Medical Cannabis Potency Testing Project

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Given the rapidly growing use of medical cannabis for a wide variety of indications and the manifold different underground sources currently supplying patients, there is a natural interest in investigating the potency, purity, and chemical content of the available supplies of medical cannabis. While the availability of medical cannabis has increased in the wake of the passage of California's Proposition 215 and other state medical marijuana initiatives, scientific research on its content remains frustrated by the continued federal ban on medical cannabis research.

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In an effort to cast light in this obscure area, a research project was undertaken by a group of us, including researchers, growers, and medical cannabis buyers' clubs, with support from California NORML and MAPS, to analyze samples of medical cannabis from various patients' cooperatives and providers around the country. This effort proved to be a lesson in the difficulties and uncertainties of cannabis research in a society where freedom of pharmacological research has been stifled by an effectively totalitarian drug bureaucracy.

From the outset, our project was frustrated by a lack of access to qualified research labs with expertise in analysis of cannabis. The leading research lab in the country declined to do business with us for fear of compromising government contracts, while the other likely candidates were all foreign and thus not legally accessible to us because of DEA regulations. In the end, we were fortunate to obtain the services of a laboratory that had the requisite DEA license and equipment (a gas chromatograph mass spectrometer, or GCMS), but no prior experience in cannabis analysis—in fact, its primary business was drug urinalysis! The analysis of our samples was accordingly a learning process for both the lab and ourselves.

Our original aim had been to obtain a broad-spectrum quantitative analysis of as many of the 60-plus naturally occurring cannabinoids as possible, in the hope of detecting differences that might produce differing therapeutic effects among the samples. To our disappointment, however, our lab could obtain laboratory standards only for the three most common cannabinoids, delta-9-THC, cannabidiol (CBD), and cannabinol (CBN).

A total of 47 different samples of medical cannabis were submitted by over a half dozen different providers and patients' cooperatives ranging from California to the East Coast. Included were 42 samples of sinsemilla bud, three samples of hashish or resin; one liquid sample of a milk-based cannabis drink ("Mother's Milk"), and one capsule of an oral whole leaf preparation.

Upon analysis by GCMS, the potency of the 42 sinsemilla samples was determined to range from 10.2% to 31.6% THC, with a mean of 19.4%. These results were surprisingly high, given that the average potency of marijuana in the U.S. has been typically estimated at around 3% to 4% by

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NIDA, with higher grade sinsemilla ranging towards 10% - 15%. The highest potency recorded came from a sample of hashish, which registered 68.6%. Yet even a sample of Mexican commercial grade registered a surprisingly high 11%, twice what we had expected. All of this cast a troubling shadow of doubt on our test results, although it appeared likely that we were dealing with highly potent varieties.

In contrast, the CBD levels observed were surprisingly low. Only four of the sinsemilla samples had more than 0.3% CBD, and 35 of them had only trace amounts (<0.1%). However, one sample had an astoundingly high CBD content of 28.0% (plus 11.6% THC). Another registered 5.6% CBD and 13.4% THC. Aside from these two anomalies, the CBD results were frankly disappointing, as we had hoped to discover significant variations in the content of the samples, with accompanying variations in medical activity. Because CBD is suspected to have peculiar efficacy for control of muscle spasms and for damping anxiety and "panic reactions" caused by THC, we had hypothesized that certain patients would tend to prefer high-CBD varieties. In fact, however, it appears that few patients are ever exposed to high-CBD cannabis. Unfortunately, we were unable to procure additional specimens of the high-CBD varieties for further testing.

As for CBN, the majority of samples showed only trace amounts. The highest level detected was 1.4%, and only one other sample tested above 1%. CBN is a breakdown product of THC, so high CBN levels are expected in old, degraded samples. This was confirmed by the fact that one of the samples above 1% CBN was known to be a year old. The prevalence of low CBN in the samples was evidence that most available medical cannabis tends to be fresh and well-preserved. Otherwise, these results were of limited interest, as there are few if any known medical effects of CBN.

Another disappointing surprise was the failure to detect more than trace levels of THC or CBD in the liquid "Mother's Milk" sample. Upon further investigation, the lab determined that this was because it is impossible to extract cannabinoids from fat-based liquids using standard methanol extraction techniques. Consulting with other researchers, we found that there is no known method for isolating THC from fat-based liquids.

