An Evaluation of Growing Environment on the Production of Secondary Metabolites in Cannabis

Scott Churchill
VP of Scientific Development
MCR Labs

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Introduction

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Background

- Cannabis cultivation options
- Environmental impact
- Plant compound production?

Variables

- Plant genetics
- Nutrition/irrigation
- Lighting due to plant orientation

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Hypothesis

- Clones sharing the same genetic information will express different secondary metabolites as a function of the environmental conditions that they are grown in

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Design

- Three cultivators
- Five cultivars
- Indoor and outdoor growing environments
- Samples were provided to two labs for analysis

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Methodology

- Targeted quantitative analysis
- Untargeted broad range scan

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Results

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Overview of Findings

- Targeted approach
  - Trends show higher secondary metabolites in samples grown outdoors
- Untargeted approach
  - Greater number of larger oxygenated sugar conjugated species vs lighter oxygenated species such as linalool, terpinolene, and borneol
- Strain specific trends
- Heavy metal observation

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Targeted Data Tables

Sample Name/ Target Analyte WT%	Field Trip 9 Indoor	Field Trip 9 Outdoor	Starfighter Indoor	Starfighter Outdoor	Critical Mass Indoor	Critical Mass Outdoor	SFV Kush Indoor	SFV Kush Outdoor	MOB Indoor	MOB Outdoor
D9 THC	0.5	**0.4**	0.3	**0.5**	3.5	**0.6**	2.1	**1.0**	3.2	**1.0**
THCa	25.0	**27.8**	16.1	**20.4**	16.4	**15.4**	17.0	**18.4**	12.9	**11.4**
CBGa	0.8	**0.9**	0.9	**2.1**	0.5	**0.6**	0.2	**0.4**	0.2	**0.5**
Total Cannabinoids	27.0	**30.1**	17.5	**24.0**	20.8	**17.0**	19.6	**20.8**	17.1	**13.5**
Total Terpenes	1.8	**2.2**	0.9	**1.3**	0.5	**0.9**	0.8	**1.2**	0.9	**1.4**
Total Measured Metabolites	28.8	**32.3**	18.4	**25.2**	21.3	**17.9**	20.4	**21.9**	17.9	**14.9**

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Targeted Data Tables

Sample Name/ Target Analyte PPB	Field Trip 9 Indoor	Field Trip 9 Outdoor	Starfighter Indoor	Starfighter Outdoor
Arsenic	BQL	**ND**	ND	**ND**
Cadmium	125.5	**ND**	181.9	**BQL**
Mercury	BQL	**ND**	BQL	**ND**
Lead	BQL	**BQL**	BQL	**BQL**

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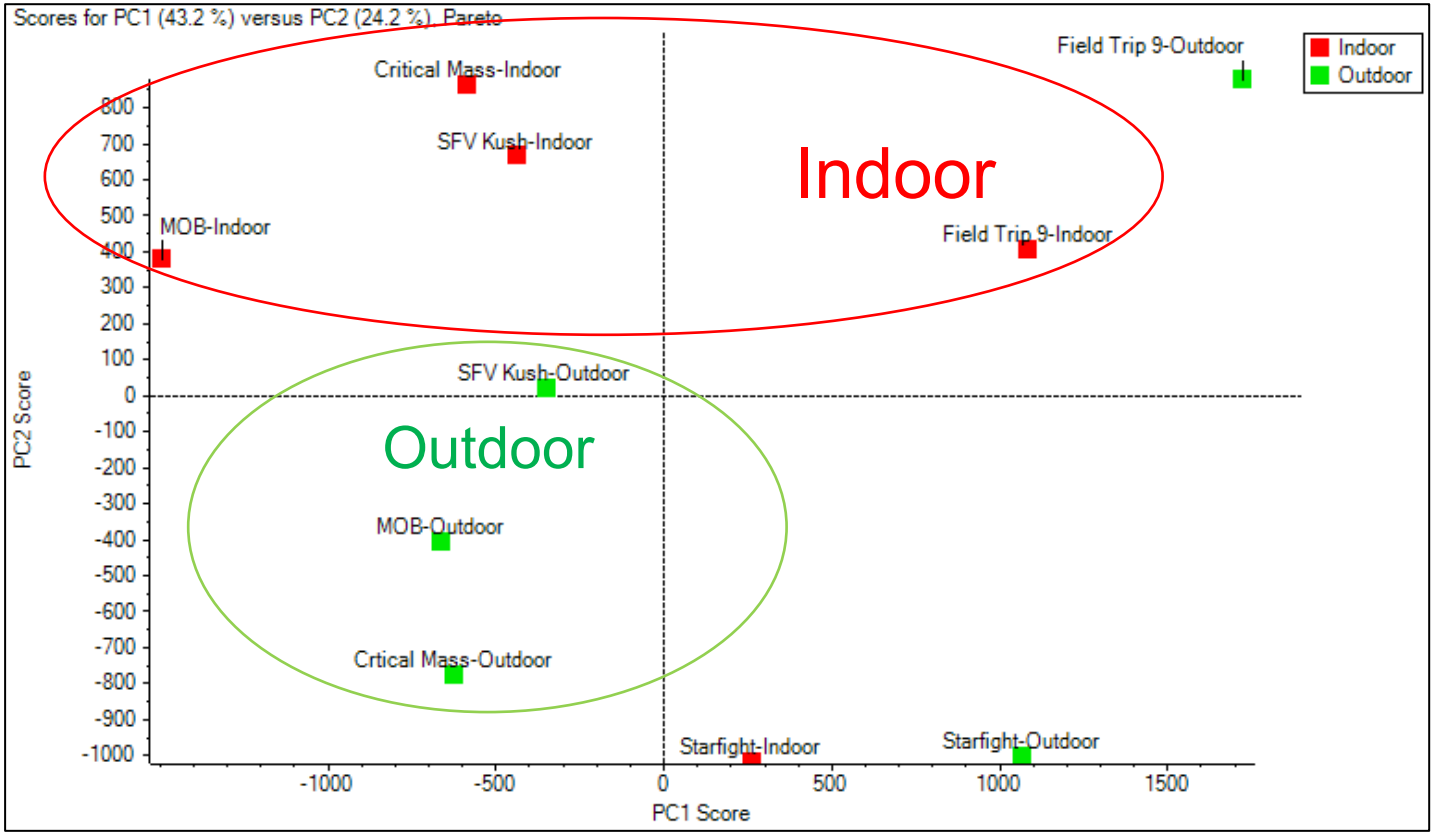
Score Plot – Indoor/Outdoor Differences



