

Potency of Marijuana



Susan A. Stoner, PhD

It can be hard to predict how cannabis might affect people. This is partly due to differences from person to person. It is also partly due to differences in potency of cannabis. We might expect stronger cannabis to have stronger effects, but what does “stronger” actually mean?

What does “stronger” mean?

In general, “stronger” means containing a higher concentration of the active ingredient. With cannabis, this isn’t so simple. Cannabis is a plant that has multiple active ingredients. A major family of chemical compounds in cannabis is called cannabinoids. The main ingredient that’s responsible for getting people “high” is a cannabinoid called delta-9-tetrahydrocannabinol, or “THC” for short. Another active ingredient is a cannabinoid called cannabidiol, or “CBD” for short. It doesn’t get people high but has other types of effects. CBD dampens the effect of THC. Other cannabinoids and chemical compounds in cannabis plants such as terpenes and flavonoids may also have effects. How these interact with THC and CBD and each other is not well understood but is called the “entourage effect.” Interactions between different concentrations of different cannabinoids in different samples of cannabis probably account for differences in how strong cannabis feels or how strong its effects are. Everything else being equal, in general, the more THC in cannabis, the stronger it may feel, and the more CBD in cannabis, the less strong it may feel.

What accounts for differences in cannabinoids in cannabis?

The level of cannabinoids in cannabis can vary depending on the form of cannabis, the strain of the plant, the way in which the plant is grown, the part of the plant that is used, the way the cannabis is prepared for use, and the way it is stored.

Form of Cannabis

Cannabis plants are sexually dimorphic, meaning they can be male or female. Normally, the male cannabis plant fertilizes the female plant. Female plants are the most potent. The National Institute on Drug Abuse considers >10% THC to be “very high THC.” The U.S. Drug Enforcement Agency (DEA) considers >12% THC to be “high potency.”

Cannabis consumers in states with legalized cannabis sales (“legal states”) have access to a wide variety of cannabis products in a range of forms in the legal marketplace. What is available on the black market in states without legal cannabis sales (“illegal states”) is more limited. In illegal states, the most widespread forms of cannabis come in plant form: marijuana (cannabis containing leaves, stems, and seeds) and sinsemilla (buds/flowers of female cannabis plants). Hashish and hash oil may also be readily available in illegal states. In 2017, the average THC concentration found in seized cannabis was 9% in marijuana, 18% in sinsemilla, 46% in hashish, and 56% in hash oil.

In legal states, consumers have access to tinctures, topicals, edibles, “flowers” (sinsemilla), pre-rolls (pre-rolled joints) made from ground cannabis or sinsemilla, and many different forms of extracts and concentrates including but not limited to kief, hash, resins, rosins, waxes, sauces, hash oil, distillates, and crystals.

Species vs. Strain

Strains of cannabis are known by their unique names, such as “Blackberry Kush,” “White Widow,” and “Pineapple Skunk.” There are two species of cannabis in common use as a medicinal or recreational drug: *Cannabis sativa* and *Cannabis indica*. Most strains are either pure sativa or pure indica or a hybrid between the two. Sativa is reputed to have more invigorating and cerebral effects while indica is reputed to have more sedating and body relaxing effects. There is no scientific evidence to support these differences, and there’s no clear difference between the species in THC or CBD content. Each strain has a reputation that it has certain effects (energizing, euphoric, sedating, focusing, creative, etc.), but there’s no scientific evidence to support this either. Some strains tend to have more THC or CBD than others. Crossbreeding and genetic modification have produced strains with very high levels of THC. However, potencies are not reliable because they are affected by cultivation and processing techniques.

Cultivation and Processing

The way cannabis is grown affects the amount of cannabinoids in the plant and, therefore, its potency. The amount and quality of cannabinoids, terpenes, and flavonoids produced depends on temperature, humidity, light, and soil acidity. The most potent part of the cannabis plant is found in the unfertilized flowers of female plants grown in isolation from male plants so as not to develop seeds. Because it’s difficult to control growing conditions, cannabis grown outdoors varies quite a bit in potency. Even indoor-grown cannabis varies in potency due to variations in growing conditions. For that reason, “White Widow” grown in one state might be very different in potency than “White Widow” grown in another state. Cannabinoids, terpenes, and flavonoids degrade over time, so cannabis freshness affects its potency.

