

# Investigating the Impact of Common Drugs (Caffeine, Advil, and Benadryl) on Tetrahydrocannabinol (THC) Detection

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**Abstract:** Forensic science covers numerous distinct areas of specialization. One of these is drug detection, in which investigators test for drugs in human fluid samples such as urine, blood etc. Some commonly used medications and substances can affect the accuracy of drug detection. THC (Tetrahydrocannabinol) is one of the main psychoactive compounds in cannabis. This study focused on the impact of caffeine, Advil, and Benadryl on THC detection. In this study, a lemonade drink with THC (THC lemonade), 0.14 mg of THC in 10 mL of lemonade, was used as a reference fluid sample instead of human bodily fluids. The observed results showed that there is no impact of caffeine until 400 mg is dissolved in 10 mL of THC lemonade. An extremely high concentration of caffeine (600 mg of caffeine in 10 mL of THC lemonade) is required to show negative THC detection results. Whereas lower concentrations of both Advil (10 mg), and Benadryl (25) mg in 10 mL of THC lemonade are enough to show negative THC results. Further experiments need to be done to determine the lowest amounts of Advil and Benadryl required for the negative test results. These results showed that Advil and Benadryl have a higher impact on the detection of THC compared to caffeine.

*Keywords: THC, drugs, caffeine, Advil, Benadryl*

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Cannabis ranks among the most commonly used substances worldwide (Sharma et al., 2012). The cannabis plant produces two key compounds: 9-tetrahydrocannabinol (THC) and cannabidiol (CBD). While these compounds share similar chemical structures, they differ significantly in their mechanisms of action and effects on brain functions (Stella, 2023). Both THC and CBD demonstrate potential for therapeutic applications. THC is often considered the principal “psychotropic” compound produced by cannabis whereas CBD is referred to as the principal “non-psychotropic” compound. Although THC is

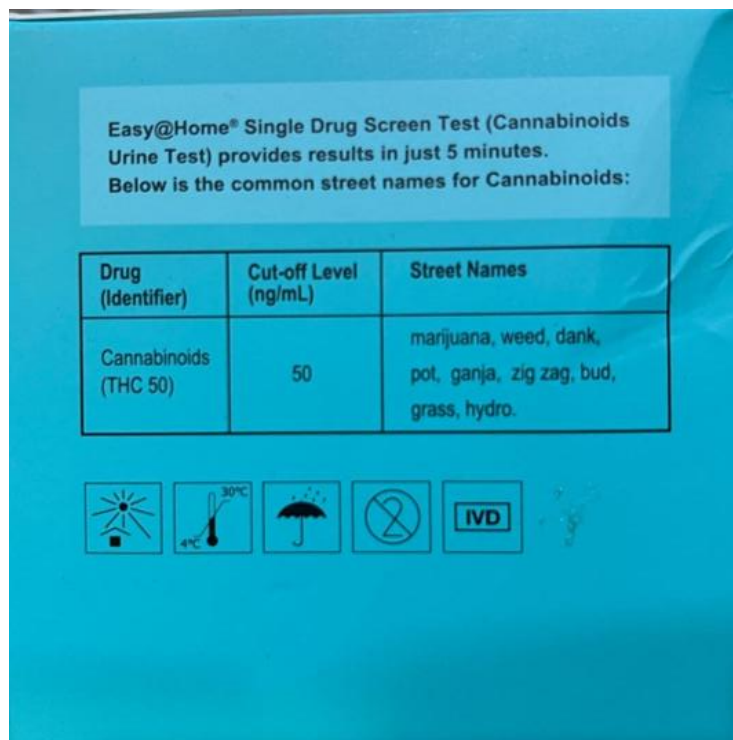
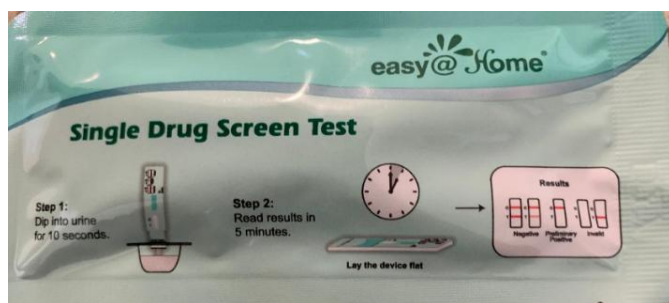
used as a recreational drug, it can potentially lead to dependence and behavioral disturbances and its heavy use may increase the risk for psychotic disorders. It is important to have reliable drug testing methods for the detection of THC since some common drugs or substances can significantly impact the detection of THC in many ways (Venkatratnam, and Lents, 2011). For instance, certain medications and substances can interfere with the accuracy of drug tests, leading to false positive or negative results. Therefore, it is essential to identify common medications and substances that impact THC detection to develop a new

testing method for accurate results. In this research activity, the impact of three common substances or medications: caffeine, Advil and Benadryl, on the detection of THC in THC containing lemonade (THC lemonade) was investigated.