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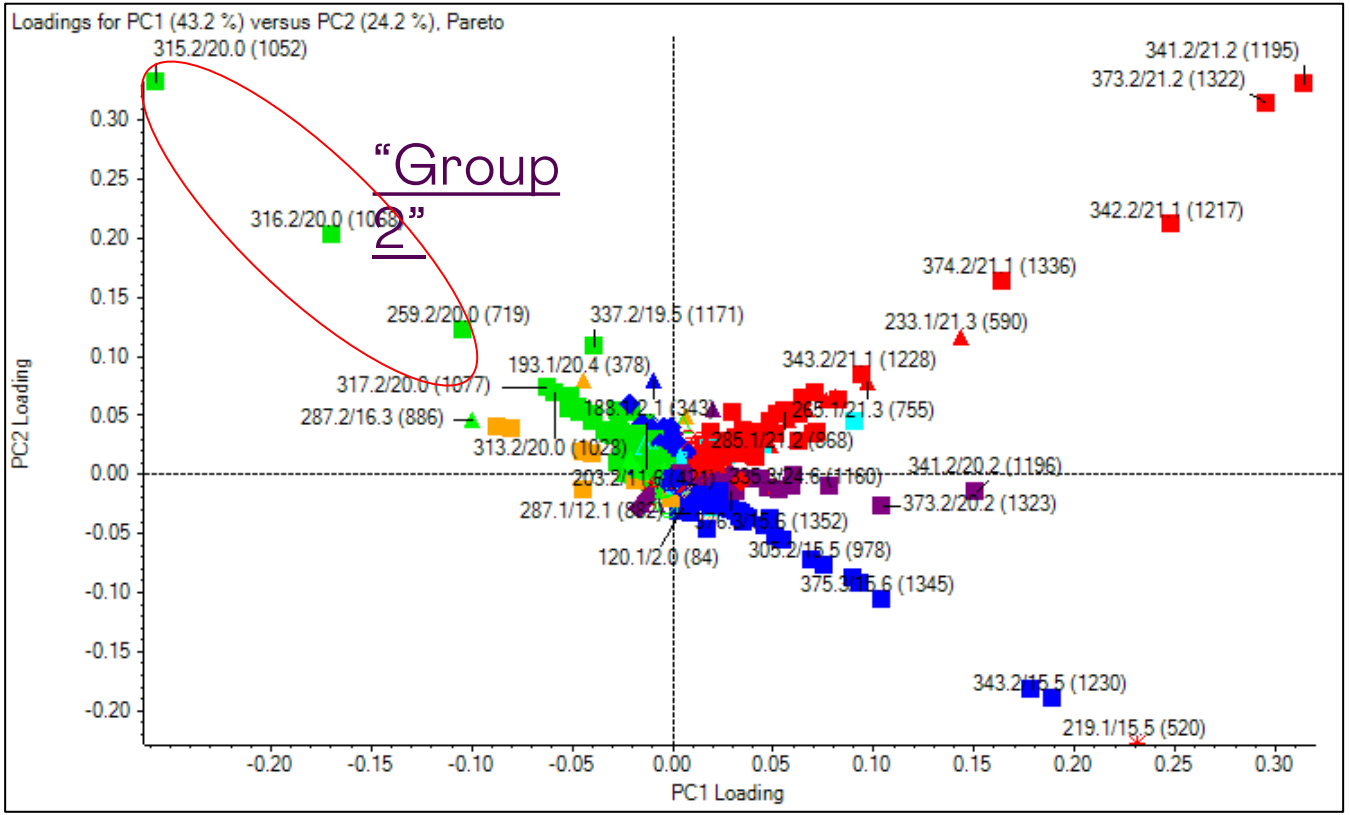
PCA: PC1 vs PC2 – Loadings Plot – Group 2



