## Illicit drug sniffer

Illicite drugs (n=5)



Active compounds



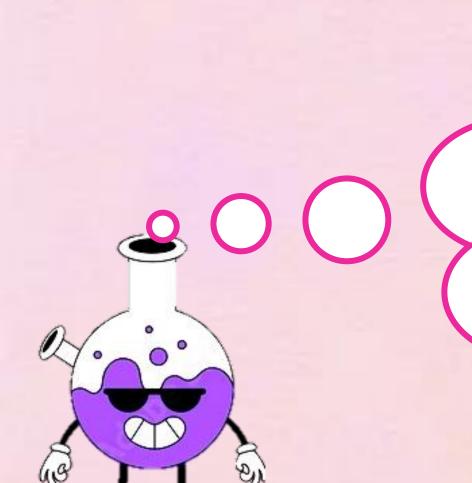
Year of Seizure

# Characterization of the smell of drugs

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Illicit drugs are chemically diverse substances each with distinct chemical compositions. These variations influence their volatile organic compound (VOC) profiles, which are recognized as valuable tools in forensic science and public health, giving information about drug production methods, origin, and even adulterants.



undecane

piperonal

α-pinene

d-limonene

β-myrcene

This project aims to characterize **VOCs** from a panel of illicit drugs offering predictive VOC signatures, drug differentiation, and forensic traceability.



β-phellandrene

1,2-propanediol 1-acetate

3-propyl-2,4-pentadien-1-ol

3-heptanone

3-carene

			10.11	
	Ketamine	95%	2019	
İ	Ecstasy 5	46% MDMA	2019	
1	Ecstasy 4	29% MDMA	2018	
	Ecstasy 3	42% MDMA	2018	
7	Ecstasy 2	88% MDMA	2019	
	Ecstasy 1	95% MDMA	2018	
	Amphetamine 2	96.5% Amphetamine sulphate	2019	
	Amphetamine 1	23% Amphetamine sulphate	2018	
	Heroine 3	55%Heroin	2018	
	Heroine 2	55% Heroin	2018	
	Heroine 1	48% Heroin	2018	
	Cocaine 3	92% Cocaine	2019	
	Cocaine 2	80% Cocaine	2018	
	Cocaine 1	76% Cocaine	2019	
	Opium	-	2019	
	Cannabinoids (Hashish 2)	1,51% THC	2019	
	Cannabinoids (Hashish 1)	23% THC	2019	
	Cannabinoids (Marijuana 2)	15% THC	2019	
	Cannabinoids (Marijuana 1)	16% THC	2019	

Drug seizures, including concentration (%) and year of seizure

Ecstasy	Amphetamine	Cocaine	Heroine	Cannabinoid
Others N =41	Others N = 71	Others N = 70 25 %	Others N = 15 24 %	Others N = 77  22 %
N <sub>vocs</sub> = 53	N <sub>vocs</sub> = 84	N <sub>vocs</sub> = 78	N <sub>vocs</sub> = 20	N <sub>vocs</sub> = 87
benzyl methyl ketone	methyl-3,4-methylenedioxyamphe	The same of the sa	propane diamide	β-myrcene
3,4-methylenedioxyphenyl acetone	3-methyl-denzonitrile	cyclohexanone	benzyl methyl ketone	4-carene
4-hydroxy-4-methyl-2-pentanone	amphetamine	propyl acetate	1,2-propanediol, diacetate	α-pinene
2-propyl-1-pentanol	methamphetamine	p-xylene	1,2-propanediol, 1-acetate	β-ocimene
2-butoxy-ethanol	4-methyl-5-phenylpyrimidine	benzaldehyde	1,2-propanediol, 2-acetate	d-limonene
2,2,3-trimethyl-hexane	indane	4-methyl-5-phenylpyrimidir	ne	β-cymene
2-ethyl-1-hexanol	(phenylisopropyl)benzaldimine	amylene hydrate		β pinene

### **Volatile Profiles Across Drug Types**

218 VOCs were identified across 95 illicit drug samples.

- Cocaine, heroin, and cannabinoids exhibited profiles dominated by 3–4 VOCs.
- Ecstasy and amphetamine showed lower VOCs dominance.
- No VOCs were detected in opium and ketamine.

### **Recommendation:**

For low-emitting substances, more sensitive techniques (e.g., HiSorb probes, vacuum-assisted SPME) are advised.