## Materials and Methods

First, the credibility of the test strips was evaluated with the lemonade containing THC and regular lemonade. It is necessary to test the drug test kit since some kits are not

reliable (Moyer et al., 1987). Then, the tests were performed with 10 mL of THC lemonade with specific amounts of caffeine, Benadryl, and Advil separately. A Single Drug Screen Test kit (Easy@Home, Burr Ridge IL) for Cannabinoids (THC 50) in human urine was purchased from Amazon.com. The calibrator of the test strip is 11-Nor- $\Delta^9$ -COOH, which is the main secondary metabolite (Lucas et al., 2018) of tetrahydrocannabinol (THC), which is formed in the body after cannabis is consumed.



**Fig. 1.** Single Drug Screen Test kit (Easy@Home)

The detection limit (cut-off level) is 50 ng/mL and minimum and maximum detection times are 2 hours and 5+ days. The HOWDY lemonade with THC (THC lemonade) was purchased online (The Patriot Band, College Station TX). The HOWDY lemonade is a non-alcoholic lemonade with 5 mg of THC in each can of 12 fl oz (355 mL). The Tetrahydrocannabinol (THC) is the most

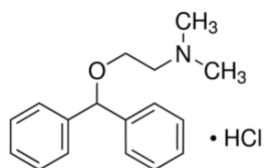
famous of all the cannabinoids by far and is the principal psychoactive compound found to naturally occur in the cannabis plant. A regular Tropicana lemonade bottle, as a reference fluid, was purchased from HEB grocery store. Tablets of caffeine [trimethylxanthine (systematic name is 1,3,7-trimethylxanthine or 3,7-dihydro-1,3,7-trimethyl-1H-purine-2,6-dione)] 200 mg,

Advil 200 mg (Ibuprofen), and Benadryl (Diphenhydramine Hydrochloride)

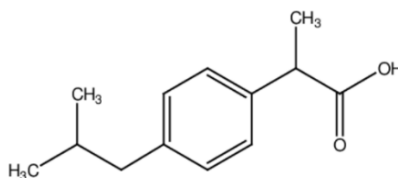
25 mg were purchased from Walmart (Walmart Inc., Bentonville AR).



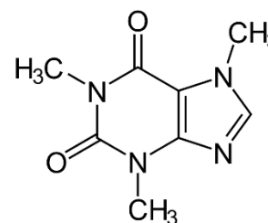
Fig. 2. HOWDY Lemonade can with 5mg THC and Tropicana regular lemonade bottle.



Diphenhydramine Hydrochloride (Active ingredient in Benadryl)



Ibuprofen (Active ingredient in Advil)



Caffeine

Fig. 3. Pictures of Benadryl, Advil, and caffeine tablets and their molecular structures.

In this study, the effects of common substances (caffeine, Advil, and Benadryl) in the detection of THC were investigated using THC drug test strips. First, the credibility of the test strips was evaluated with the THC

lemonade and regular lemonade. Then, the tests were performed with 10 mL of the THC lemonade with specific amounts of caffeine, Advil, and Benadryl separately.

The cap of the test strip was pulled out to expose the absorbent end. Then, the absorbent end was immersed into the beaker with the solution of THC lemonade or THC lemonade with specific amounts of caffeine, Benadryl, and Advil separately for 10 seconds. Then the strip was recapped and laid flat on a clean, dry surface. The results were read in 5 minutes. The test results were read as follows:

a) A colored band is visible in each Control Region (C) and the appropriate Test Region (T) - Negative results - THC concentration is zero or below the detection limit.

b) A colored band is visible only in the Control Region (C) - Preliminary positive results for THC

c) Colored band is not visible, or a colored band is visible in the Test Region (C) only - Invalid results

Note that there is no meaning attributed to line color intensity or width.

