Delta 8-THC, Delta 10-THC, and THC-O Acetate
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How will history look upon a society that passively allows the manufacture, sale, and use of the following mind-altering substances?

1. A chemical synthesized from a surplus plant material using an acid and an organic solvent, such as toluene, which is usually used in the manufacture of paint products. This chemical may exists naturally in the plant but at very low levels, if at all; therefore it must be synthesized for mass production.
2. A chemical rediscovered by a random accident and resulted from the extraction and distillation of plant material in the presence of a fire retardant used to extinguish forest fires. This chemical does not occur naturally.
3. A chemical also synthesized using not only an acid and an organic solvent but by also using a very toxic chemical needed to complete the process. If synthesized from its nearest analog molecule, it can be made by using only the last step, specifically through the use of a very toxic chemical. It can be synthesized from a variety of sources and is three times more potent when compared to its nearest analog. This chemical also does not occur naturally.

What are these synthesized chemicals?
They are: #1-Delta 8-THC[1], #2-Delta 10-THC[2], and #3-THC-O[3], also known as THC-O-Acetate.

What feedstock can be used to form these chemicals?
One source is hemp-derived cannabidiol, more colloquially known as CBD.[1]

The Basic Chemistry
CBD is considered a hydrocarbon molecule comprised of twenty-one carbon atoms, thirty hydrogen atoms, and two oxygen atoms. It can therefore be denoted as $C_{21}H_{30}O_2$. There are other molecules that have the exact same number of carbon, hydrogen, and oxygen atoms, and they are known as isomers.[4]

Both the Delta 8-THC and Delta 10-THC variants are isomers of CBD. Also, the naturally occurring and psychoactive Delta 9-THC in cannabis plants (hemp and marijuana) is an isomer of CBD. All of these variants thus have the same molecular formula, namely $C_{21}H_{30}O_2$. However, they are different structurally.[5]

A simple analog to consider would be through the use of a chemical Lego® block model.[6] For an example, a carbon atom could be represented by a red block, a hydrogen atom could be represented by a white block, and an oxygen atom could be represented by a blue block. For the CBD molecule, one could symbolically represent it by connecting twenty-one red blocks (C_{21}), thirty white blocks (H_{30}), and two blue blocks (O_2) all together in a manner to represent its structural arrangement. Using the exact same number of blocks, differently shaped models could be made to represent Delta 8-THC, Delta 9-THC, and Delta 10-THC.

In the example above, the CBD building block model would be altered structurally by one's hands. In the world of chemistry, these structural alterations to CBD can be facilitated through the use of different levels of temperature, various catalysts (in the form of an acid), and various organic solvents (such as toluene) into other molecules such as Delta-8, Delta-9, and Delta-10 THC.[1,2] There are also by-products formed after the structural transformation along with some residual acid and organic solvent. In the FDA governed pharmaceutical world, the by-products and solvent are removed and the acid is neutralized. However, few, if any, safeguards exist in the cannabis world because there is not the usual regulatory oversight by the FDA.[7]

Keep in mind that the manner in which a molecule interacts and affects the human body and mind is dependent upon its atomic makeup, specifically the number and type of atoms present, and its structural arrangement.[8] In the case of CBD and its isomers, the way that they can affect the body and mind can be traced back to how they interact with the receptors where they connect. A CBD molecule is molecularly the same but structurally different from the other variants of the THC molecule, hence they can each affect the body and mind in similar and/or completely different ways.

Delta 8-THC
Delta 8-THC was first synthesized in 1967 by Israeli chemist Raphael Mechoulam.[5] It exists naturally in cannabis plants, but only in very small (normally ~0.1%)[1] or in trace amounts.[5] There was therefore a need to synthesize the molecule so that it could be studied in depth because of its rarity in cannabis plants.

The passage of the Hemp Bill and subsequent rush to cash in on this crop via the production of CBD has resulted in a glut of this chemical in the marketplace.[10] However, it has been known for decades that CBD can be

synthesized into other molecules, and one of those molecules is Delta 8-THC [5], which can have reportedly similar but milder mind-altering effects as Delta 9-THC.[11]

Multiple concerns arise when synthesizing Delta 8-THC from CBD. It is usually not performed in a manner that guarantees the safety of the consumer. Since a strong acid and an organic solvent such as toluene, which is normally used in paint products, are used, the resulting product needs to be "washed" in a base in order to neutralize any residual acid and any remaining organic solvent needs to be removed. There are also other by-products that may need to be removed, some of which are unknown. The reaction by-products can also include traces of Delta 9-THC. Given that there are few, if any, testing protocols and almost no regulatory oversight for this product, it is basically the "Wild West" for the consumer.[7, 9, 12]

Delta-8 THC is reportedly weaker in its effects when compared to Delta-9 THC, which has many unwanted side-effects including cyclic nausea and vomiting, anxiety, and paranoia.[13, 14] Delta 9-THC can also trigger mental illnesses such as psychosis and schizophrenia, especially in teens.[15] Could these same side-effects, even if slightly milder, also apply to Delta-8 THC? Only time will tell.

