



Lethal Highs

BY MARCY MASON

*How CBP's
laboratories
are protecting
America from
designer drugs*



★ Bill Wagner, a senior chemist at CBP's Chicago laboratory, pioneered analytical techniques to identify potential designer drugs.

photo by Mary Mason

'These packets were lethal. There were three synthetics in the mix and it was a deadly combination.'

—Bill Wagner, senior chemist, CBP Chicago laboratory

me that these were mostly sedatives. So I did some research online.”

Bishop discovered that people in Europe were smoking the herbs like tobacco and getting an effect that appeared almost identical to marijuana. “People were saying they had massive, massive highs from this product and in my mind, I was thinking: ‘That’s impossible. There’s no combination of those herbs that would cause that kind of an effect,’” he said.

Furthermore, the packets were explicitly marked “not for human consumption.”

As Bishop pursued his research, his suspicions grew. He learned that there was a potent painkiller called HU-210 that produced many of the same effects as natural THC, tetrahydrocannabinol, the main mind-altering ingredient found in the cannabis plant, or marijuana. Although HU-210 had been originally developed in the late 1980s at Hebrew University in Jerusalem for medicinal benefits, the chemical had become part of a new wave of street drugs known as synthetic cannabinoids. HU-210 is extremely powerful. Bishop noted that researchers had described it as 100 to 800 times more potent than natural THC and it had much longer lasting effects.

Then, in November 2008, several large shipments, each containing 1,500 of the little Spice packets, arrived from the Czech Republic. Bishop knew something was up. As with many of the previous shipments, he sent samples to the CBP laboratory in Chicago for testing. Those had all come back negative. But this time, Bishop wanted to see if the samples contained any traces of HU-210.

The testing was slow and arduous. “I had never seen anything like this before. This was really new stuff to us,” said Bill Wagner, one of the lead scientists at CBP’s Chicago laboratory. Wagner suspected that the substance had been spray dried on plant material, and needed to be removed before any kind of analysis could be done. Once that was accomplished, Wagner spent hours using special equipment to break the substance down into separate chemical components. His initial analysis uncovered two synthetic cannabinoids. But he didn’t find any visible evidence of HU-210. So Wagner tried another type of analysis using his instrument at a higher level of sensitivity. This time, he unmasked the drug. “It was present in such small amounts I had to change my analytical technique to detect it,” said Wagner, who spent more than 10 hours testing the sample.

“These packets were lethal, Wagner said. “There were three synthetics in the mix and it was a deadly combination. I can’t imagine anybody not having bad effects after smoking that mess.”

The shipments at the DHL facility were seized and the lid was irreparably blown off of the murky world of the designer drug trade. Wagner contacted the Drug Enforcement Administration, the agency responsible for domestic enforcement of federal drug laws, to explain what the CBP lab had uncovered. In March 2009, a story about the CBP Chicago lab’s discovery was sent out as an intelligence alert in the Microgram Bulletin, a law enforcement newsletter published by the DEA to inform the forensic community about new drug-related developments. “They were the first laboratory to identify that material,” said Jill Head, the supervisory chemist for the DEA’s Special Testing and Research Laboratory Emerging Trends Program. “The material

In late 2007, not long after Steven Bishop began working as an agriculture specialist for U.S. Customs and Border Protection at the DHL express courier hub in Wilmington, Ohio, he noticed there was a steady stream of shipments listed as “herbal incense” arriving at the port. For months, the CBP officers assigned to the facility had been testing the shipments to see if they contained illicit drugs, but the results always turned up negative. There was nothing illegal about the goods, so they were released into the U.S. commerce.

The officers were perplexed. Why would anyone spend the money to express ship potpourri into the country?

Bishop, a botanist, was intrigued. He began targeting the shipments that were increasing exponentially in number. The contents were always the same. Each package contained nearly a dozen little, shiny, foil packets filled with an herbal mixture marketed under the brand name, Spice. Bishop also noticed something odd about the ingredients. “I started looking through all of the different herbs that were listed on the label,” he said. “It was pretty obvious to

that CBP analyzed was very significant to us. We had first heard about these kinds of materials back in 2006, but this was the first time that we had seen analytical results saying that an actual synthetic cannabinoid was present and added to plant material.”

Since 2009, the CBP labs have continued to be on the frontline of protecting the American public from designer drugs, a highly dangerous and deceptive group of psychoactive substances that are specifically designed to skirt around existing drug laws. With the alarming growth and sophistication of these synthetic drugs, the expertise and innovative contributions of the CBP labs are critical to keeping the country safe.