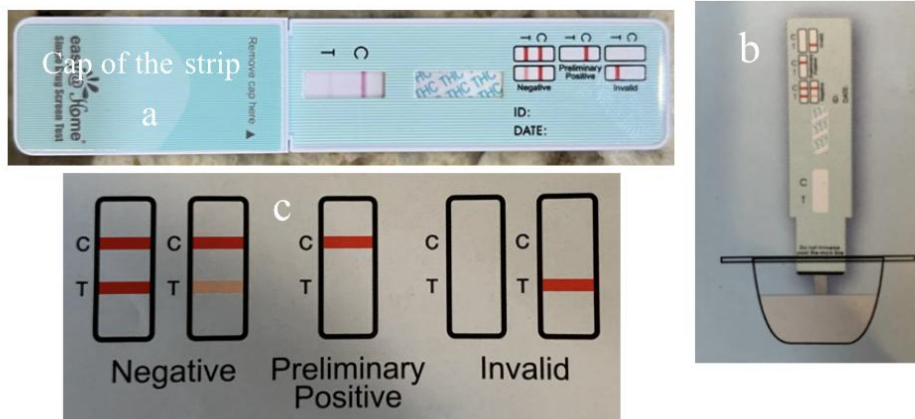


Fig. 4. (a) The strip was laid flat, (b) Strip is immersed in solution, and (c) outcome of results

## Results

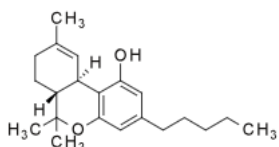
### Test for THC Lemonade and Lemonade

First, the credibility of the test strips was evaluated with the THC lemonade and regular lemonade.

THC lemonade showed positive results whereas the regular lemonade showed negative results. These results indicate that the strips are able to detect THC but not lemonade without THC.



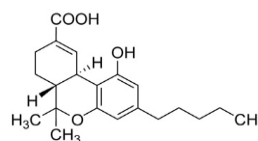
THC Lemonade



Tetrahydrocannabinol (THC)



Lemonade



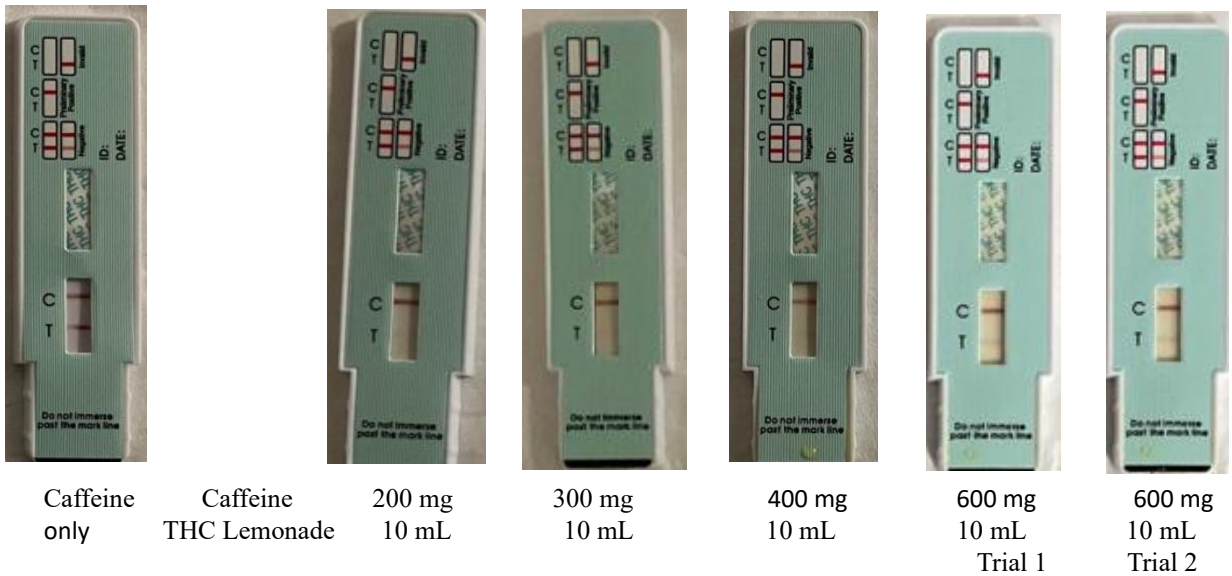
11-Nor- $\Delta^9$ -COOH

**Fig. 5.** Results from THC lemonade and lemonade and molecular structures of THC and 11-Nor- $\Delta^9$ -COOH (main secondary metabolite of THC)

**Test for the Impact of Caffeine on Tetrahydrocannabinol (THC) Detection**

The impact of caffeine was evaluated by dissolving 200, 300, 400 and 600 mg of caffeine in 10 mL of THC lemonade separately. Note that only 0.14 mg of THC is in 10 mL of THC lemonade.

The test results showed that there is no impact of caffeine until 400 mg is dissolved in 10 mL of THC lemonade. Whereas negative results for THC were observed after dissolving 600 mg of caffeine.

