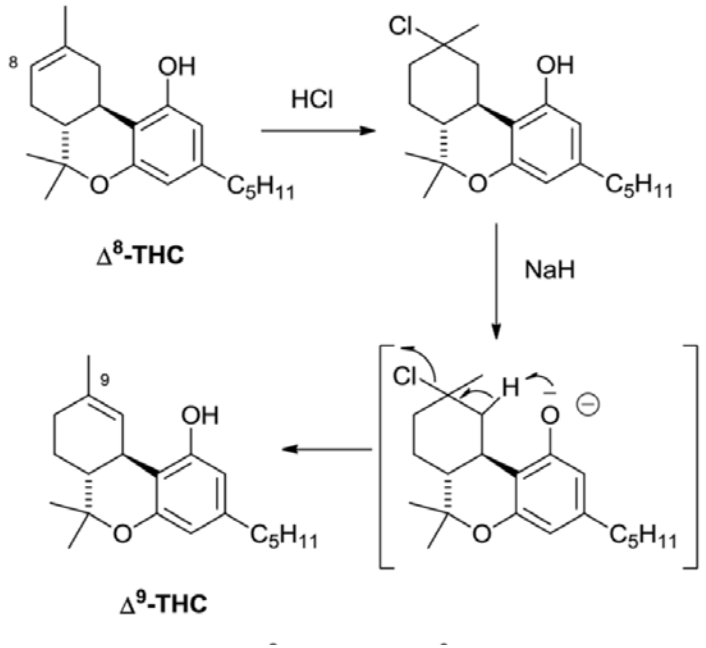
Our analytical Instruments can quantitate THC & cannabinoids

-The D8 location is thermodynamically more stable than the D9 location

-D8-THC and D9-THC show a similar profile of activity on cannabinoid receptors, with D8-THC being only slightly less active than D9-THC

-Compounds from the D8 series can be converted into their D9 isomers by addition of hydrochloric acid and base-mediated dehydrohalogenation

-This reaction is of great relevance, since D8-THC is much easier to synthesize than D9-THC



Conversion of D8-THC into D9-THC

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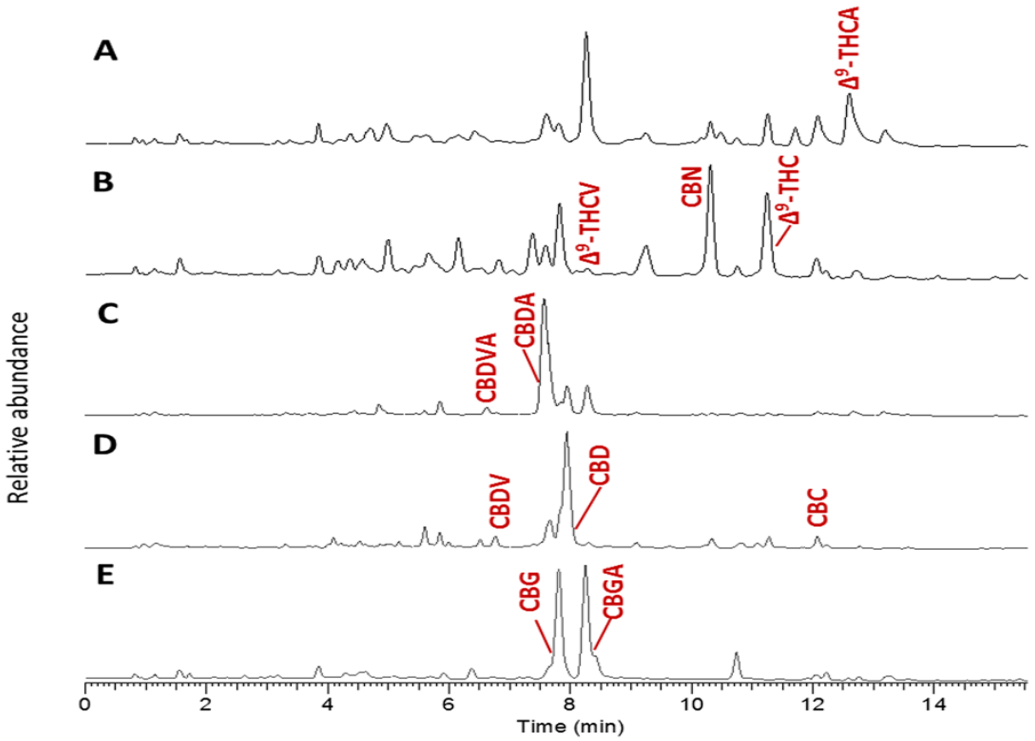
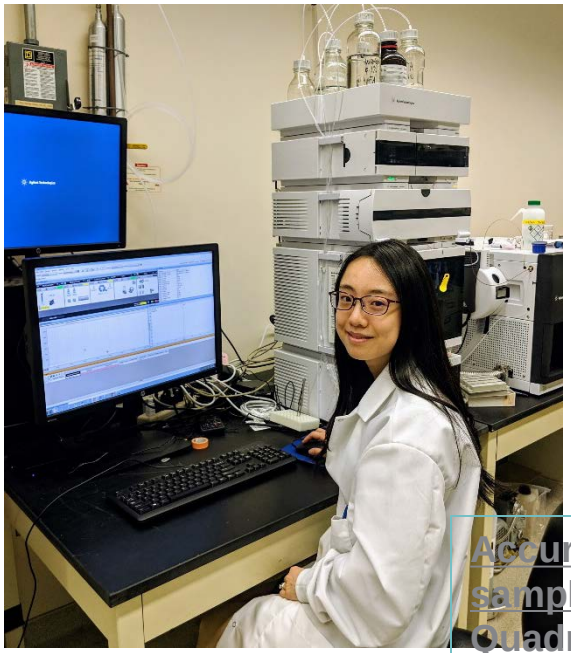
Illustrative example of quantitation of hemp bioactives





