

Bitter pill

Testing times for party drugs

BY **DAVE SAMMUT** AND
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Determined recklessness around party drugs, and the sometimes tragic outcomes, has fuelled the call for pill testing. So what's involved for chemists?

Australia has an abundance of laws aiming to save people from themselves. Recreational drugs and narcotics are illegal in every state and territory. Billions of dollars are spent enforcing these laws. Our gaols are filling fast on the back of drug-related crime. And yet, says the Australian Bureau of Statistics, deaths caused by 'party drugs' have increased 300% in the last 20 years (bit.ly/2Vd1s2t). Over the summer of 2018–19, pill testing at music festivals became a highly politicised issue in Australia. Arguments raged between two broad camps: 'just don't take drugs' and 'harm minimisation'. And while the two sides bickered, five young people died at music festivals in New South Wales alone.

'I know all the risks but I'm still going to take drugs at festivals', stated a 21-year-old student from Sydney, writing in *The Age*. 'Push legality aside and draw a comparison to drinking', says the student '... [drugs] simply offer something different on a night out, something that in moderation can help you have a better time.' (bit.ly/2LaPntI)

Across various festivals and pill-testing trials in Europe and the UK over recent years, published results show that about two-thirds of users decide not to take drugs found to contain harmful substances. Of course, this means that one-third still intend to do so.

Whichever side we might take individually, we can at least consider as chemists what pill testing involves – the methodology, the science (and its limitations) and what analyses can be realistically conducted, in the field, over short time periods.

Party drugs cover a very wide range of chemical compounds (see box p. 21), presenting a significant challenge even before considering the additional challenge of analysing unknown fillers and contaminants that could pose as much or greater risk than the intended drug itself.

Analytical methods vary widely, both in complexity and capability. This article focuses just on the methods that can be applied to drug samples that start as a powder or small-sample shaving from a pill, as is relevant to pill testing at festivals. Urine, saliva and blood

detection methods, for example in mobile drug detection in road policing (see April 2017 issue, p. 20), are a separate issue.

The simplest possible form of pill testing is the use of drug detection kits. These offer a basic, binary response to the presence or absence of a specific drug analyte. Drug detection kits typically involve a spot/colour test based on the presumed reaction between the target analyte and a chemical indicator.

Kits are relatively inexpensive, and can be used by an unskilled operator. However, they typically do not give a reliable indication of the drug purity, or of the presence of potentially lethal contaminants. And, of course, the test has to be selected on the basis of the anticipated drug or drug class. Multiple tests may be required to improve specificity, or for drug mixtures.

In a 2000 review of 12 kits, toxicologists O'Neal et al. concluded that, 'Although these tests are sensitive and can be relatively specific, the actual colour observed ... depends on many factors such as the concentration of the drug, whether the drug is a salt or free base, which salt form is present, the presence of contaminants in the sample, the colour discrimination for the analyst and the conditions under which the [test] is performed.'

(www.ncbi.nlm.nih.gov/pubmed/10725655)

Mass spectrometry-based methods – supported by gas or liquid

From M1 to XTC – party drug names

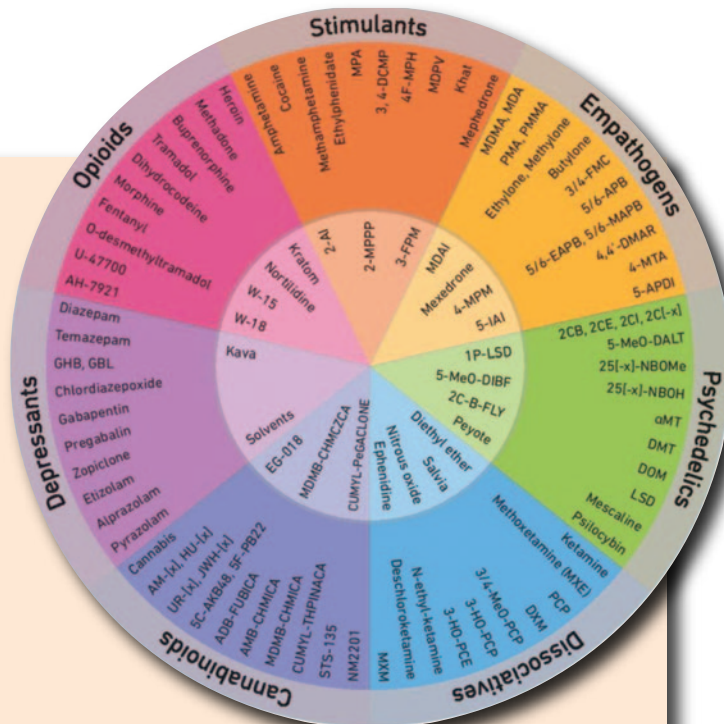
Even the terminology around modern ‘party drugs’ can be confusing. There are so many names and rapidly evolving slang terms that it can be hard to follow. So here is the basic breakdown.

