

Cannabis Emissions and the Source of the “Skunk-like” Odor

by Byers Scientific | March 19, 2021 | Blog | Resources



Have you ever wondered why the term ‘skunky’ is so often used to describe the detectable emissions of particularly smelly cannabis? Well, a research team lead by Byers Scientific has discovered the answer in their ongoing research to isolate and mitigate the odor-causing compound(s) found in cannabis.

Byers Emissions Analysis comprehensively measures all the complex emissions coming from the plant using the Leaf Enclosure Method. This method, which was engineered for cannabis by our very own Dr. Alex Guenther, allows us to capture and analyze the types and quantities of site-specific terpenes. We then qualify and quantify this data by generating site-specific gas-phase emission rates. Through a recent research collaboration with Iowa State University and private odor identification experts, Byers Scientific was able to identify the compound 3-methyl-2-butene-1-thiol (i.e., 3MT) as the primary source of the traditionally objectionable odor of cannabis. This specific volatile chemical appears to be the primary culprit responsible for the downwind skunky-like odor complaints commonly reported for commercial cannabis operations across North America.

A Skunk's Spray Contains a Thiol Also Found in Cannabis

A skunk's spray or musk is comprised of seven compounds, six of which are sulfur-containing thiols, including 3MT, which give the musk its distinct and pungent smell. The human olfactory system has evolved over time to detect

substances, such as these sulfur-containing thiols, at exceptionally low levels. This level of recognition is called the odor detection threshold (ODT). Our nose can sometimes detect compounds at levels that are extremely difficult and in some cases, nearly impossible to detect with ambient air samples using highly sensitive analytical equipment.

We Sense the Emissions from Cannabis

Our sense of smell—like our sense of taste—is part of our chemosensory system, or the “chemical senses”. In order for us to smell a particular thing, molecules from that thing must make it into our noses. We can smell things because the emissions that we smell are the result of constant off-gassing. More precisely, molecules are escaping from the subject because they are “volatile”, meaning they evaporate easily i.e., they go into gaseous (vapor) state with little to no energy put into them. These volatile emissions also have an extremely low boiling point. Once the molecules are in a vapor-state they can make their way into our noses.

The Human Olfactory System Receives Odor for the Brain to Identify

Olfactory sensory neurons give us the ability to smell. These neurons, which are open to the air, connect directly to the brain and each olfactory neuron has one odor receptor. Vaporized odor molecules (chemicals) floating in the air reach the nostrils and dissolve on to a thin layer of mucous membrane called the olfactory epithelium. Once the neurons detect the molecules, they send messages to your brain which identifies the smell. There are more smells in the environment than there are receptors, and any given molecule may stimulate a combination of receptors, creating a unique representation in the brain. These representations are registered by the brain as a particular smell. Human olfactory is designed sensitively to detect malodorous chemical compounds in parts per trillion (ppt) before we get rotten food in our digestive system where sickness would be inevitable. Therefore, the cannabis emissions that are sulfur-containing compounds, such as thiols, can be detected by the human nose.

The Cause of the Common Cannabis Odor

Utilizing a triangulation approach of analytical chemistry (i.e., Gas Chromatography-Mass Spectrometry, GC Olfactometry), Leaf Enclosure Method and field observation, the research team was able to conclude that 321 MBT is likely responsible for the common 'skunk-like' odor of cannabis. The compound is also the same odorous volatile chemical which has previously been reported to carry responsibility for the skunky-like aroma and flavor defect in light-struck beer.

Historically, the objectionable odor of cannabis has often been tied to terpenes which are aromatic compounds found in many plant emissions. This important discovery linking the 'skunky' cannabis and 321 MBT supports the more persuasive expectation of a sulfur component within the chemical profile of the cannabis plant emission.

Future Research in Progress to Evaluate and Mitigate Cannabis Emissions

This finding represents true progress in the scientific understanding of the source of the distinctive and divisive odor of cannabis; however, this is only the first critical step in fully researching this issue. Our leaf enclosure studies reveal other thiols present in the plant emissions and, more importantly, other compounds in the plant's gas-phase emissions and atmospheric reactions may significantly affect the perception and measurement of 321 MBT. Efforts are currently underway by Byers Scientific to further evaluate the odor and the most appropriate approach for mitigation.

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