

SOFT-DFC Snapshot – Δ9-Tetrahydrocannabinol

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The growing legalization and decriminalization of cannabis have expanded the availability of products containing delta-9-tetrahydrocannabinol (THC), leading to concerns about potential misuse in drug-facilitated crimes (DFCs). THC's popularity as a recreational drug aligns with its frequent appearance in studies on DFCs. THC is consistently cited as one of the most common findings in prevalence studies.¹⁻⁶

Unlike traditional "date rape" drugs, THC – on its own – does not induce the classic unconsciousness often seen in DFC cases.⁴ Consequently, the importance of the role of cannabis products may not immediately be recognized. Nonetheless, it is essential to recognize that THC's pharmacological effects can lead to behavioral alterations, potentially rendering an individual more vulnerable to DFCs, such as sexual assault.²

It is known that cannabis potency has markedly increased over the last two decades, potentially influencing its use in DFCs. For instance, the average THC content in confiscated marijuana plants escalated from 4% in 1995 to over 16% in 2022.⁷

The proliferation of cannabis-infused edibles and vaping products on the market may also play a role in DFCs. These concentrated products are frequently consumed without a clear understanding of the dosage, resulting in potentially more pronounced pharmacological effects compared to smoking cannabis. Additionally, edibles can be easily misrepresented as innocuous items, making surreptitious administration more likely than in previous years.

Lastly, cannabis products may be shared with the victim, and once they are under its influence, the offender exploits the impaired state – an occurrence known as an "opportunistic" DFC.⁸

Drug Class: ⁴	Miscellaneous
Generic Name:	dronabinol; cannabis; Δ9-THC; THC, Marijuana
Brand Name(s):	Marinol; Syndros
FDA Approval:	The FDA has approved the use of Marinol and Syndros for therapeutic uses in the United States, including for the treatment of anorexia associated with weight loss in AIDS patients and nausea associated with cancer chemotherapy. ¹⁰
Pharmacological Effects:	The unique combination of THC's behavioral effects challenges straightforward classification as a stimulant, sedative, or hallucinogen. ⁸ In addition to inducing euphoria, THC can also reduce anxiety, alter the perception of space and time, trigger hallucinations, and impair cognitive function. ¹¹ It can also cause hypotension and dizziness. Notably, its impact on short-term memory may be one of the drug's most significant adverse effects in the context of DFCs. ⁸ Significant CNS depression has

been observed, particularly in children who inadvertently ingest cannabis.¹² Importantly, THC's effects are dose-dependent and can vary based on the user's experience with the drug.⁸

When co-ingested with alcohol and opioids, THC can have an additive CNS depressant effect.¹¹

Administration:

Smoking remains the predominant method for recreational cannabis use. When smoked, peak blood concentrations can be reached within 3 to 10 minutes.¹¹ In contrast, oral formulations exhibit variable absorption, leading to a delayed peak concentration of approximately 120 minutes.¹¹

Metabolism/Elimination:

THC undergoes extensive metabolism, primarily in the liver. Liver enzymes, particularly cytochrome P450 enzymes CYP2C9 and CYP3A4, convert THC into its primary active metabolite, 11-hydroxy-THC (11-OH-THC). This metabolite is further oxidized to form the inactive compound 11-nor-9-carboxy-THC (THC-COOH). Glucuronide-conjugated metabolites enhance their excretion via urine.

Single Dose Studies:

Urine:

Both the SOFT DFC Committee and the AAFS Standards Board have established the importance of testing urine samples from alleged victims of drug-facilitated crimes for THC's primary urinary metabolite, THC-COOH, at a decision point concentration of 10 ng/mL or lower.^{9,13} Urine is easily collected, straightforward to analyze, and provides a longer window of detection of THC ingestion compared to blood.

The elimination of THC-COOH in urine is highly variable, with only about 20% of a THC dose being excreted through this route.¹⁴ This variability is particularly pronounced when comparing infrequent and frequent users.

Over three weeks, six healthy males with prior marijuana use each smoked one marijuana cigarette per week.¹⁵ This study observed that the peak urine concentrations of THC-COOH after smoking a single 1.75% or 3.55% THC cigarette varied substantially. The concentrations reached a maximum of 90 ng/mL at about 34 hours and 153 ng/mL at about 94 hours for the respective THC cigarettes. While the average half-life for THC-COOH elimination via urine was approximately 30 hours, longer half-lives were noted.

The urinary excretion profile of THC-COOH following oral cannabis ingestion in 18 healthy adults found the average maximum concentration was between 107 and 713 ng/mL, based on the dose.¹⁶ The average time to reach these maximum concentrations was 9 hours.