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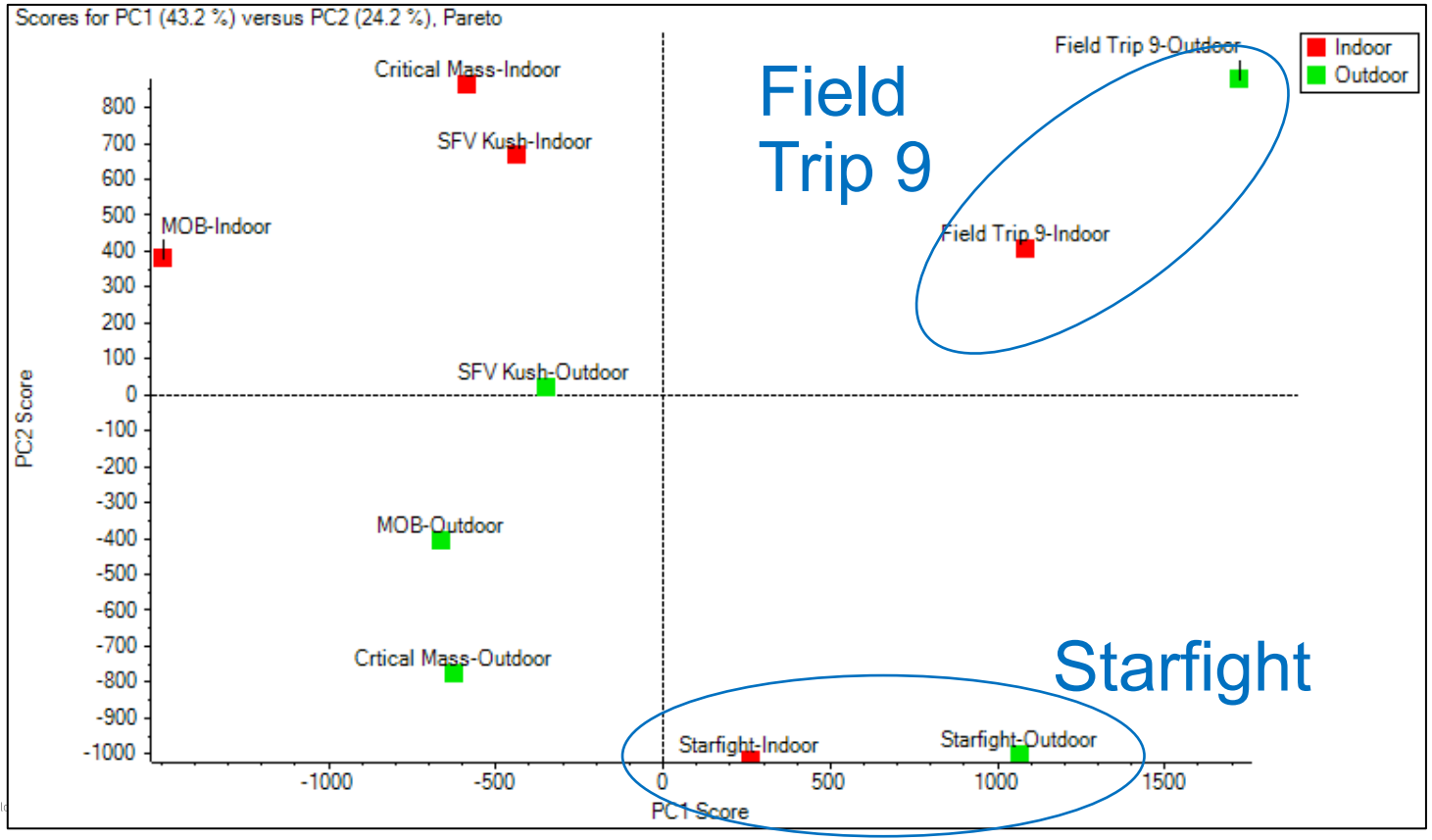
Score Plot – Unique Strains



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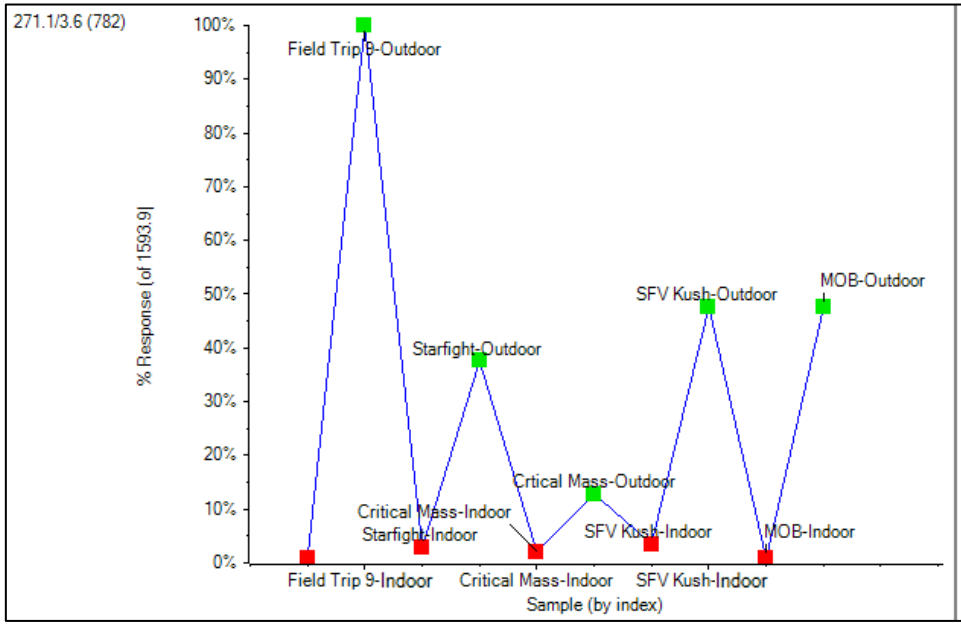
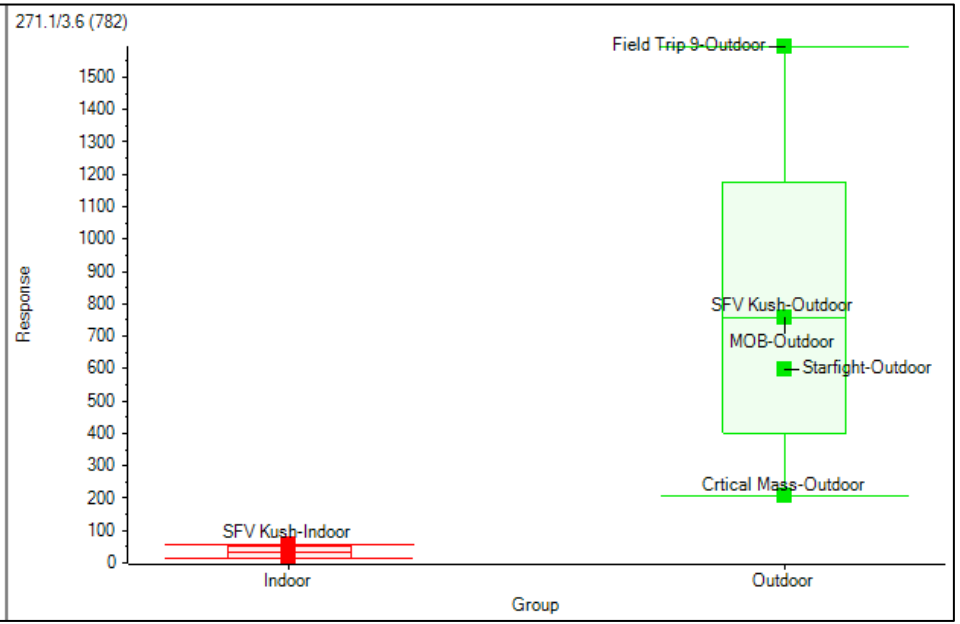
Unknown A: m/z 271.060, RT = 3.6 min