Washington State

In Washington, all cannabis products sold in the legal marketplace are tested and labeled for THC and CBD concentration. A spot check of the online menu of a cannabis retailer in Seattle in May 2019 shows a wide range of THC and CBD concentrations in available products (see Table 1). Most flower, pre-roll, and cartridge products are listed with their THC and CBD concentrations. Out of 220 varieties, only 9 were listed with <10-12% THC. Other concentrates are listed with only their THC concentrations. Tinctures, topicals, and edibles are listed with their THC and CBD content per package. The dosage for topicals and serving size for edibles is usually 10 milligrams THC. With THC, the more milligrams you use, the stronger the effects.

Has Cannabis Become Stronger?

The short answer is yes. The DEA has been testing the chemical makeup of seized cannabis for since at least 1972. At that time, most of the cannabis seized was not grown in the U.S. On average, it contained less than 2% THC. In 1980, the average THC content of seized marijuana was 1.2% and sinsemilla was 6.3%. By 1997, the averages were 4.2% and 11.5%. In 2017, these percentages were 9.4% and 17.8%. CBD content has not increased over time. In addition, sinsemilla has accounted for larger and larger proportions of seized cannabis over the years, so high potency cannabis is much more widely available than it was decades ago. The chart below shows changes in THC and CBD content as reported by several authors.

In the legal marketplace, high potency products seem to be some of the best sellers. Therefore, cannabis growers have selectively bred plants for high THC content. Some varieties of flowers available in retail marijuana stores are labeled to have over 30% THC. However, the potency listed on labels is not always reliable, and results vary from lab to lab.

Increases in potency of available cannabis probably mean that cannabis users today take in higher levels of THC compared to users in the past. At this time, we don’t fully understand the implications of increasing availability of increasingly potent cannabis with regard to public health.

References

1. Chandra S, et al. New trends in cannabis potency in USA and Europe during the last decade (2008–2017). *European Archives of Psychiatry and Clinical Neuroscience*. 2019 Feb 1;269(1):5-15.
2. ElSohly MA, et al. Constituents of Cannabis sativa L. XXIV: the potency of confiscated marijuana, hashish, and hash oil over a ten-year period. *Journal of Forensic Science*. 1984 Apr 1;29(2):500-14.
3. ElSohly MA, et al. Potency trends of Δ 9-THC and other cannabinoids in confiscated marijuana from 1980–1997. *Journal of Forensic Science*. 2000 Jan 1;45(1):24-30.
4. ElSohly MA, et al. Changes in cannabis potency over the last 2 decades (1995–2014): analysis of current data in the United States. *Biological Psychiatry*. 2016 Apr 1;79(7):613-9.
5. Jikomes N, Zoorob M. The cannabinoid content of legal cannabis in Washington State varies systematically across testing facilities and popular consumer products. *Scientific Reports*. 2018 Mar 14;8(1):4519.
6. McLaren J, et al. Cannabis potency and contamination: a review of the literature. *Addiction*. 2008;103(7):1100-9.
7. Mehmedic Z, et al. Potency trends of Δ 9-THC and other cannabinoids in confiscated cannabis preparations from 1993 to 2008. *Journal of Forensic Sciences*. 2010 Sep;55(5):1209-17.
8. Sevigny EL. Is today's cannabis more potent simply because it's fresher? *Drug Test Anal*. 2013 Jan;5(1):62-7.
9. Smart R, et al. Variation in cannabis potency and prices in a newly legal market: evidence from 30 million cannabis sales in Washington state. *Addiction*. 2017 Dec;112(12):2167-77.
10. United Nations Office on Drugs and Crime. Why does cannabis potency matter? *World Drug Report 2009 Series*.

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