

Poisoned by milk

Education in Chemistry

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In August 2008, China was host to the Beijing Olympics, one of the biggest sporting events ever staged, attracting billions of global TV viewers. But as the world looked on, one of China's most famous food safety scandals was already unfolding. Babies were falling ill in Gansu province in the northwest and 50,000 would eventually be hospitalised. By the 22nd September, four babies had been reported dead and at least two more are thought to have died before the scare was over. The culprit? A chemical called melamine, which was traced to powdered milk used in baby formula. Melamine was being used by parts of the Chinese dairy industry to bulk up their milk – its high nitrogen content gives a false impression of protein levels during nutritional testing. Unfortunately, melamine crystals can also form kidney stones that block tiny tubes in the kidneys, leading to kidney failure.

More babies fell ill and more companies became embroiled in the scandal as it developed. Potentially tainted milk was soon discovered in some of the food industry's best known brands. Chocolate producers Cadbury's and Mars pulled products from the shelves. During all of this, chemists in food analysis labs everywhere were receiving calls from concerned food manufacturers. They had to work hard to identify those products that contained the toxic chemical. The trouble was that melamine was not one of the chemicals that labs usually tested for and, initially, they didn't know how to identify it. Campden BRI was one of the UK companies facing this problem. 'With an issue such as melamine, there is no standard method that works on food, drinks or ingredients,' says a spokesperson for the company. Analysts at the company had to work fast to develop a reliable testing method, a process that took them around a week. That sounds fast, but every second counts in a food safety crisis.

Key to their new analytical method – and those of other food analysis companies, such as Premier Analytical Services (PAS) – was chromatography. Chromatography works by exploiting the fact different chemical substances have different solubilities. During the melamine scandal, both Campden BRI and PAS used chromatography as a separation method to pull melamine out of the mix of ingredients in their clients' products. This is never a straightforward process, since most processed foods contain many different ingredients, including chemicals that may be very similar to the contaminant the food analyst is searching for. 'When looking for a specific contaminant, this often has to be separated from the bulk of the food matrix, and then from other compounds with a similar chemical nature by chromatography,' says Campden BRI.

Liquid chromatography is a good choice for separating out the individual chemicals when looking for non-volatile compounds like melamine that don't vaporise very easily. However, gas chromatography can also be used if melamine is first chemically converted into more volatile derivatives. Gaseous methods have the advantage of allowing 'odour port assessment' – analysis by expert 'sniffers', who are experienced in identifying taints by their smell. Food analysts also have access to mass spectrometers, which they use to carry out the definitive final analysis of components from a separation. Each compound generates a specific spike on a mass spectrum, indicating its molecular mass.

As a result of the rigorous tests that were carried out, food testing companies were able to provide their clients with a definite answer as to whether their products had been tainted with melamine. In the majority of cases, Campden BRI says, it was able to reassure clients that their supply chains had not been affected. In the remaining cases, products could be traced and recalled.

The tests that were developed by chemists a decade ago have proved useful more recently too, for testing nutritional supplements used by weightlifters and other athletes. Melamine can also be used to falsely bulk up the protein content of some of these supplements. In 2015, South African scientists tested 138 nutritional supplements for melamine using liquid chromatography and mass spectrometry. They found that 64 contained melamine. Although the contaminant was present at what are considered safe levels by the World Health Organisation, athletes who use higher than the recommended dosage of supplements may be risking their health. So the scientists recommended that food safety authorities continue to test for melamine and track levels in these products.

In China, consumer confidence in the dairy industry remained devastated for a long time following the 2008 crisis, but the melamine scandal did influence the country's revised food policy and new Food Safety Law, which came into effect the following year.

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