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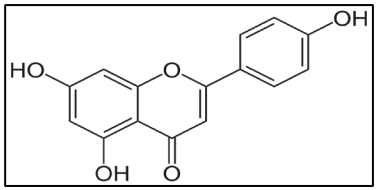
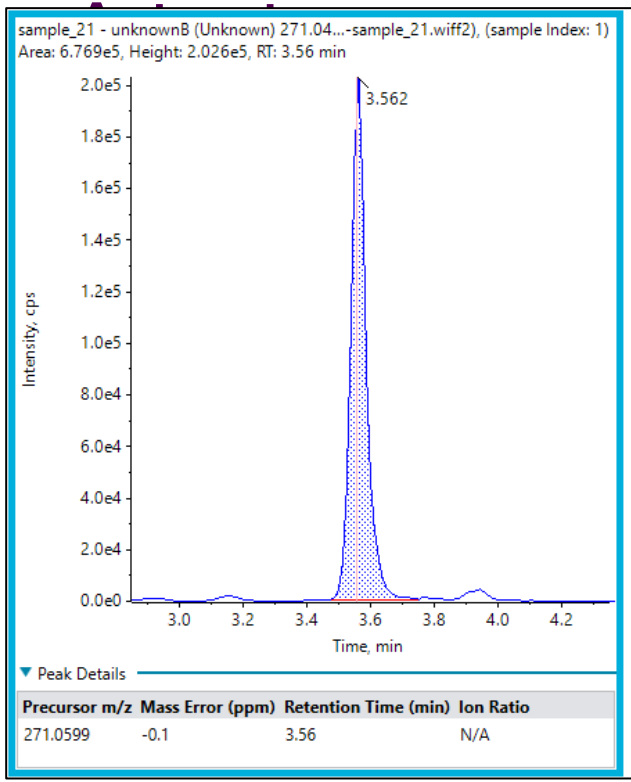
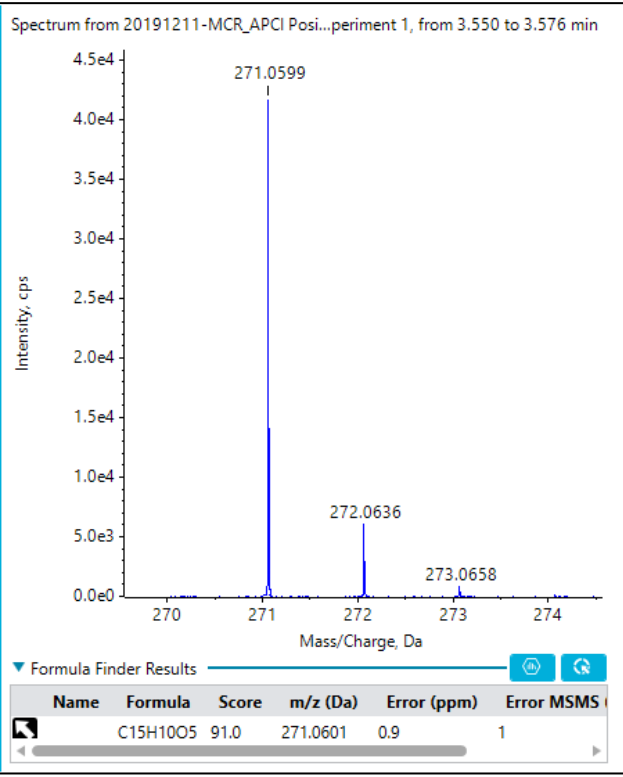
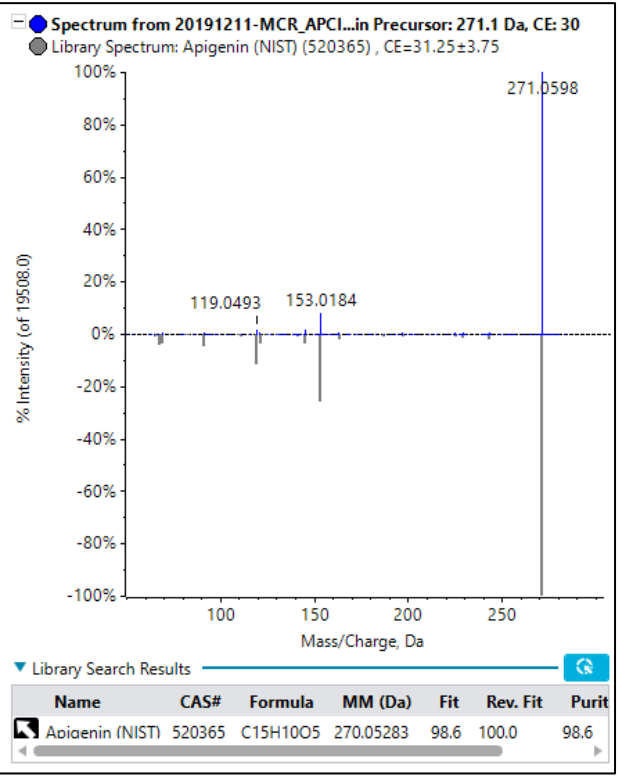