Stimulants/hallucinogens

- cocaine, methyl (1*R*,2*R*,3*S*,5*S*)-3-benzoyloxy-8-methyl-8-azabicyclo[3.2.1]octane-2-carboxylate
- LSD, lysergic acid diethylamide
- amphetamines (speed)
- methylamphetamines (‘speed’, ‘ice’, ‘crystal meth’) – note that the difference between ‘ice’ and ‘speed’ is commonly purity, typically 80% vs 10–20%, respectively.
- MDMA, 3,4-methylenedioxy-methamphetamine (‘Ecstasy’, ‘caps’, ‘E’, ‘doopa’, ‘eccy’, ‘XTC’, ‘Molly’) – usually sold in pill form, but also as a powder, crystals or capsules
- MDA, methylenedioxyamphetamine (‘Sally’)
- new synthetic cathinones: mephedrone (‘Meow Meow’, ‘M-Kat’); MDPV, methylenedioxypropylvalerone (‘Bath salts’, ‘Ivory Wave’); and methylone (‘M1’).
- new synthetic piperazines: BZP, benzylpiperazine; and TFMP, 3-trifluoromethylphenylpiperazine (‘A2’, ‘Rapture’), emulating the effects of MDMA
- substituted phenethylamines, going by names such as ‘N-bomb’ and ‘Death on Impact’
- dissociative anaesthetics, such as methoxetamine (‘MXE’, ‘Moxy’)

Depressants

- alcohol
- marijuana (cannabis), active ingredient tetrahydrocannabinol (THC)
- gamma hydroxybutyrate (GHB)



The Drugs Wheel (by Mark Adley), which classifies drugs as part of seven general categories: stimulants, depressants, cannabinoids, opioids, dissociatives and empathogens.

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- benzodiazepines (‘Benzo’) – prescription medication (including diazepam/Valium, alprazolam/Xanax and oxazepam/Serepax)
- new synthetic cannabis (‘K2’, ‘Spice’, ‘Kronic’, ‘Northern Lights’)

Opioids/painkillers

- heroin (3,6-diacetylmorphine), methadone
- morphine
- fentanyl
- hydrocodone, oxycodone
- codeine

chromatography – are the most powerful of the drug detection and analysis options. Mass spectrometry can be used to measure the concentration of specific target drugs, and to detect and identify unknown drugs, contaminants and species. However, it requires expensive, relatively immobile equipment, a skilled operator, and time. Through the Emergency Department at Canberra’s Calvary Hospital, Dr David Caldicott offers a pill-testing service, for mailed samples over a 1–3 day

turnaround. So mass spectrometry is difficult for in-field testing at music festivals.

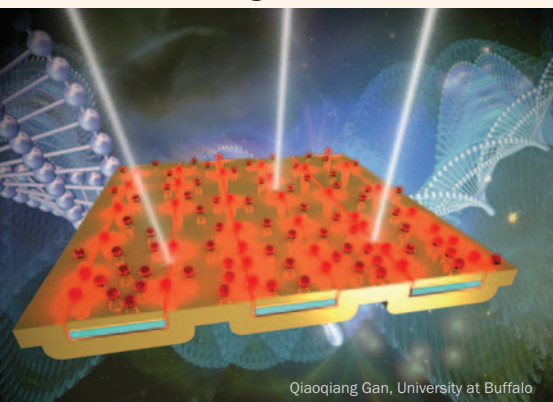
For the same basic reasons – cost, skill and importability – X-ray diffraction isn’t practical for field use. The technique difficulty is also compounded by the need for careful sample preparation, and the preference for crystalline solids.

Several instrumental spectroscopic techniques can be used for drug analysis: UV–vis, Raman and infrared. Of

these, FTIR spectroscopy is the most commonly used in the field. Although it can’t differentiate enantiomers, it can differentiate diastereomers (such as pseudoephedrine and ephedrine), free base/acid forms and salts. It is relatively affordable and portable, and can be used by a moderately skilled operator using a database of spectra.