Historical perspective

Although the term “designer drugs” was coined in the 1980s, the concept of designing drugs to get around the law can be traced back to the 1920s when opiates such as morphine and heroin were banned in the U.S. Many of the current designer drugs were initially developed in the 1980s by university research laboratories and pharmaceutical companies that were trying to find cures for ailments and medical problems. One of the most noted researchers, John W. Huffman, an organic chemistry professor at Clemson University, worked with a team of scientists for more than 20 years to develop more than 400 synthetic cannabinoid compounds to aid in the research of multiple sclerosis, AIDS and chemotherapy. “All of these drugs were designed to interact with certain receptors in the brain,” said Mike McCormick, a CBP science officer at the agency’s Washington, D.C., headquarters. “The cannabinoids bind to the brain’s receptors in the same way that THC, the active ingredient in marijuana, does.”

Much to Huffman’s chagrin, his formulas were tinkered with and used as a basis to create synthetic marijuana. As early as 2004, one of Huffman’s cannabinoid compounds, JWH-018, was being sold in Europe as part of a smoking mixture intended to substitute for real marijuana. The synthetic marijuana, which sold commercially first under the brand name Spice and then under other names such as K2 or King Krypto, gave users a high, and at the same time the drug’s chemical

manipulation allowed them to pass drug tests and avoid being arrested. “The molecular change was just enough to make the chemical different,” said McCormick. “By changing the structure slightly, it creates a separately defined chemical, and therefore, it’s not listed as an illegal substance.”

Concurrently, another family of designer drugs was coming on the market. Synthetic cathinones or “bath salts” were being chemically produced from cathinone, an amphetamine-like stimulant found naturally in the khat plant. Although synthetic cathinones visually resemble bath crystals, there is no connection between the drug and the legitimate bathing product. Bath salts usually come in the form of a white or brown crystalline powder and are taken orally, inhaled or injected with a needle.

More recently, hallucinogens, another class of designer drugs, have gained popularity. Somewhat akin to LSD, hallucinogens are known for their psychedelic effects. One of the main hallucinogen drug families, called 2C, encompasses a number of psychedelic phenethylamine substances. Typically sold as a fluffy, sparkling-white powder or in tablet form, the 2C compounds were first synthesized in the 1970s and 1980s by Alexander Shulgin, an American medicinal chemist and pharmacologist.

The problems associated with this new wave of drugs are manifold. “As these molecules are altered, we don’t really know what kind of an effect they’re going to have on the brain,” said McCormick.

Unknown effects

“One of the biggest problems we have with designer drugs is how little information we have on their acute or long-term pharmacology,” said Marilyn Huestis, the chief of chemistry and drug metabolism at the National Institute on Drug Abuse, a part of the National Institutes of Health based in Bethesda, Md. “To me, one of the most frightening things is that people are experimenting on themselves,” she said. “With most of these designer drugs, we don’t even have basic information. We don’t know what they do to animals. We don’t know what they do to humans. We don’t know how toxic they are. And here, you have people taking these drugs that aren’t synthesized under good manufacturing conditions,” she said. “They’re making them in clandestine labs with absolutely no cleanliness or quality control, so people don’t know what they’re putting into their bodies.”

Some effects, however, have been observed. “With the synthetic cathinones, the bath salts,” said Huestis, “there has been behavior that’s linked to violence and death.”



photo by Rand Careaga

★ Thomas Schoch, the assistant director of CBP’s San Francisco laboratory, draws structures of potential substances the CBP labs might encounter.

Similar to the adverse effects of cocaine, LSD and methamphetamine, bath salts produce an increased heart rate, extreme paranoia, hallucinations and violence, which causes users to harm themselves or others. “With the synthetic cannabinoids [fake pot], it hasn’t been proven yet that they can cause death by themselves,” said Huestis. “But there are many deaths involved with drunk driving as well as hallucinations where people think, for instance, that they can fly.”

“The Centers for Disease Control and Prevention put out a warning on some of the synthetic cannabinoids, specifically UR-144 and XLR-11, that those compounds are related to renal toxicity,” causing kidney failure, Huestis added. Some of the other side effects are agitation, extreme nervousness, nausea, vomiting, elevated blood pressure, tremors and seizures.

In 2010, an estimated 11,406 emergency department visits in the U.S. involved a synthetic cannabinoid, according to the DAWN Report, published by the Substance Abuse and Mental Health Services Administration in Rockville, Md. Of these visits, 75 percent were made by patients 12-29 years of age, and 78 percent of them were male.

“Designer drugs also can be very addictive. It’s estimated that one in 10 people who try marijuana develop problematic use,” said Huestis. “But it’s been well-documented that designer drugs are up to 100 times more potent, so we know that individuals are becoming dependent on them as well.”

Molecular manipulation

Beyond these problems are the ones confronted by law enforcement. “These drugs aren’t on the controlled substance list because their chemical compositions have been tweaked a little,” said Ira Reese, the executive director of CBP’s Laboratories and Scientific Services division. A controlled substance is a drug or chemical whose manufacture, possession or use is government regulated. In the U.S., the DEA determines which substances are controlled based on how dangerous they are and their potential for abuse.