Pie charts displaying the relative proportions of the VOCs contributing to each drug profile

3-hydroxy-3-methyl-2-butanone

(1-methylethyl)benzeneethanimine

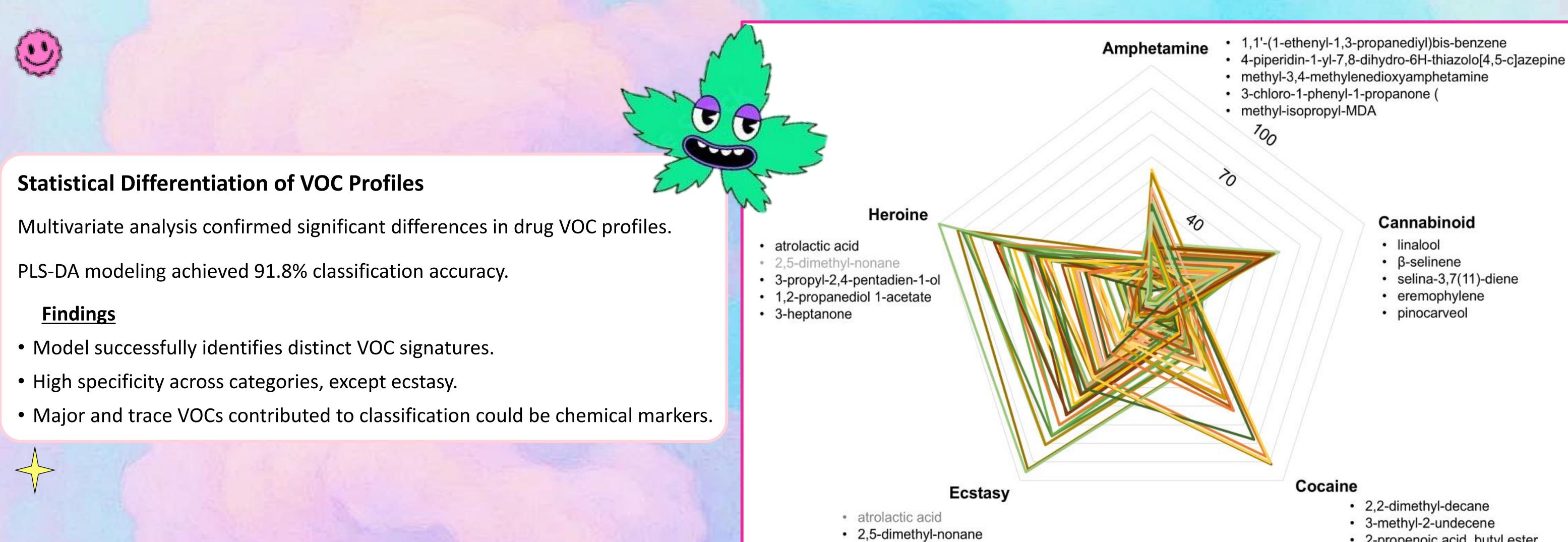
N-(phenylisopropyl)benzylmethylketimine

L-glycerol-2-benzamido-1-phenylpropane

L-proline, phenylmethyl ester

ethylmethylphenethylamine

benzenebutanenitrile

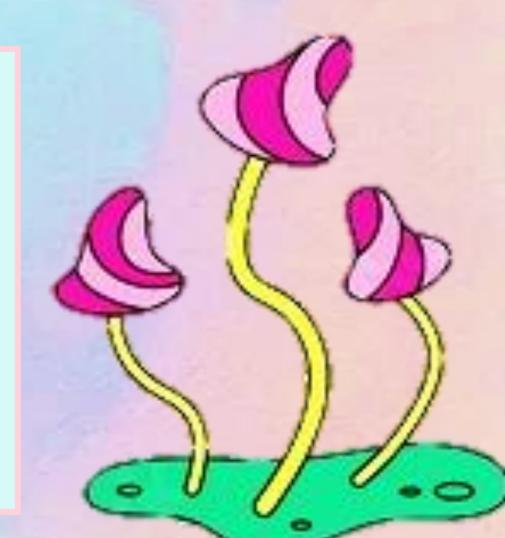


Spider chart displaying all compounds and their contribution in the PLSDA analysis

This study provides comparative VOC profiles for a wide range of illicit drugs, offering new insights into their odor signatures.

- The identification of by-products and cutting agents offers valuable leads for forensic investigations, aiding in the determination of drug origin, manufacturing methods, and distribution routes.
- Identification of chemical markers can support detection dog training.

VOC profiling represents a promising tool for both operational detection and forensic intelligence in the fight against illicit drug trafficking.



Cannabinoid

β-selinene

pinocarveol

2,2-dimethyl-decane

3-methyl-2-undecene

2,4-di-tert-butylphenol

benzaldehyde

2-propenoic acid, butyl ester

selina-3,7(11)-diene

eremophylene

linalool