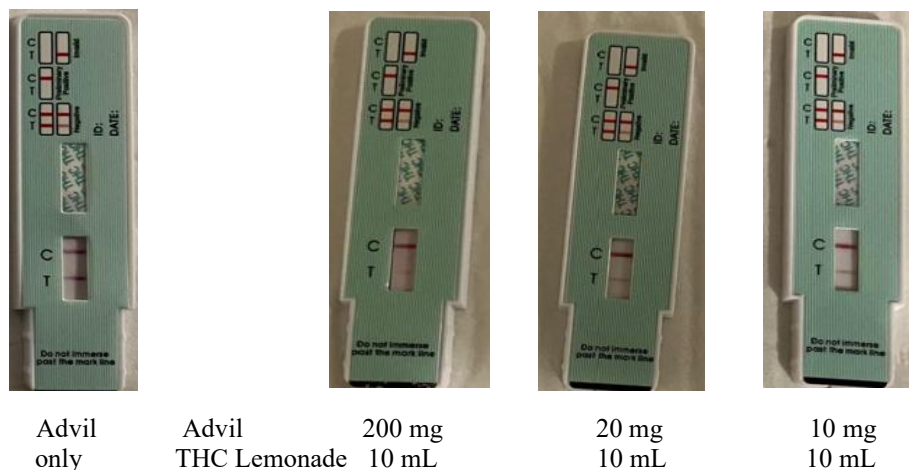


**Fig. 6.** Results for the impact of caffeine on THC detection.

**Test for the Impact of Advil on THC Detection**

The impact of Advil was evaluated by dissolving 200, 20, 10 mg of Advil in 10 mL of THC lemonade separately.

The test results showed that 10 mg of Advil is enough to give negative results.



**Fig. 7.** Results for the impact of Advil on THC detection

Further experiments need to be done to determine the smallest amount of Advil required for the negative test results.

dissolving 100, 50, 25 mg of Benadryl in 10 mL of THC lemonade, separately. The test results showed that 25 mg of Benadryl is enough to give negative results. Further experiments need to be done to determine the lowest amount of Benadryl required for the negative test results.

### Test for the Impact of Benadryl on THC Detection

The impact of Benadryl was evaluated by



Benadryl only      Benadryl + THC Lemonade 100 mg 10 mL      Benadryl + THC Lemonade 50 mg 10 mL      Benadryl + THC Lemonade 25 mg 10 mL

**Fig. 8.** Results for the impact of Benadryl on THC detection

**Table 1.** Summary of all the test results

Solution	Amount	Caffeine/ Advil/ Benadryl	Amount of caffeine/Advil/Benadryl medication (mg)	Test Results
THC lemonade	10.0 mL			Positive
Lemonade	10.0 mL			Negative
Caffeine only	200 mg in 10.0 mL of H <sub>2</sub> O			Negative
THC lemonade	10. mL	Caffeine	200, 300, 400	Positive
THC lemonade	10.0 mL	Caffeine	600	Negative

Advil only	200 mg in 10.0 mL of H <sub>2</sub> O			Negative
THC lemonade	10.0 mL	Advil	200, 20,10	Negative
Benadryl only	25 mg in 10.0 mL of H <sub>2</sub> O			Negative
THC lemonade	10.0 mL	Benadryl	100, 50, 25	Negative

### Discussion

There is no impact of caffeine until 400 mg is dissolved in 10 mL of THC lemonade. An extremely high concentration of caffeine (600 mg of caffeine in 10 mL of THC lemonade) is required to show negative THC detection results. Drinking large amounts of any liquid, including water, could interfere with a drug test result (Matteucci, 2024). Whereas lower concentrations of both Advil, (10 mg), and Benadryl, (25 mg), in 10 mL of THC lemonade are enough to show negative THC results. Further experiments need to be done to determine the lowest amounts of Advil and Benadryl required for the negative test results. These results showed that Advil and Benadryl have a higher impact on the detection of THC compared to caffeine. Even though the results here show false negative test results, it was reported that false positive results are also caused by common drugs (Olsson, 2023). The calibrator of the test strip is 11-Nor- $\Delta^9$ -COOH, the main secondary metabolite which is formed in the human body after cannabis is consumed (Chayasirisobhon, 2020). Even though the test kit is for the detection of secondary metabolites in urine, in these experiments, it was used to detect THC. Therefore, results reported here may or may not apply for the detection of metabolites of THC and further investigation using urine with THC metabolite is required to confirm the observed results here. These tests provide only preliminary results. To obtain a confirmed analytical result, a more specific

alternate chemical method such as Gas-Chromatography (GC-MS) (Huestis et al. 1995) or Liquid Chromatography/Tandem Mass Spectrometry (LC/MS-MS) (Skopp, and Pötsch, 2002) is required.

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