- NIST Library Match =







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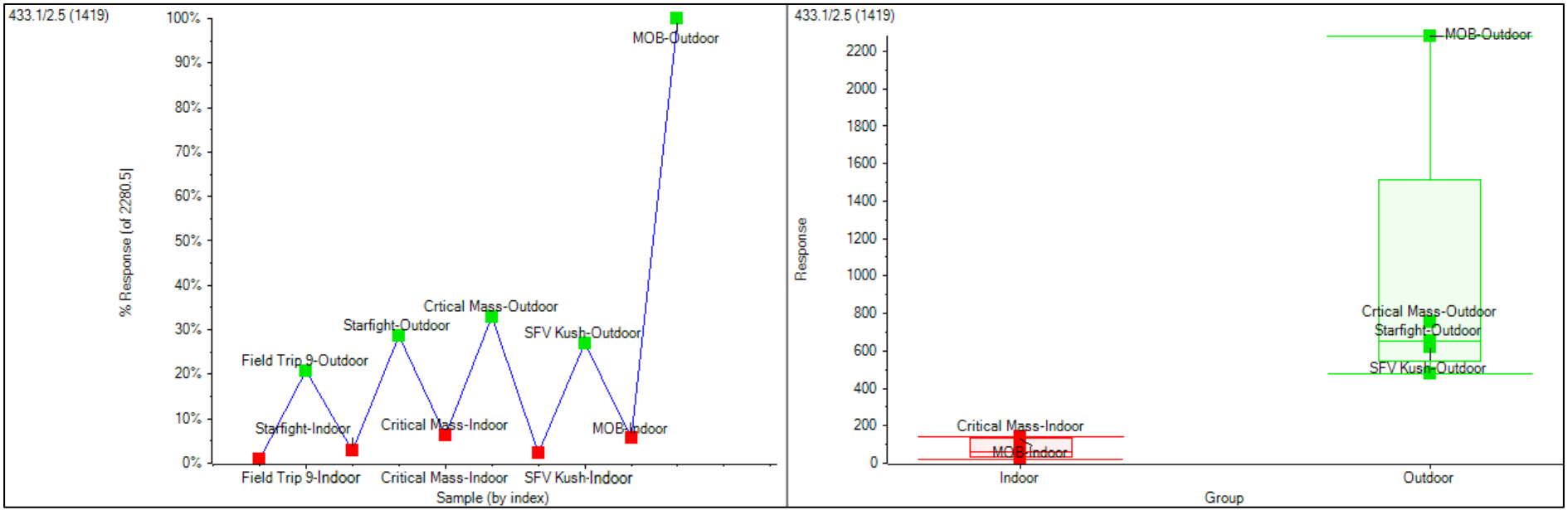