Infrared spectroscopy also has the advantage of needing only a very small sample (some alternative methods require a whole pill). The spectra should

Optical device could detect drugs, bomb-making chemicals



Qiaoqiang Gan, University at Buffalo

Surface-enhanced infrared absorption spectroscopy. Infrared light (the white beams) is trapped by tiny gaps in the metal surface, where it can be used to detect trace amounts of matter.

Infrared absorption is one of the most effective types of spectroscopy. Researchers are working to make the technology more sensitive, inexpensive and versatile, and now, a new light-trapping sensor, developed by a University at Buffalo-led team of engineers, is making progress in all three areas.

The new sensor, which works with light in the mid-infrared band of the electromagnetic spectrum consists of two layers of metal with an insulator sandwiched in between. The researchers used a fabrication technique called atomic layer deposition to create a device with gaps less than 5 nanometres between two metal layers. These gaps allow the sensor to absorb up to 81% of infrared light, a significant improvement from the 3% that similar devices absorb.

This process is known as surface-enhanced infrared absorption (SEIRA) spectroscopy. The sensor, which acts as a substrate for the materials being examined, boosts the sensitivity of SEIRA devices to detect molecules at 100–1000 times greater resolution than previously reported results. SEIRA could be used to find traces of molecules, including but not limited to drug detection in blood, bombmaking materials, fraudulent art and tracking diseases.

National Science Foundation

be relatively robust against the presence of small quantities of impurities, and as long as the test is performed quickly it should be relatively unaffected by moisture. A downside is the possibility of sampling error associated with shaving an inhomogeneous pill. It may also encounter difficulty if multiple drugs are present in the sample.

Infrared spectroscopy was the technique applied by Pill Testing Australia's Dr David Caldicott and his team of volunteers at the 'Groovin' the Moo' ACT festivals in 2018 and 2019, where Australia had its first opportunity to gather experience and data about the possibilities. The ACT sanctioned these trials, and Pill Testing Australia has offered free trials to all other Australian states and territories, where pill testing is currently banned.

The testing was conducted in an isolated tent with a private entrance, in an area in which police had agreed to avoid. As people came in, they were assessed for intoxication (and referred to the medical tent if considered not competent to accept advice), and given a questionnaire and a consent form to sign.

When a sample was submitted, it was photographed and weighed. The size of the sample varied from a few scrapings of a pill to half a tablet, at the user's discretion – the bigger the sample, the better the results. The service users were given a card with an identifier number. Tied to that number, information was retained for medical authorities about what was in the drugs, in case they have an adverse reaction at the festival or afterwards. In a couple of cases, samples were provided by the medical tent in the event of suspected overdose.

Medical volunteers and harm reduction counsellors were on hand to talk to revellers about their drug use, and amnesty bins were provided for people to dispose of unwanted drugs. The process reportedly took about 15 minutes to complete.

Two infrared spectrophotometers were staffed by professional chemists, including Associate Professor Malcolm McLeod FRACI CChem. At peak demand, samples were being analysed every 2–3 minutes – close to capacity. The query spectrum was matched to library spectra, ranked and scored to identify the major component. Further analysis was conducted by subtracting the major component and re-matching to the library.

Following the analysis, colour-coded results were posted to a board.

- Red was a warning, and meant the sample contained potentially lethal or dangerous compounds.
- Yellow was an alert, and indicated that there might be other elements in the sample (such as caffeine), or that the sample might be another drug altogether.
- White meant the drug was what they thought it was.

Some toxicologists continue to express concern. Dr John Lewis, quoted by the *RACGP News* in January, says, "The Hippocratic Oath is *primum non nocere*, "First, do no harm", and I'm not sure pill testing complies with that". Andrew Leibie expresses concern that FTIR says nothing about dose, and that "The newer and the more exotic [new drug] compounds are, the less likely FTIR is to be able to detect them, because it relies on a library match – if it hasn't been told what some of these new drugs look like, it just won't see them."