There is currently no research about the long-term effects of Delta 8-THC use. Therefore, anyone who uses this product becomes an unwitting participant in a science experiment, an experiment that could result in serious mental illnesses, physical harms, and even addiction.

Delta 10-THC

There are very few scientific research papers that delve into Delta 10-THC. Most of the information about this chemical can be found in online cannabis industry articles, which appears to be based at times exclusively on anecdotal information.

The earliest science-based information regarding Delta 10-THC is from 1984 by the same Israeli scientist, Raphael Mechoulam, who was earlier researching Delta 8-THC. It too had to be synthesized using very dangerous chemicals (an acid and organic solvent); hence no one thought that it could ever be a safe, useful, and commercially viable substance.[16] However, that all changed by a random accident around 2020 in California.[17]

It is reported that Delta 10 THC was "discovered" again by Fusion Farms after processing some marijuana plant material that was later found to have been accidentally exposed to fire retardant, which was aerially applied to control a nearby forest fire.[16] After the extraction and distillation process of this material, the finalized product contained some unknown white crystals, which was initially thought to be CBC, namely cannabichromeme. Further analysis took place, and the crystals were found to be Delta 10-THC. It was assumed that the fire retardant acted as a catalyst, which facilitated the isomerization process of the naturally occurring Delta 9-THC into Delta 10-THC. This molecule is in many ways similar to the Delta 8 THC molecule in that it needs to be synthesized for economical mass production. The only major difference between the two molecules, including Delta 9-THC, is the location of the carbon double-bond.[2, 18]

Much of what has been stated previously about Delta 8-THC can be directly applied to Delta 10-THC. It too can be synthesized from hemp derived CBD. Similarly, the acid catalysts and organic solvents that can be used to produce this chemical are generally considered to be harmful. Also, some of the critical concerns are exactly the same, specifically the residual reactants and byproducts, some known and unknown, that result.[1] There are also concerns about how this chemical will impact the user both physically and mentally because of its similarity to the Delta 9-THC molecule.[13, 14, 15]

Again, are the residual reactants and contaminates being properly removed after it is synthesized from a cannabinoid such as CBD? What exactly are the side-effects from prolonged use? Unfortunately, no one really knows the full story on Delta 10-THC either.

THC-O Acetate

THC-O acetate is formed when a THC molecule is acetylated, or specifically when an acetyl functional group is added to a chemical compound, with acetic anhydride, which is similar to the late 1870's process used to convert morphine into heroin.[1, 19] According to a documented 1942 lecture by Roger Adams, THC-O acetate was first formulated in 1895 by Wood, Spivey, and Easterield.[20] These chemists further processed the resulting crystalline acetate structure into a viscous oil and mistakenly called it cannabinol (CBN).[20] Later in the early 1940's, Wollner,

Matchett, Levine, and Loew found that that acetylated Delta 9-THC had a greater potency than the other known cannabinoids at the time.[20]

What is interesting about this molecule is that it was even considered by the United States military as a possible chemical warfare agent to incapacitate enemy troops.[21] Most of the experiments using various THC analogs and derivatives were done at the U.S. Army Laboratories at the Edgewood Arsenal in Maryland.[22] Initial testing was done on dogs by Adams et al during the mid- to late-1940's.[22]

The chemical used in the acetylation process, namely acetic anhydride, is a DEA listed chemical regulated in the Controlled Substances Act because it can be used to produce not only heroin, but also methaqualone (Quaalude-a sedative) and phenyl-2-propanone (a precursor chemical to make amphetamine or methamphetamine).[23, 24, 25] Also, acetic anhydride is a highly corrosive chemical, and thus can irritate or damage the skin, eyes, and lungs, depending on the concentration.[26] This chemical also forms poisonous gases when exposed to a fire.[26] One can just imagine the grave bodily harms that could be incurred if this chemical is not properly handled in a manufacturing facility and/or if the THC-O acetate is not properly processed and is then later smoked, vaped, or dabbed.

As noted previously, the acetylation process, when applied to morphine, produces heroin. It was found that this process increased the blood-brain barrier penetration of heroin 100-fold when compared to morphine, which could be the reason why heroin is so addictive.[27] Heroin is also reported to be two to four times more potent than morphine.[28] Similarly, THC-O acetate is reported to be 3 times more potent than Delta 9-THC.[29] Therefore, it is very likely that THC-O acetate is going to be even more addictive when compared to Delta 9-THC based on how acetylation can change the behavior of a drug.

It is not a stretch to believe that the cannabis industry will begin to apply the acetylation process to a variety of the CBD & THC analogs in an attempt to make a family of very powerful and addicting drugs that can literally fly under the current regulatory framework because it is solely focused on controlling Delta 9-THC. In fact, some manufacturers are already making THC-O acetate directly from synthesized Delta 8-THC versus naturally occurring Delta 9-THC.[30] Given how the acetylation process generally increases the strength of a drug two to four fold, it is easy to see that Delta 8-based THC-O acetate will be just as intoxicating and addictive as marijuana derived Delta 9-THC. Sadly, no one in government is doing anything about it.

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