“When we find a new chemical compound, we report it to the DEA and it gets placed on the controlled substance list within 90 to 120 days,” said Reese. “But then, the molecular structure is tweaked a little bit more, which means it’s not on the list again. So it has to go through the same 90 to 120 day

process to get on the list to make it illegal.”

“On average, we see a new compound every week,” said McCormick. “It’s quite a challenge because as a drug’s molecular structure starts to change, it takes a lot of work to figure out what these substances are. This happens every time a new designer drug comes out.”

What makes designer drugs especially dangerous is the perception that they’re safe. Often marketed as legal highs, the public is led to believe that these drugs have

been tested and pose no danger. They’re camouflaged as harmless household products such as plant food, room fresheners, stain removers, toilet bowl cleaners, incense or bath salts. “Unless these drugs are prohibited, it makes it very difficult to protect the public from using them,” said Reese.

Understanding how the drugs are metabolized by the body is also important. “You need to be able to identify what the drug is,” said Huestis. “Most of our drug testing is measured in urine, but we don’t know how

photo by Jennifer Alfred

★ Neele Shepard, the lead drug chemist at CBP’s Chicago laboratory, analyzes suspected designer drugs at the international mail facility in Chicago.



these drugs are metabolized by the body,” which makes them hard to detect. Not only is this dangerous in an emergency room setting, but as Huestis noted, it’s important to be able to identify these drugs for military, athletic and law enforcement testing purposes.

Drug source

Most of the designer drugs are coming from Asia. “China and India play primary roles in the manufacture of much of this,” said Carlos Cortez, a CBP senior intelligence officer. “Most of it enters the U.S. through the West Coast at international mail centers and express courier hubs. CBP is at the forefront of intercepting these drugs and the CBP labs are critical in their identification.”

When the designer drug boom first took off in 2009, CBP officers in the field would detain suspicious looking packages, do preliminary testing and then send the samples to the labs for further analysis. “At the field level, all we are doing is trying to make an initial identification of what we have before us,” said Cortez. “Is it marijuana? Is it cocaine? Is it heroin? Is it methamphetamine or Ecstasy? We test for all of them and even if it tests negative, that still does not mean that it’s not a designer drug. It could be a synthetic cannabinoid or a synthetic cathinone, but only the lab can identify that for us.”

By 2011, the designer drug market had exploded and the labs were inundated with test samples. “We were just way overloaded. We had a huge backlog of 300 to 400 samples,” said Neele Shepard, the lead drug chemist at CBP’s Chicago laboratory. “We had a long turnaround time and we thought, ‘Why not go out to the field and screen these packages onsite? If we can identify the substances right away, it will lower the number of samples that come in. This will not only decrease our turnaround time, but we’ll be able to give the officers a quick answer.’”

So every two to three weeks, Shepard and her team travel to the ports in their region, which extends from Maine to Minnesota down to Kentucky. “They’ll set aside packages for us that they think are of interest,” she said. The CBP scientists will then test the samples using an infrared spectrometer that analyzes the substance and generates a spectrum or a unique fingerprint of the chemical. “It’s a quick process. Within 10 seconds you have a spectrum,” said Shepard. After the spectrum is collected, it’s

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—John Landers, CBP assistant area port director for tactical operations, Cleveland

run through a database. “We run a search and see if we get a match,” she said. If the sample requires further analysis, Shepard’s team will send it to the lab where it will undergo more testing.

Testing designer drugs is much more difficult than testing traditional drugs. “It’s very time consuming,” said Shepard. “If something comes in and it’s cocaine, that’s easy to identify. It takes two hours to analyze the sample and write it up. But with designer drugs, we might be looking at three separate pieces of data from separate pieces of equipment and you still don’t know. There’s no database to look at,” she said.

Faster analysis

To help speed up the onsite testing, the CBP labs launched a pilot in May at the DHL facility in Cincinnati. “The Chicago CBP lab scientists trained our officers on how to use some of their equipment and we’ve been turning around analysis within 24 hours,” said John Landers, CBP’s assistant area port director for tactical operations in Cleveland. “We’ll pull a sample, drop it into the spectrometer and when the reading comes out, we download it and email it to the lab. They’ll send us an email back that same day and then we’re able to reach out to our investigative arm, Homeland Security Investigations/ICE, and say, ‘We have an official lab determination. Do you want to investigate this?’”

According to Landers, on average, four out of every 10 samples are identified as a synthetic cannabinoid. “Identifying the substance in a timely manner is what’s key for a controlled delivery, where law enforcement intercepts the package and is present when the delivery is made,” he said.