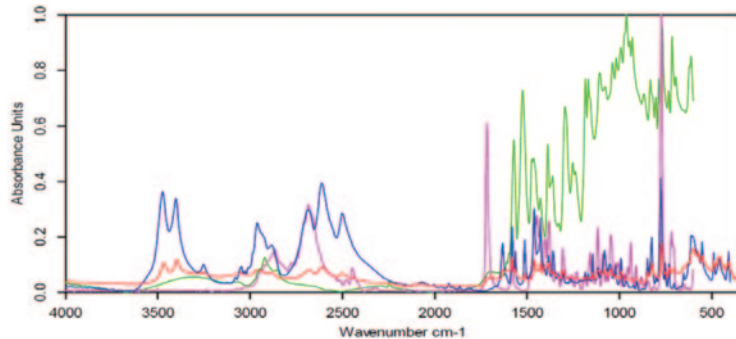
It is worth considering any liability that might accrue to the volunteer chemists conducting the pill testing. Marsdens Law Group has stated that the waivers signed by participants 'do not extinguish the duty of care which does exist. In circumstances where it is highly possible that a lot of patrons may be under eighteen, drunk, or under the influence of drugs, the legal effect of any waiver could be minimal'.

Pill Testing Australia disagrees: 'Our legal advice is very clear that prosecutions against such services would be very difficult to sustain given

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Algorithm	Standard
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Hit No.	Hit qual.	Compound name	Entry no.	Lib. index	CAS number
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2	206	KETAMINE HCL	910	2	1867-66-9
3	161	DORACRYL BRILLIANT RED X-4GS 300%	979	4	

Example of a single-component FTIR analysis of sample GTM001 presented as 'MDMA' that indicates MDMA as a component with low score with other ranked matches MDEA and safrole.



Example of a single-component FTIR analysis of sample GTM001 showing the IR spectrum of the sample (red) and overlaid IR spectra for MDMA (blue), MDEA (pink) and safrole (green).

Reproduced with permission from Makkai T., MacLeod M., Vumbaca G., Hill P., Caldicott D., Noffs M., Tzanetis S., Hansen F., 2018, Report on Canberra GTM Harm Reduction Service, Harm Reduction Australia

our objectives and protocols'. It emphasises that at no point do the volunteers or health professionals ever say that a drug is 'safe'. In fact, they specify that the only way you can be sure that you won't have an adverse reaction is to not take the drug. 'We will give sound advice and information but in the end, it is the consumer that makes the final decision.'

The 2019 trial tested 170 samples, of which 113 returned a match score above instrument cut-offs. Matches were also achieved below instrument cut-offs, but with substantially lower confidence. MDMA was the prominent substance identified and to a lesser extent cocaine, ketamine and methamphetamines. Seven dangerous substances containing *N*-ethylpentylone were also identified, all of which were voluntarily discarded

to the amnesty bin provided.

Regardless of the pill testing itself, the opportunity to have a competent medical intervention between the purchase and ingestion of the drug must surely be a positive step in the harm minimisation approach. And international data has suggested that over time, pill testing results in a strong decrease in the presence of impurities in drugs sold illicitly, or of pills that don't contain what they are 'supposed to'.

According to Caldicott, there are two things that change young people's minds about drug taking: 'The idea that what they're taking could kill them and the idea that they've been ripped off ... We're able to provide both of those messages'. The Sydney student commented in *The Age* that, 'In the absence of a better system, most of us

just turn to past experiences and word of mouth as a safety net, which is exactly why we need pill-testing.'

The proponents would contend that the ACT trials argue strongly in favour of the pill-testing concept. A number of lives were potentially saved at the 2019 'Groovin the Moo' festival alone. Opponents would argue that pill testing condones and facilitates drug use. This article won't attempt to resolve the politics for either side.

What can be said is this: the Australian Medical Association has come out in favour of pill testing, as has the Royal Australian College of General Practitioners and the Royal Australasian College of Physicians. So it is worth considering whether the RACI should take a position on this as well, particularly as some of our members are already involved.

Perhaps the last word should go to Caldicott: 'As an emergency doctor ... there is not a parent I've ever spoken to who is prepared to turn around and say, "Do you know what? As long as [my child's] death serves as a lesson to others I'm OK with it"'

Dave Sammut FRACI CChem and Chantelle Craig are the principals of DCS Technical, a boutique scientific consultancy providing services to the Australian and international minerals, waste recycling and general scientific industries.

A note of thanks to RACI

As this is our 50th article for *Chemistry in Australia*, the authors (Dave Sammut and Chantelle Craig) would like to thank RACI for letting us contribute. We feel privileged to be able to pursue our hobby as writers, and we love the opportunity to learn about the topics as we research each article. Our particular thanks go to Sally Woollett, who has always offered a gentle and supportive editorial hand, and whose guidance makes us look better writers than we actually are; and to Catherine Greenwood, for all her hard work in making our simple words into attractive articles. And our thanks to all of the RACI members who have been so kind as to read our work, and occasionally to offer commentary or praise (no hate mail so far).