Investigating poisoning

Forensic science at work

Tony Hargreaves

Investigating serious crimes such as murder, rape and terrorism requires forensic science experts. These people work alongside the police to find the evidence that will bring the culprit to court. In this article, ***Tony Hargreaves*** *looks at criminal poisoning and shows how forensic science is used to solve serious murder cases.*

"23 cats killed in 3 years – poisoning suspect arrested"

It is not just people who are poisoned – it can be animals, both pets and wildlife. In many cases this is accidental poisoning, when chemicals such as pesticides are used incorrectly, but there have also been criminal cases of animal poisoning. When animals are poisoned investigators often focus on tracking down the 'bait station' and in one case a piece of chicken was found to contain a poison made from a common household product. To get a conviction it has to be proven that this was put down intentionally as bait.

Poisons, medicines and food

We tend to think that a poison is a special type of chemical substance that can kill a person, usually by swallowing it. But poisons are not special substances and many everyday substances can be poisonous if swallowed in large enough amounts. For example, if you take paracetamol for a headache it works perfectly well so long as you use the correct dosage. The headache disappears and no harm is done. However, if you take an overdose, the paracetamol can kill you. It is the size of the dose that makes the difference.

Food can also be a poison. For example, marzipan contains cyanide and this is what gives it its almond flavour. In normal amounts it is harmless because the amount of cyanide is so small. However, if you ate a kilogram of marzipan you would soon be dead from cyanide poisoning. In reality it would not be possible to ingest such a large amount as this would cause vomiting so there's no need to worry about a few extra slices of Christmas cake!

Obviously some substances are more poisonous than others. If you swallow a gram of sodium chloride (common salt) it will cause no harm. However, if you swallow a gram of sodium cyanide you will be dead within seconds.

In poisoning cases the substances used by the murderer are usually the more toxic chemicals so that a tiny amount may be put into a victim's food or drink without it being noticed.

How poisons work

A poison works by damaging the body's normal chemical reactions. For instance, respiration is an essential chemical reaction in the human body.

Forensic scientists at the scene of a murder

Key words

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careers

The new EU symbol for toxic substances

If a person inhales carbon monoxide this attaches to the haemoglobin and prevents it transporting oxygen from the lungs to the cells. Respiration stops and the person dies. Thus, carbon monoxide is regarded as a poisonous gas (see Box 1).

Box 1: Carbon monoxide

Carbon monoxide (CO) is a deadly gas which is produced during incomplete combustion of carbon-containing fuels. It is colourless, odourless, tasteless and difficult for people to detect. It can be produced in homes by gas or wood-burning heaters and cooking equipment, particularly if they are old. Symptoms of poisoning include headaches and dizziness at low levels of CO but it can cause death at high levels. Carbon monoxide detectors are available and are useful if CO is suspected of being produced by household equipment. Carbon monoxide poisoning is diagnosed by measuring the level of CO in the blood.

Most poisonings take place not by inhaling but through swallowing. Some poisons are absorbed through the skin, such as the chemical weapons that were used until quite recently in warfare.

The crime scene

Where a body is found in suspicious circumstances, it is the responsibility of the forensic scientist to find the evidence that will lead the police to the culprit. If it is a case of suspected poisoning there may be some of the poison left at the crime scene and there will certainly be residues of it in the dead body.

Analysing a few specks of suspicious white powder from a crime scene is usually quite straightforward and it can often be identified within a matter of hours. Poison that is inside the body is more difficult to analyse - see Box 2. Usually the forensic scientist has to cut open the body and remove some of the organs. These are then prepared by dissolving a sample of the organ. The prepared solution is then analysed in a modern analytical instrument.

If it was thought, for example, that the deceased had died from swallowing arsenic then the stomach would be removed so that its contents could be dissolved in acid. The solution produced is then placed into an instrument called an Atomic Absorption Spectrophotometer (AAS) – see Box 3.

The instrument passes the prepared solution into a flame. Certain metals produce characteristic colours as you may have seen in flame tests in the school lab. The AAS analyses the light from the flame. This enables the substance to be identified and the amount present to be detected.

A flame test on copper sulfate gives a characteristic coloured flame.

Box 2: A notorious poisoner

Marie Lafarge, a Frenchwoman, was convicted of poisoning her husband with arsenic in 1840. This was the first case in which someone was convicted mainly upon forensic analysis results. She had purchased arsenic from the apothecary saying that it was to be used to kill the rats that infested her house. Her husband, Charles Lafarge, fell ill and was seen by a doctor. His condition was thought to be due to cholera, a disease that was common at that time. Later, suspicions were aroused when residues of white powder were found in a glass he had drunk from. Soon Charles was dead and samples from his body were taken for analysis using tests which showed that he had ingested arsenic. Marie was brought before the court, found guilty and sentenced to life imprisonment.

Box 3: Atomic Absorption Spectrometers

A solution of the suspected poison, such as arsenic, is passed into a high temperature flame where it emits light. The light is analysed by the instrument and the amount of arsenic measured. The instrument is also used to analyse samples for a wide range of metals.

A taste of poison

In the days before these modern scientific instruments, the forensic scientist had to use basic chemical tests. However, not many chemical methods were available and so in some cases the scientist had to taste the actual body fluids to identify the poison. This was done by comparing the taste of a body fluid with standard solutions of known poisons. Needless to say this was an unpleasant task. It was especially obnoxious when the body was not fresh but had been decomposing for a few months.

Working as a forensic scientist

To be a forensic scientist you need to have a science degree, usually in chemistry, biology or a related subject such as biochemistry or pharmacology. An assistant forensic scientist would need good GCSE passes and A-levels including at least one science A-level. In general most of the forensic science work involves chemistry, particularly analytical chemistry.

Forensic scientists analyse a wide range of evidence including human remains, firearms, explosives, DNA, body fluids, wildlife, fingerprints and impression marks. In addition to routine analysis, forensic science also involves research to enable the police to keep one step ahead of the criminal.

A forensic science technician examines a handgun for fingerprints and traces of blood.

Tony Hargreaves is a part time university lecturer with an interest in the applications of chemistry. He teaches chemistry, forensic science and maths.

Look here!

More information about careers in forensic science:
http://tinyurl.com/ars5kst

How animal poisoning is investigated:
http://tinyurl.com/alow7bz