Later, we located a lab that claimed to have developed a secret, proprietary method for extracting cannabinoids from fat. With considerable difficulty, we arranged to have the lab test the Mother's Milk. To our disappointment, however, once again only trace amounts of THC and CBD were detected. Just to make sure, one of us swallowed a sample of the Mother's Milk (which by now had spent several

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Table: THC and CBD Test Results (Round 1 vs. Rounds 2 and 3)

	1st Round		2nd Round		3rd Round (New Lab)	
Sample name	THC -1	CBD-1	THC-2	CBD-2	THC-3	CBD-3
High CBD	11.6%	28.0%	4.0%	16.2%	2.8%	8.8%
Sinsemilla BB 006	25.2	<.1	18.2	<.1	14.9	<.1
Sinsemilla BB 008	27.4	<.1	35.1	<.1	21.0	0.07
Sinsemilla MR001	18.0	<.1	11.7	<.1		
Sinsemilla BB 009	10.2	1.3	7.6	2.8		
Sinsemilla SCJ	14.2	<.1	14.1	<.1		
Sinsemilla BB 007	21.1	<.1			12.8	<.1
Sinsemilla Tri 501	27.2	<.1			20.0	<.1
Sinsemilla BB 010	18.0	0.3			8.7	<.1
Sinsemilla BB 004	18.6	<.1			13.0	<.1
Sinsemilla AQ	23.7	<.1			17.6	<.1
Hashish	68.6	0.1			44.0	<.1
Mother's Milk	<.1	<.1			<.1	
NIDA Leaf			3.9%	<.1		
Low-grade Leaf			2.1	<.1		

months in the freezer) and found it to be delightfully potent. Evidently, the lab's technique had failed. It appears that further advances in testing technology will be needed in order to properly analyze fat-based oral cannabis products such as Mother's milk, bhang, ghee, and possibly baked goods such as brownies.

The extraordinarily high THC potency in the sinsemilla samples raised troubling doubts about the reliability of the test results. The lab director expressed concern about the sample preparation, saying that he had noted a tendency for the oils to separate from the rest of the liquid during extraction. We therefore decided to re-submit some of the samples for a second round of testing. We selected six samples, including the one with anomalously high CBD. As a check, we added two new samples with presumably low potency: a sample of low-grade leaf, and some of the government's own marijuana, grown for NIDA, whose potency is known to be in the 2.9 - 3.9 % range.

In the second round of testing, the average THC potency for the seven samples declined slightly to 15.1% from 17.8% in the first round. For the six low-CBD samples, second-round potencies varied between 65% and 128% of their first-round values (see table). The high CBD sample registered a precipitous decline of 60 - 65% in both THC and CBD, bolstering suspicions of some kind of irregularity in the sample. NIDA's marijuana came in at 3.9%, at the high end of its expected range, and the low-grade shake came in at 2%. One sinsemilla sample registered a record 35% on re-testing.

The second round of testing failed to dispel our uncertainty about the results. Overall, the trend of the data seemed to confirm our suspicions that the first round results had been systematically too high. However, the wide variation in individual test results between the two rounds undermined confidence in any firm conclusions. While it seemed reasonable to infer that we were dealing with some genuinely potent cannabis, the high-range results for NIDA's pot suggested that the second round might still be too high.

After some months of head-scratching, we stumbled upon the opportunity to re-check our test results via a circuitous route to a second lab. This lab, recognized for its expertise in cannabis potency testing, was the same one that tested the Mother's Milk. In addition to the Mother's Milk, we submitted seven sinsemilla samples, the high-CBD sample, and the high-potency hashish. The potencies were uniformly lower in the third round than the first, by proportions ranging from 25 - 50%. All of this clearly implied that our first round test results had been systematically on the high side. Still, the average potency of the seven sinsemilla samples was an impressive 15.4%, four or five times greater than NIDA's marijuana.

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From this, we can safely conclude that the marijuana currently being provided by underground cannabis clubs is far superior in quality to that currently provided by NIDA to the eight legal medical marijuana patients. Due to its higher THC content, patients need consume only a fraction of the harmful, non-medically-active tars and gases in cannabis smoke in order to achieve the same effective dose. This is of course especially significant in light of the recent Institute of Medicine report, which singled out smoking as the major adverse health hazard of medical marijuana. Aside from THC, we could find no significant presence of the other tested cannabinoids, CBN and CBD, except in one or two anomalous samples. There is thus little evidence that patients are currently making use of differing varieties of cannabis to treat different medical conditions, although it is possible that other, untested cannabinoids remain lurking in the background. Finally, our experience shows that laboratory measurements of cannabinoid content can vary widely from test to test and lab to lab, and are entirely undependable in the case of fat-based cannabis liquids. •