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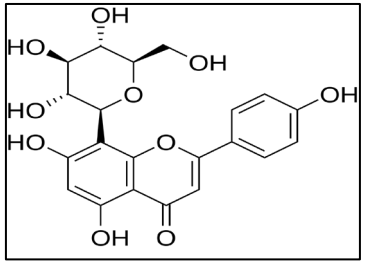
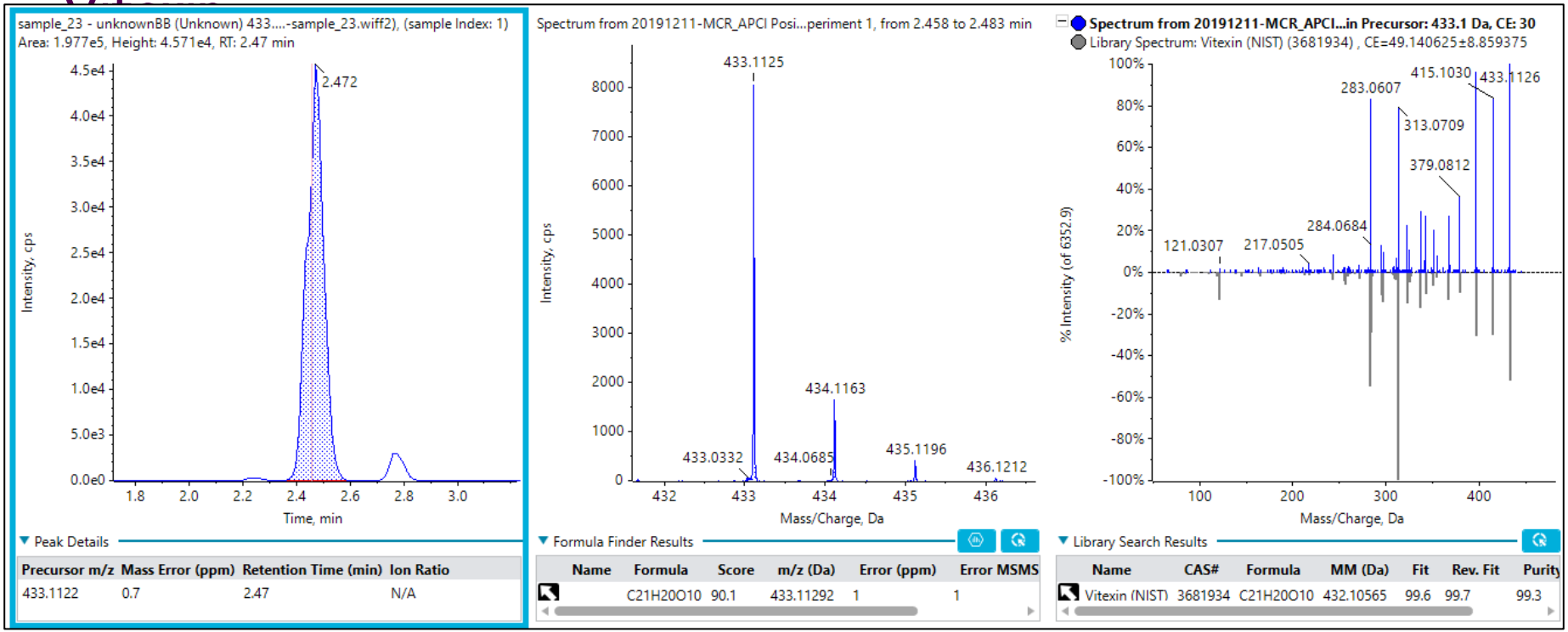
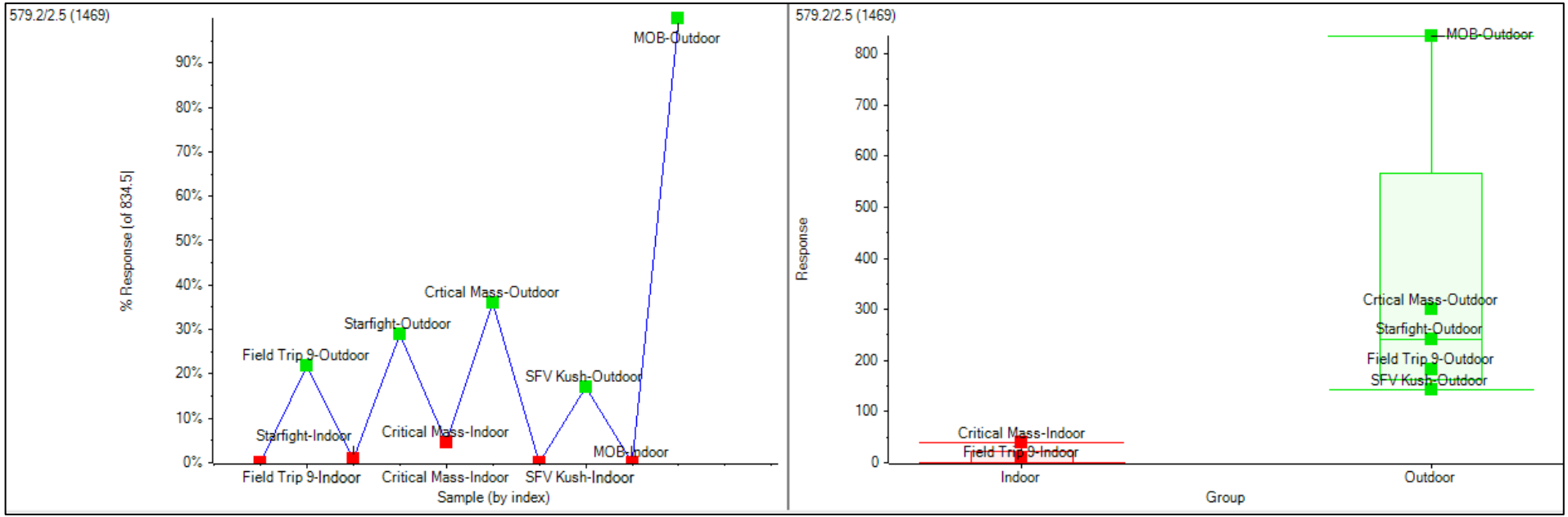


- NIST Library Match = Vitexin



Unknown B Conjugate: m/z 579.1703, RT = 2.5 min



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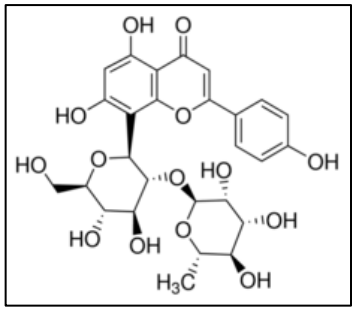
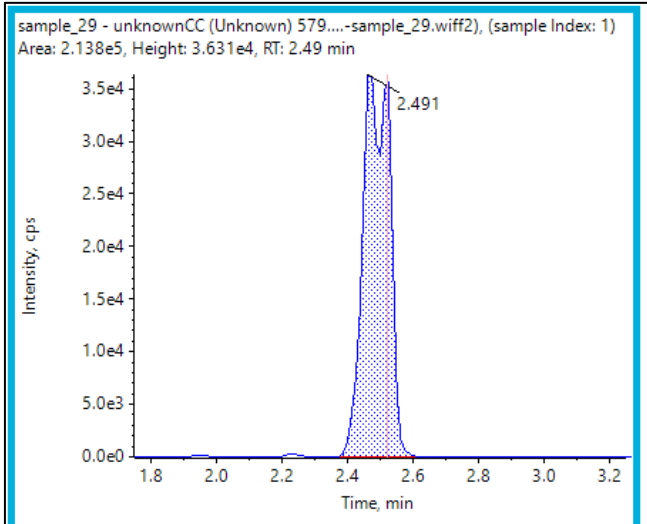
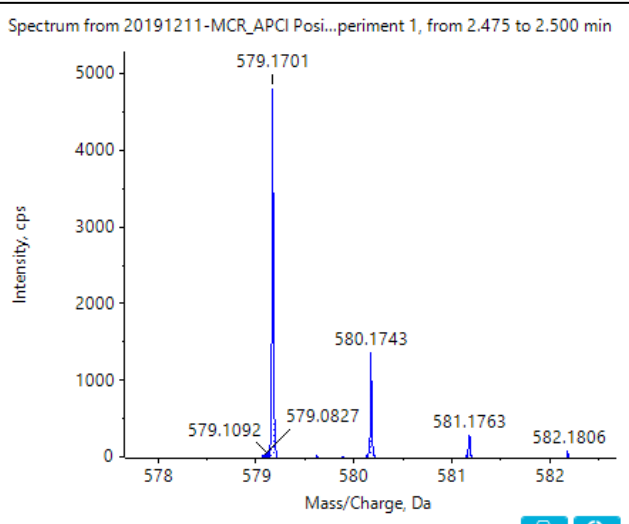
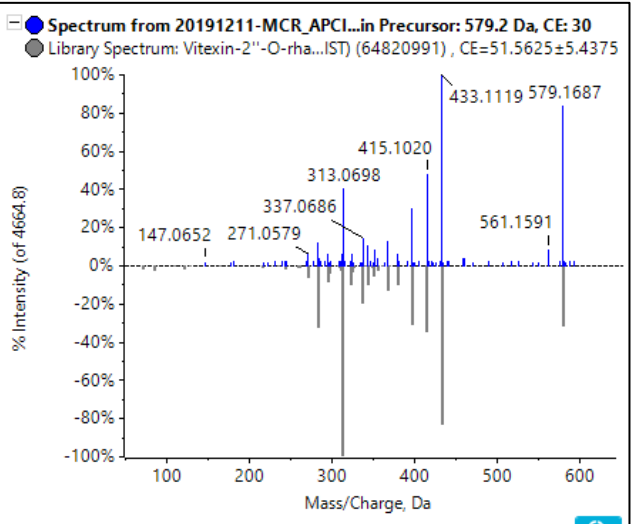
Unknown B Conjugate: m/z 579.1703, RT = 2.5 min



