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THE MOST POISONOUS SUBSTANCES IN THE WORLD

When we think of deadly poisons, most of our minds will jump instantly to arsenic. George III of England, Napoleon Bonaparte and the Gaungxu Emperor of China are all thought to have died from its effects – either from a deliberate assassination or accidental exposure.

It sounds horrific – but arsenic is positively innocuous compared to the other substances that exit on our Earth.

Consider tetrodotoxin (TTX), a poison found in puffer fish and blue-ringed octopuses that leaves you paralysed as your body goes through some agonising reactions. Your lips and tongue will begin to burn, your mouth will erupt with saliva and you'll get very sweaty. You'll no longer be able to speak, swallow, seizures will begin and your body will slowly shut down – all while you are completely lucid but unable to move. Death comes after six hours of symptoms and there is no antidote.

Often these poisons are alarmingly close to home. One lethal chemical – cardiac glycoside digoxin – can be found in a common garden flower, while the deadliest can be seen in many hospitals; just 2kg would be enough to wipe out the whole of the human race. Watch the full clip to find out where these chemicals come from and why they are so lethal.

Scientists recently discovered a new type of botulinum toxin (a.k.a. botox) that they believe is the deadliest substance known to man.

Its LD50 is tiny – at most 1 nanogram per kilogram can kill a human. Extrapolating from its effect on mice, an intravenous dose of just 10^-7g would be fatal to a 70kg person. This is the most toxic substance in nature: just one gram (0.04 ounces) couldkill 14,000 people if swallowed – or 8.3 million if injected!

The toxin, which comes from the bacterium *Clostridium botulinum*, blocks the chemical that makes nerves work, causing botulism and death by paralysis.

There are seven types of botulinum toxin, named type A–G. Type A and B are capable of causing disease in humans, and are also used commercially and medically. Types C–G are less common; types E and F can cause disease in humans, while the other types cause disease in other animals.

Researchers recently found an eighth type of toxin in stool samples of an infant with botulism. It just so turns out that eighth type, known as type H, is the deadliest substance in the world.

Like botulinum toxins, most snake venoms are a mixture of many proteins which are often neurotoxins with LD50s below 1 mg/kg. A crucial complication here, however, is the speed of activity. While some snake venoms may be highly potent, other, less potent venoms might kill faster. This is vital information. A potent but slow-acting venom might leave enough time to intervene, while a fast-acting poison with a lower LD50 might kill you before you can get help.

The radioisotope used to kill Alexander Litvinenko is extraordinarily toxic even in quantities less than a billionth of a gram. The LD50 of this compound is not a property of its chemistry. While other toxic metals such as mercury and arsenic kill through the interaction of the metal with the body, polonium kills by emitting radiation which shreds sensitive biomolecules, such as DNA, and kills cells. Its half-life - the time taken for half of the ingested material to decay - is about a month, leading to a slow death by radiation poisoning.

The harmful effects of mercury are perhaps most famously exemplified by Lewis Carroll's Mad Hatter, who was chronically exposed to mercury while plying his trade. But the toxicity of mercury is actually far more complicated, depending critically upon the kind of mercury involved. Organic and inorganic mercury compounds have different effects and hence LD50 values (which are typically between 1mg/kg and 100 mg/kg).

Pure mercury is considerably less toxic, as dramatically illustrated by the case of a dental worker who attempted suicide by injecting the liquid element into her veins. Ten months later she was effectively symptom-free, despite having mercury distributed throughout her lungs.