Drug Analysis

Powders, tablets, capsules, herbal materials and liquids which are suspected to contain controlled drugs are routinely submitted to forensic laboratories.
This section is intended to explain how these materials are examined and their ingredients identified, and how it is decided whether or not they contain controlled drugs.

Examining submissions

The first stage in drugs analysis is to examine the submitted items and develop an analytical strategy. Most analytical techniques only require very small samples, so representative subsamples of the submitted material must be obtained. If the submission is a single bag of powder or a tablet, this is straightforward – it is homogenised and a subsample taken for analysis. If however the submission is large, a sampling strategy has to be applied. This will typically involve sorting the material into types, which may include presumptive testing (see below), followed by application of a statistical sampling strategy to ensure that the subsamples analysed are representative of the whole.

Identification

A variety of analytical techniques can be employed to identity the materials present. These vary from simple colour tests, based on chemical reactions, to advanced techniques such as Nuclear Magnetic Resonance (NMR) spectroscopy,

A conviction for drug possession or trafficking can result in serious consequences, so the forensic evidence presented to courts must be absolutely reliable. The many different analytical techniques which laboratories can apply to drug analysis have different discriminating powers. Advanced techniques are capable of producing definitive results, but can be too expensive or slow for routine operations. Other techniques are simple and inexpensive, but can produce ambiguous results. In addition, it is good practice in forensic analysis, where practical, to use two, completely independent, analytical techniques.

To address these points, a protocol has been developed by an international group of experts, the Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG), to define which combinations of analytical techniques are necessary to demonstrate the identity of a substance to a satisfactory level of proof for presentation as evidence (see www.swgdrug.org).

The SWGDRUG recommendations divide analytical techniques into three categories, A, B and C.

Category A includes primary analytical techniques such as Infrared Spectroscopy, Mass Spectrometry and Nuclear Magnetic Resonance Spectrometry. These produce very reliable identifications derived from the molecular structure of the substance being analysed.

Category B includes chromatographic techniques such as Liquid Chromatography, Gas Chromatography and Capillary Electrophoresis, as well as Microcrystalline Tests (material is dissolved and treated with a reagent that causes it to crystallize; examination of the crystals under the microscope can indicate which drug is present). Although strong evidence, Category B techniques are not definitive. It is possible, for example, for two different materials to have the same elution time in a chromatograph.

Category C techniques are presumptive tests, including chemical reaction colour tests, immunochemical assays and ultraviolet spectroscopy. Although a quick and simple way to help to sort suspect materials, these techniques cannot be relied on to provide an identification, as they may only indicate that a material is one of a type and false positive responses from unrelated compounds can also occur.

SWGDRUG requires that a combination of techniques be applied before an identification can be reported. This can be a Category A technique coupled with at least one other independent technique from Category A, B or C. For example a Gas Chromatography – Mass Spectrometry (GC-MS) system combines a Category B technique (chromatographic separation) with a Category A technique which uses a completely different analytical principle (molecular identification by Mass Spectrometry) to produce a definitive identification. Commercial GC-MS systems are fully automated and capable of continuous operation, so GC-MS has become a workhorse technique in drug analysis laboratories.

If a Category A technique isn't used, at least three other techniques must be applied, including two independent Category B techniques. For the identification of Cannabis – which remains one of the most commonly encountered drugs - visual identification of macroscopic and microscopic features of the plant can be used as two Category B techniques, as long as the distinctive botanical characteristics of the plant can be discerned.

Assessing Purity

It may also be necessary to report the purity of the materials being examined. The most commonly applied quantification techniques are either liquid or gas chromatography. Samples are passed through a chromatographic column so that the components are separated and emerge sequentially. Detectors placed at the end of the chromatographic column can be used to produce a chromatogram, which consists of a series of peaks showing the different components emerging over time. The size of the peaks within the chromatogram can then be related to the quantity of material present.

Assessing Whether a Material is Controlled

Once identified, a material has to be checked against the relevant legislation to establish whether it is controlled. Within the United Kingdom, the Misuse of Drugs Act 1971 (as amended) sets out which chemicals are controlled drugs.

There are a variety of routes by which materials can come under the control of the UK's Misuse of Drugs Act (MDA).

- Internationally, two key United Nations Conventions address drug control; the 1961 'Single Convention on Narcotic Drugs', which covers traditional, often plant-derived, drugs of abuse, such as heroin, cocaine and cannabis, and related synthetic narcotics, and the 1971 'Convention on Psychotropic Substances', which covers synthetic drugs such as LSD, amphetamine and the benzodiazepines. The materials covered by the Conventions are updated from time to time and are listed in two UN documents, the 'Yellow List' (of narcotics) and the 'Green List' (of psychotropics). All signatories to the UN's Drug Conventions, of which the UK is one, are obliged to control these materials within their national legislation.
- The European Union also operates a 'Joint Action in New Psychactive Drugs' which involves identifying and assessing the risks presented by new drugs appearing within Europe. If a risk assessment indicates a significant hazard, the

European Council can instruct all EU member states to enact controls in their national legislation. Any such materials are then added to the UK's MDA listing.

- Finally, the UK can unilaterally add materials to the MDA list. The MDA includes a requirement for an independent Advisory Council on the Misuse of Drugs (ACMD) to advise ministers on drug control and it is this body which assesses new drugs and advises on whether control under the MDA is required. This activity has become increasingly important in recent years as a series of novel materials (the so-called 'legal highs') have appeared. Recent ACMD-led additions have included synthetic cannabinoids (2009) cathinones, including mephedrone (2010) and phenazepam (2012).

The list of materials within the MDA is, however, not a simple list of named substances against which a chemical, once identified, can be compared. Instead, in a bid to avoid the problems of 'designer drugs' (structural modifications which produce a material which retains the effect of the original drug, but which falls outside the legal controls), the UK has developed a series of 'generic controls'. These are intended to control groups of substances by defining a core molecular structure and a series of possible modifications, all of which are controlled. Thus, for example, Ecstasy (3,4-methylenedioxy-N-methylamphetamine) is not specifically named within the MDA, but is instead controlled because it is within the scope of a generic control on phenethylamines (amphetamine-like materials). Generic controls are also in place for other 'families' of synthetic drugs, including the anabolic steroids, barbiturates, cathinones, fentanyls, piperazines, synthetic cannabinoids and tryptamines.

The role of the drugs analysts is therefore firstly to assess submissions to establish an analytical strategy, and then to apply a variety of analytical techniques to identify materials present. They then have to be able to compare these with the controls within the MDA to assess whether the submission contains a controlled drug. Finally, they present their findings in the form of witness statements. They may also be called to court to present their findings in person and to answer questions about their work and conclusions.