Blood/Plasma/Serum:

Blood, plasma, and serum specimens allow for more meaningful quantitative assessments of positive findings; however, the ability to detect THC and its metabolites in these specimens depends on the THC dose used and if the individual is an occasional or heavy user.

Six males who were chronic marijuana users smoked a single cigarette containing either 1.75% or 3.55% THC¹⁷ and achieved maximum plasma concentrations ranging from 50-267 ng/mL for THC, 3-16 ng/mL for 11-OH-THC, and 15-101 ng/mL for THC-COOH. The detection windows using a GC/MS method with a 0.5 ng/mL lower limit of quantitation ranged from 3-27 hours for THC, 0.5-27 hours for 11-OH-THC, and 48-168 hours for THC-COOH.

Another study evaluated 11 occasional and 12 heavy cannabis users who smoked a single marijuana cigarette prepared to contain 500 micrograms per kilogram of their body weight.¹⁸ The maximum concentrations detected in the serum of the occasional users were 12-86 ng/mL for THC, 2-17 ng/mL for 11-OH-THC, and 11-51 ng/mL for THC-COOH. For the heavy users, the maximum concentrations were as high as 245 ng/mL for THC, 32 ng/mL for 11-OH-THC, and 311 ng/mL for THC-COOH.

Desrosiers et al. evaluated 11 occasional 14 frequent marijuana users.¹⁹ After smoking a marijuana cigarette containing 6.8% THC, whole blood and plasma samples were analyzed using an LC-MS/MS method with a lower limit of quantitation of 1 ng/mL. Detection windows for the occasional users ranged from 1-6 hours for THC, 1-5 hours for 11-OH-THC, and more than 30 hours for THC-COOH. For the frequent users, THC, 11-OH-THC, and THC-COOH were detected for more than 30 hours after smoking the single cigarette for some of the study's subjects. For context, the following median blood-to-plasma ratios were reported in this study: THC (0.68), 11-OH-THC (0.63), and THC-COOH (0.59).

Nine males and nine females with a history of long-term cannabis use and a 3-month abstinence ate a single brownie containing 10, 25, or 50 mg of THC.²⁰ Blood samples were tested using an LC-MS/MS method with a limit of quantitation of 0.5 ng/mL. The maximum concentrations detected in the blood of these individuals were up to 5 ng/mL for THC, 5 ng/mL for 11-OH-THC, and 44 ng/mL for THC-COOH. Detection windows were as long as 22 hours for THC, 12 hours for 11-OH-THC, and 94 hours for THC-COOH.

Hair:

Hair allows for the most extended window of detection for THC and metabolites, but it comes with the disadvantage of being more challenging to analyze, a requirement of methods that are more

sensitive than what is needed for analyzing blood or urine, and the general inability to differentiate exposures from one week to the next.

Thirteen males with a history of occasional or chronic cannabis use smoked a 2.7% THC cigarette.²¹ A second 2.7% THC cigarette was smoked seven days later, and a hair specimen was collected from each. Using a GC-MS/MS method with detection limits of 1 pg/mg for THC and 0.1 pg/mg for THC-COOH, only 52% of the occasional users had detectable amounts of either THC or THC-COOH compared to 85% of the chronic users. Concentrations of THC in the hair ranged from 3.4 to more than 100 pg/mg, while the concentration of THC-COOH ranged from 0.1 to 7.3 pg/mg.

DFC Cases:

Most prevalence studies of DFCs report cannabinoids as one of the most common findings.¹⁻⁶ This is likely due to the lengthy terminal half-life of THC-COOH, allowing for its detection for days after use. Yet, interpreting THC-COOH findings becomes challenging if the victim had consumed THC a day or two before the offense, as previous usage can obscure the results.

In the experience of the DFC Committee, there have been only a handful of sexual assaults in which a cannabis product alone was used to facilitate the crime. Most did not progress to prosecution.

One such case occurred in December of 2023 when a 33-year-old man was accused of providing an 11-year-old girl with a THC-infused edible before raping her in the bathroom of a Miami mall.

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Disclaimer:

SOFT-DFC Snapshots are short reports of critical information about the more common drugs associated with drug-facilitated crimes (DFCs). They do not have complete literature reviews about the drug or drug class. One key aspect is their focus on the ability to detect a drug after a single-dose administration, as is often the situation in DFC investigations. As such, these summaries also highlight instances in which available data is limited, hoping this will encourage further research studies. Finally, *SOFT-DFC Snapshots* point to the use of these drugs in actual DFC cases, as cited in the medical and open literature.