

# Analysis of CBD and Other Cannabinoids in Infused Drinks

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## Abstract:

The rapid increase in popularity of consumer-based products has been made possible by a quickly changing regulatory positions on cannabis and hemp. The decriminalization, legalization, and 2018 Farm Bill have all emboldened entrepreneurs to bring innovative consumer products to the market. The lack of regulatory oversight or even self-governance of the community has meant that testing and best practices have lagged. The need to evaluate both the potency and efficacy is a large part to build customer confidence and ensure the long-term viability of the cannabis market. While potency has been on the rise as new and reliable test methods are developed, efficacy testing is more difficult. In this study, we investigate two drink products to evaluate potency and efficacy of the delivery method. Specifically, tea bags that contain hemp buds and a coffee beans that contain hemp. We want to understand the amount of cannabinoids present in the product and how much of those are being consumed by brewing.

## Goals:

**1. Measure the potency claims of each product:**

Determine the amount of cannabinoids in the product and compare it to the label claims.

**2. Evaluate the efficacy of the delivery method:**

Determine the amount of cannabinoids in the brewed product and compare to what is expected.

## Method:

The coffee sample was prepared by grinding the entire bag (~57g) of the coffee beans to ensure homogeneity. Approximately 1.25g of the ground coffee was analytically weighed and placed into a 50 mL centrifuge tube along with 20 mL of HPLC grade methanol. The sample was vortexed for 1 minute, allowed to sit for 15 minutes, and vortexed for an additional minute. Approximately 1 mL of the methanol extract was filtered using 0.45-micron syringe filter into an HPLC sample vial.

The contents of an entire tea bag were ground for homogeneity and weighed into a centrifuge tube. As before, 20 mL of methanol was added and the sample was vortexed and filtered as mentioned above.



**Figure 1: Commercial Tea and Coffee**

The National Coffee Association USA recommends 1-2 tablespoons of freshly ground coffee should be brewed in 6 ounces of boiling water for 5 minutes (if not using a coffee maker with manual settings). A sample containing 16.667 grams of coffee was brewed and syringe filtered using a 0.45-micron syringe filter into an HPLC sample vial.

The Dilmah School of Tea recommends 2 bags of tea in 8 ounces of boiling water for 5 minutes. Due to limited sample, 1 tea bag was brewed in 4 ounces of boiling water.

Table 1 shows the mass, volume, and expected cannabinoid concentration based on the preparation method used and the label cannabinoid potency information.

	<b>Mass of Product (g)</b>	<b>Volume of Water (mL)</b>	<b>Expected Cannabinoid Concentration (mg/mL)</b>
Coffee	16.6677	177	0.08
Tea	2.2118	118	0.13

**Table 1**

Once the tea and coffee was brewed, the ground coffee and filter was left to dry. After brewing the tea, the contents were removed from the tea bag and allowed to dry. The tea bag was also retained and allowed to dry. Once dry, the tea was ground as before. The ground coffee and tea were then extracted as mentioned above to see if any cannabinoids remained on the product after brewing.

All samples were analyzed using an HPLC-UV system. The specifications of the method are listed in Table 2. Calibration curves for CBD, CBDA, THC, THCA, CBG, CBN, and CBC were created using certified reference materials (CRMs) and had  $R^2$  greater than 0.999.

## Results:

The label of coffee product, Buddha Beans Coffee Co. *Organic Mexico- 50 mg*, indicated that it contains 50mg of “hemp” within the 2oz (57g) bag. Since we do not know the exact chemical composition of the hemp that was added, it is hard to assign an exact expected value for each cannabinoid, thus it was assumed that hemp means total cannabinoid content. Using this assumption, the coffee was found to contain 96% of the label claim at about 48mg of total cannabinoids/bag of coffee. Only cannabidiol (CBD) was detected in the sample. This is consistent with a product made from pure CBD (isolate). A certificate of analysis found on Buddha Beans Coffee Co. website also showed only CBD and no minor cannabinoids.

The label of the tea product, High Tea with Hemp *Blended Herbal Tea- Purification*, indicates their product contains 15mg “Organic CBD Hemp Buds” within each tea bag. Like with the coffee, this makes assigning an exact expected value for each cannabinoid difficult, it is assumed that it relates the total cannabinoid content. A single tea bag was used for testing. The contents were homogenized and extracted as mentioned above. The contents were then analyzed and found to contain 8.1mg of cannabinoids. Compared to the assumed 15mg, this represents 54%. Additionally, the empty tea bag was extracted to see if cannabinoids were present however, no cannabinoids were detected on the tea bag.

Initial Testing	Coffee mg/bag	Tea mg/tea bag
Label (Total Cannabinoids)*	50	15
Test Results (Total Cannabinoids)	48	8.1
% Label	96%	54%

**Figure 2: Initial Potency Testing of Coffee and Tea**  
\*Assume label indicates total cannabinoid content

The brewed samples were then analyzed and compared to the expected value. The expected value is again assuming total cannabinoid content. No cannabinoids were detected. The limit of detection is 1 microgram per milliliter. Since cannabinoids are not very soluble in water, the process of brewing is not an effective way to transfer from the coffee grounds or tea bag to the brewed product. To confirm, the brewed coffee grounds and tea was allowed to dry and then reanalyzed via the extraction method mentioned above. Those results are shown in Figure 4. The coffee tested at 98% of the sample that was not brewed. This confirms that the cannabinoids are not being “extracted” from the coffee during the brewing process.

Analysis of Brewed Drink	Coffee	Tea
Expected CBD (mg/mL)	0.08	0.13
Test Results (mg/mL)	Not Detected	Not Detected

**Figure 3: Potency Testing of Brewed Coffee and Tea**  
LOD: 0.001 mg/mL

<b>Post Brew Extraction Testing</b>	Coffee	Tea
Initial Results (mg/g)	0.83	3.72
Results after Brewing (mg/g)	0.81	2.07
Percent of Initial Testing	98%	56%
<b>Figure 4: Initial Potency Testing of Coffee and Tea</b>		

### Conclusion:

Both the coffee and tea products contained cannabinoids. The coffee beans were consistent with label potency claims at 96%. The tea only produced 54% of the label. Again, not knowing the exact make-up of the “15mg of CBD hemp buds”, we are not able to determine the exact expected values, and this would need to be further investigated.

Brewing the coffee and tea produced drinks that contained no detectable cannabinoids. Re-extraction of the brewed coffee and tea confirmed that the cannabinoids were still present in the coffee grounds and tea. This is consistent with cannabinoids not being water soluble.

### References:

Extraction & HPLC methods developed based off of papers from Association of Analytical Chemists (AOAC) & American Society for Testing and Materials (ASTM International)

Brewing Methods based off of recommendations from National Coffee Association USA (NCAUSA), Dilma School of Tea, & World Associations of Chefs Societies

Samples provided by CBD.how