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Empa researchers investigate dioxin decomposition in the Yushchenko case

Elimination rate faster than expected

In 2004 the current Ukrainian president, Viktor Yushchenko, suffered a severe case of dioxin poisoning. In order to understand how the human body reacts to remove the poison, Empa researchers have analyzed over a hundred samples taken from the politician. They succeeded for the first time in identifying decomposition products which are created, and they also observed that when the dioxin dose is very high – as was the case with Viktor Yushchenko – the excretion rate is higher than expected.

Dioxin is regarded as an extremely poisonous pollutant which degrades very slowly. In the case of the Ukrainian president, Viktor Yushchenko, scientists from Empa's Analytical Chemistry Laboratory together with doctors from the University Hospital, Geneva, have traced the mechanisms by which dioxin is broken down and excreted by the human body. The work has just been published "Online First" in the renowned medical journal "The Lancet". "We were able to identify and also quantify dioxin decomposition products for the first time ever," is how Empa expert Markus Zennegg, who performed the majority of the analyses, summarizes the most important result. The researchers discovered that the main path of excretion was via the digestive tract, confirming what was already known from animal studies. They also uncovered a massive reduction in the elimination half-life, down to about 16 months instead of the previously observed five to ten years. The elevated dosage had obviously caused the body to increase its production of the enzyme responsible for the decomposition of dioxin.

The work was only possible thanks to the cooperation of Viktor Yushchenko himself. The Ukrainian president agreed to the publication of the results and allowed doctors in hospitals in Geneva and Kiev to take more than one hundred samples of blood, urine, faeces, sweat, skin, skin cysts and adipose tissue over three years.

«The Dirty Dozen»

Dioxins form a complete group of substances, of which 2,3,7,8-tetrachlorodibenzo-p-dioxin (abbreviated to TCDD) is the most toxic. There are no technical uses for dioxins, which are formed as unwanted by-products during combustion processes. Dioxins are very stable and linger in the environment for long periods. They belong to the "dirty dozen", a group of long-lived organic pollutants such as pesticides manufacture and use of which was forbidden in 2001 by an international agreement, the Stockholm Convention. The main symptom of acute dioxin poisoning is chloracne, recognizable by the obtrusive growths and cysts which develop on the patient's skin. Other organs, principally the liver, are also affected.

The Yushchenko file: a chronology of events

In the winter of 2004 elections took place in Ukraine to choose a new president. Viktor Yushchenko, the candidate thought most likely to win, suddenly fell ill with a mysterious sickness. After three months of tests, the cause was identified as dioxin poisoning. The fact that this condition occurs very infrequently made the diagnosis difficult, but coincidence also played a role. The chloracne, which became very visible on the victim's face after a few weeks, led an English doctor in the correct direction. Two independent laboratories subsequently discovered that Yushchenko had a level of dioxin in his blood which was 50,000 times higher than the population average. Since only pure TCDD was found, it was deduced that he must have been intentionally poisoned with synthetically manufactured dioxin.

The Seveso accident and Agent Orange

The facts that he was intentionally poisoned and the very high dose make the Yushchenko case unique, though the Ukrainian politician is by no means the first victim of dioxin. In 1976, for example, there was a dramatic accident at chemical factory in Seveso, in northern Italy. A chemical cloud containing large quantities of TCDD, contaminated an area of 15 square kilometers. Since then TCDD has become known unofficially as the Seveso poison. The decontamination work and clearing up took years to complete. Dioxin pollution also occurred during the Vietnam War when the US Air Force dropped large quantities of the defoliant chemical Agent Orange, which was contaminated with dioxin, over extended areas of the country.

References

«2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) poisoning in Victor Yushchenko: identification and measurement of TCDD metabolites», O. Sorg, M. Zennegg, P. Schmid, R. Fedosyuk, R. Valikhnovsky, O. Gaide,. V. Kniazevych, J.-H. Saurat, The Lancet, Online First, Aug 5, 2009 (www.thelancet.com)

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