- NIST Library Match = Vitexin-2'-O-Rhamnoside







▼ Peak Details

Precursor m/z	Mass Error (ppm)	Retention Time (min)	Ion Ratio
579.1703	-0.4	2.49	N/A

▼ Formula Finder Results

Name	Formula	Score	m/z (Da)	Error (ppm)	Error MSI
	C32H26N4O5S	89.4	579.16967	0.7	1.7

▼ Library Search Results

Name	CAS#	Formula	MM (Da)	Fit
Vitexin-2''-O-rhamnoside (NIST)	64820991	C27H30O14	578.16357	93.2

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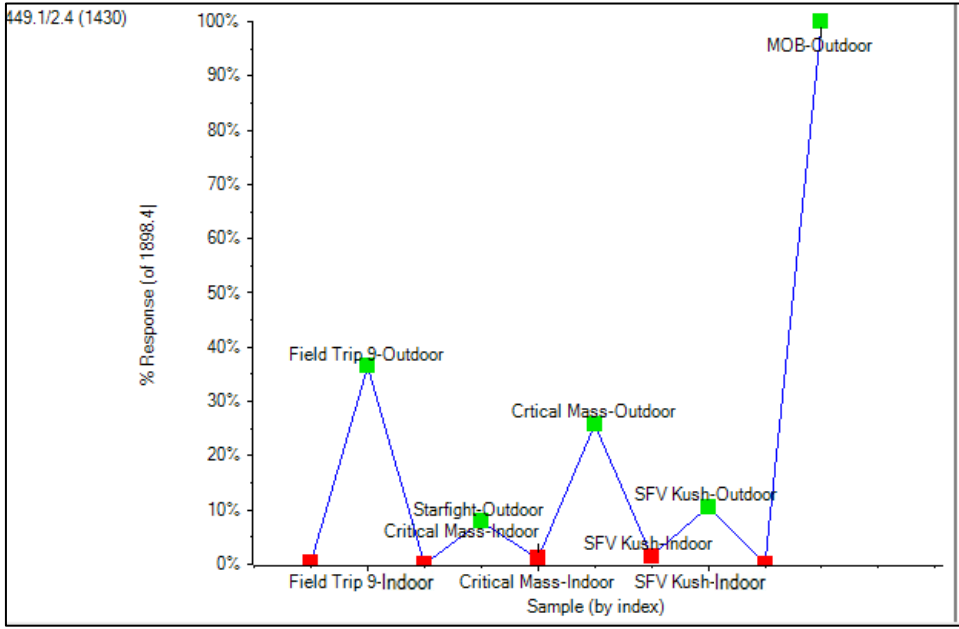
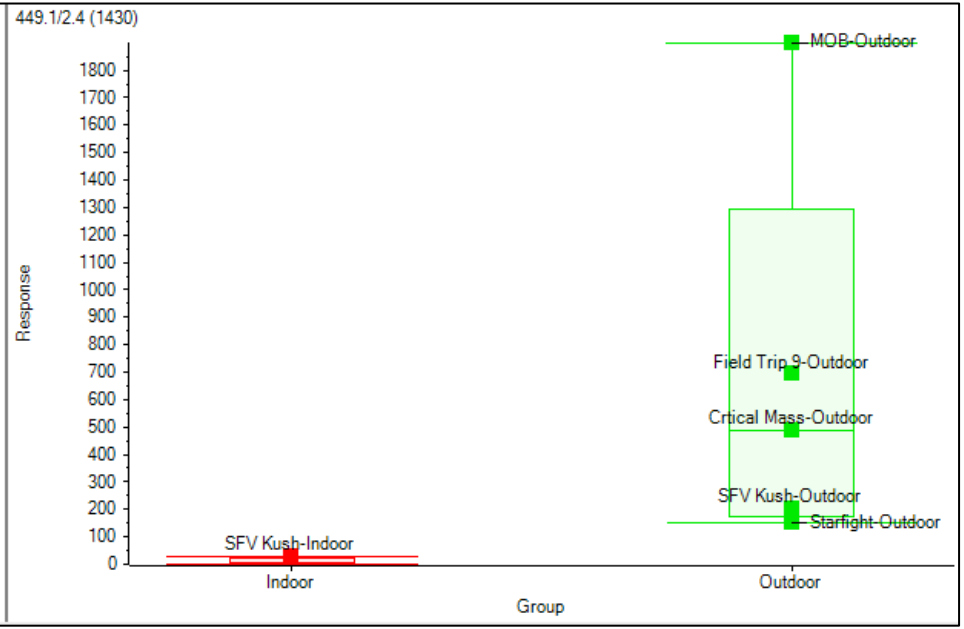
Unknown C: m/z 449.1074, RT = 2.4 min