A case in point happened prior to the pilot last December, when the CBP lab expedited an analysis of a suspected synthetic

drug sample targeted by an officer at the Cincinnati DHL facility. “He sent it to the lab, we identified it, and we got him a report very quickly,” said Shepard. The sample, which was manifested in the shipping documents as acrylic paint, turned out to be XLR-11, a dangerous synthetic cannabinoid.

The officer initiated a controlled delivery, which led to the discovery of a clandestine manufacturing facility in Jacksonville, Fla. There, the imported drugs were being mixed with acetone, a chemical used in nail polish remover, and sprayed on plant material that was strewn across a massive tarp on the floor of a dirty warehouse. Law enforcement agents shuttered the operation and seized more than 530 pounds of the drug-laced potpourri. They also collected 30,000 foil packets of 40 different product brands. Documents found on the premises indicated that during the two weeks the site was in operation, more than 1.1 million empty packets had been ordered. Had they been filled and sold, the retail value was estimated at more than \$40 million.

“Thanks to the CBP labs’ findings, we’re able to identify the people who are involved in trafficking these drugs,” said Landers. “That allows us to stop the importation, shut down distribution networks, and protect the public from being harmed by this material.”

Criminal convictions

Legal action results from some of the cases too. “Many times the officers send us samples and we’re able to develop evidence that can be used against people who are distributing synthetic drugs,” said Thomas Schoch, the assistant director of CBP’s San Francisco laboratory. Such was the case in July for a DEA-led investigation that resulted in the federal conviction of a Tempe, Ariz., designer drug manufacturer and distributor, Michael Rocky Lane.

'It's a worldwide epidemic. It's a very serious problem and it's not going away anytime soon.'

—Ira Reese, executive director, CBP Laboratories and Scientific Services

“We got an early indication that this person was importing things that were dangerous and could be considered controlled substances,” said Schoch. “In May 2012, a suspicious parcel was transiting through the San Francisco Air Mail Center and our CBP officers picked it up. We had a chemist on-site at the time, so he ran a quick test using our portable instrument and determined that it had the chemical signature of a cathinone,” said Schoch. “It was sent to the lab and our analyst identified the substance as alpha-PBP, a synthetic cathinone.”

The package was seized and used as evidence in the trial. “This is an example of how we were able to help stop someone who is distributing these dangerous drugs and protect the public,” said Schoch.

The CBP labs have worked with the DEA to protect the public from designer drugs in other ways. “The CBP labs often encounter a lot of compounds very early in the process, whether it’s the first time that these substances have ever been seen in the country or just very early where we may have heard of something or seen one or two instances of it showing up,” said Joshua Yohannan, a forensic chemist who works in the DEA’s Special Testing and Research Laboratory Emerging Trends Program.

Protecting the public

In terms of protecting the public, getting this data early is extremely critical, said Yohannan. “The market for these drugs is changing so rapidly that early identification is key to figuring out where the next generation of compounds is going,” he said. “A lot of the work that we do to protect the public really focuses on the identification of these materials. Realistically, nobody knows what he or she is buying in those packets. There’s no information whatsoever.”

The communication exchange between the agencies on the lab level is vital. “When CBP finds something that’s new, they let us know that they’ve seen it, and possibly could send us a portion so that we could analyze it and understand that material,” said the DEA’s Jill Head. “What that allows us to do is have the synthetic organic chemists who work here make that material if it’s not available to buy. We then have a reference to check against and can send the material to all of the DEA labs so that they can make an identification. When they make an identification, then that gives the prosecutor something to work with,” she said. “If you can’t identify the drug, then the case can’t go to trial. But if the case does go to trial and there is a conviction, that helps the public, because it opens the possibility of taking those materials off the street,” she said.

The CBP labs’ contributions go further. They participate in major sting operations

including Project Synergy, a DEA-led operation that was the largest synthetic designer drug bust in U.S. law enforcement history. The seven-month operation, which ran from December 2012 until June of this year, involved a myriad of law enforcement agencies across 35 states. Approximately 3,300 pounds of designer drugs and \$15 million in cash and assets were seized. Teams of lab personnel from CBP and DEA worked side by side at the mail facilities and express courier hubs. “We were running some tests on the substances that were found inside the packages,” said Yohannan, who was assigned to the Federal Express facility in Memphis, Tenn. The packages that appeared to contain synthetic drugs were pulled out of circulation. “They were detained by CBP and sent to the CBP laboratories for a full analysis and to make an identification,” he said.

The growth of designer drugs, however, is skyrocketing. According to the 2013 World Drug Report published by the United Nations Office on Drugs and Crime, the number of new psychoactive substances is proliferating at an unprecedented rate, posing unforeseen public health challenges. “It’s a worldwide epidemic,” said Reese, who oversees the CBP labs. “It’s a very serious problem and it’s not going away anytime soon.” ■



★ Placing a suspicious sample on an infrared spectrometer, CBP Science Officer Mike McCormick tests for the latest designer drugs.

photo by Robert Helman