LC/MS TIC of (A) untreated and (B) decarboxylated high-Δ9-THCA; (C) untreated and (D) decarboxylated high-CBDA; and (E) partly decarboxylated high-CBGA Cannabis strains

Accurate quantitative analysis of natural products in plant or in biological samples: Agilent 1290 Infinity II UHPLC interfaced with **an Agilent 6470 Triple Quadrupole MS with ESI.**

Microbial contamination

- Microbiological contaminants pose a potential threat and processors need to check for microbes and mycotoxins
- Bacteria and fungi may cause opportunistic infections in immunocompromized individuals
- Total aerobic microbial count (TAMC): <100 CFU/g
- Total yeast and mold count (TYMC): <10 CFU/g
- Total coliforms
- *Escherichia coli* (toxin producing <1CFU/g)
- *Salmonella* spp. (<1CFU/g)

Heavy metals

From Health Canada:

- Arsenic (0.14 µm/kg body weight per day),
- Cadmium (<0.09 µm/kg),
- Lead (<0.29 µm/kg),
- Mercury (<0.29 µm/kg).

Product Specification sheet: *Cannabis* ssp. *sativa*, variety Bedrocan (hemp flowers)
Market: to be sold on the pharmaceutical market. Strength: THC: approx. 22% cannabidiol: <1.0%

Take Home Message:
TEST!
And
Ensure you keep all your documentation!

	Method	Specification	
P. aeruginosa, S. aureus and Bile tolerant gram neg bacteria	5.1.4.-1.	Absent	
Absence of heavy metals			
lead	Ph. Eur (current ed.) "Heavy metals in herbal drugs and fatty oils" (monograph)	max. 20.0	ppm
mercury		max. 0.5	ppm
cadmium		max. 0.5	ppm
arsenic (indicative)		-	
nickel (indicative)		-	
zinc (indicative)		-	
Absence of aflatoxines	Ph. Eur (current ed.) "Determination of aflatoxins B_1, B_2, G_1 and G_2 in herbal drugs" (2.8.18)	<4	µg/kg
Loss on drying	Ph. Eur (current ed.) "Loss on drying" meth. C (2.2.32)	≤10.0	%
Assay (UPLC)			
fingerprint	Monograph	similar	
dronabinol (THC)	Monograph	approx. 22	%
cannabidiol (CBD)	Monograph	<1.0	%
Related substances (UPLC)			
cannabinol (CBN)	Monograph	<1.0	%

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Acknowledgements

- **New Jersey Agriculture Experiment Station**
- **Rutgers Natural Plant Products Program (NUANPP)**
- **Center for Food Systems Sustainability, Institute for Food, Nutrition & Health (IFNH)**
- **Rutgers Center for Sensory Sciences and Innovation (CSSI)**
- **Shimadzu Analytical Instruments**
- **Agilent Analytical Instruments**

For information on analytics, postharvest & quality control:

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