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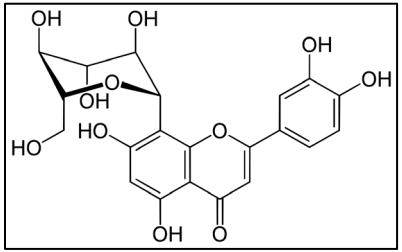
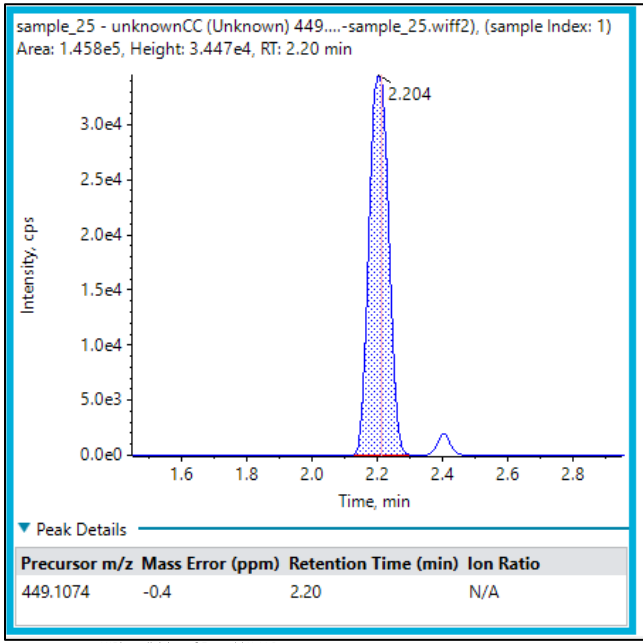
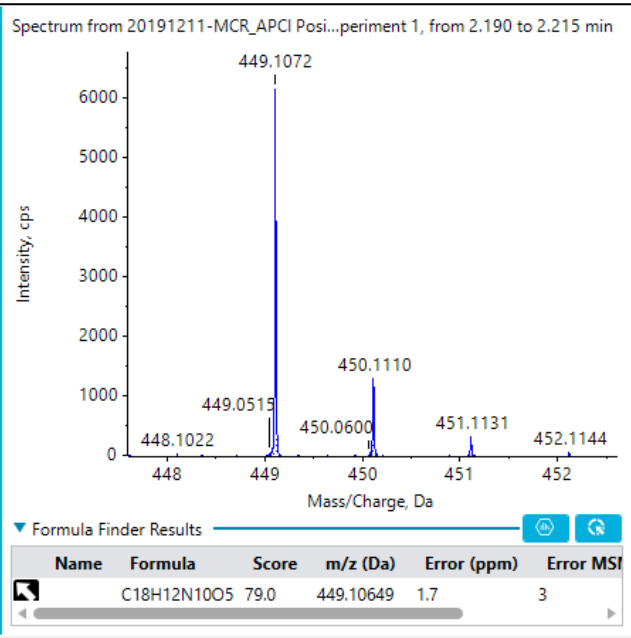
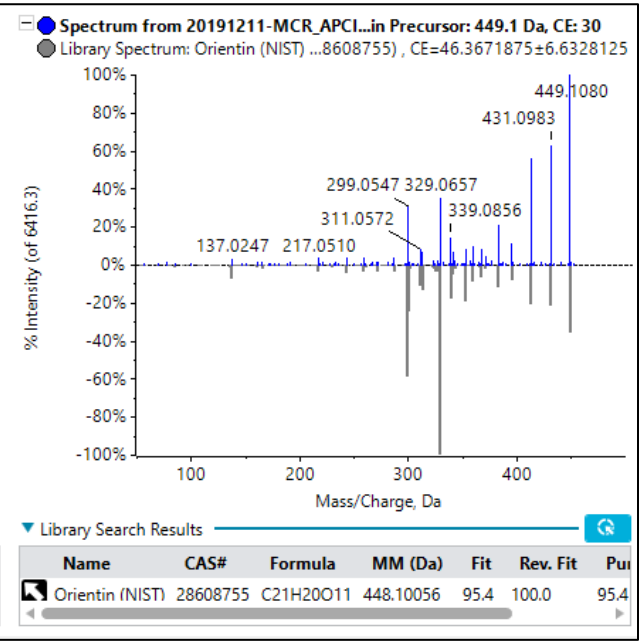


- NIST Library Match = Orientin







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Targeted Approach Findings

- Levels of secondary metabolites (cannabinoids, terpenes, etc.) were elevated in outdoors samples vs indoor samples overall
- Limited data for heavy metals shows that the two strains evaluated showed cadmium detected in the indoor plants but not outdoor plants

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Untargeted Approach Findings

- Indoor & outdoor samples are mostly separated by PC2
- Some strains are unique, and their indoor vs outdoor profiles are similar
- The types of natural products that are elevated are different depending on if it is grown indoors or outdoors

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Conclusion

- Cultivation method impacts both amount and type of secondary metabolites
- Implications for recreational and medical cultivation
- Future studies

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Q&A

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