The Dose Makes the Poison: An Introduction to Everyday Toxicology

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ABSTRACT

Toxicity is often associated with inherently dangerous or synthetic substances, while familiar foods, herbs, medicines, and household ingredients are generally perceived as safe. However, the fundamental principle of toxicology is that the effect of any substance largely depends on its dose. This article explores the concept that "the dose makes the poison" through several everyday examples, including water, salt, caffeine, spices, herbs, tea, garlic, lemon juice, and bananas. It highlights how substances that may provide nutritional or beneficial effects at appropriate levels can produce adverse effects when consumed excessively or inappropriately. The article also examines common misconceptions surrounding natural products, vitamins, herbal and Ayurvedic preparations, medicines, and traditional home remedies, emphasizing that natural origin does not inherently guarantee safety. Particular attention is given to the growing influence of health-related misinformation on social media and the tendency to follow unverified recommendations. By connecting fundamental toxicological principles with familiar experiences, this article aims to promote greater awareness of dose-dependent toxicity and encourage rational, informed, and responsible consumption of everyday substances.

INTRODUCTION:

Imagine you end up stranded in a desert. The most important thing in your life at that point in time becomes "water" what we commonly call 'the elixir of life.' You finally manage to stroll to the end of the desert and get access to fresh and clean drinking water from a nearby village; you begin consuming large quantities of water in a very short period. After some time, you start to feel lightheaded, confused, nauseated, drowsy and fall to the ground. What you've just experienced are the toxic effects of water. Yes, you heard that right, water is toxic to the human body when taken in high quantities. Medically, we like to describe the condition as 'water overdosing' or 'water intoxication.' Nearly 500 years ago, a German-Swiss physician named Paracelsus (Grandjean, 2016) observed and pointed out something that forms the prime foundation for the field of modern toxicology, i.e., the dose. His famous quote translated from German was "All things are poison, and nothing is without poison; only the dose makes a thing not a poison." People usually misinterpret that natural is always safe and synthetic is always bad.

"Dose" is a way of determining how much of something is needed for intake. Consider table salt for instance, a pinch makes the food tasty, a spoonful spoils your meal, and a full cup immediately causes toxic symptoms. Being in the field of toxicology, we use another fancy term called the 'lethal dose'. Lethal dose is the specific quantity of a chemical, drug, or toxin that is capable of causing death. Scientists use this concept to understand how much exposure is too much and adjust them to keep people and animals safe. Such doses are fixed after certain scientific tests and assays. The lethal dose value of cyanide for an adult human is approximately 350 mg. Compare it to that of caffeine, which is around 13 grams, equivalent to 100 espresso shots, enough to give your heart intense palpitations. Similar is the case with salt and sugar used on a regular basis. Nobody is going to sit and eat two kilograms of sugar in one go, which is considered its lethal dose, unless the person is trying too hard to get diabetes. Cyanide is infamous because it takes just a few hundred milligrams to shut down your cells from utilising oxygen. For comparison, white salt needs 210 grams to give a lethal effect, while cyanide does the job in 0.3 grams. So next time someone says a substance is absolutely safe and non-toxic, ask them, "Are you sure about that?"

THE TOXICOLOGY HIDDEN IN OUR KITCHEN

There are several ingredients used in the kitchen of all the households. In fact, it is the place that is capable of acting as the go-to pharmacy in any household to get immediate relief for problems like bloat or gassiness in the stomach, sore throat, toothaches, colds, headaches, constipation, acidity, localised inflammations, or even to brew a cup of coffee to stimulate your brain for those all-night studies. Whenever we were feeling gassy, our mother would have given us a small quantity of strong-smelling, straw-coloured water, and a few minutes later, a huge burp relieves the gas. It is due to something called ajwain (carom seeds), which has an active principle called thymol, which is mainly responsible for this action. Now since you've learnt about this trick, the next time you feel uncomfortable due to gas, you take a pack of ajwain seeds, and try to soak the seeds on your own without knowing the proper quantity, thinking the more the better, you are going to feel that heartburn sensation along with nausea and sometimes end up vomiting. Thymol overdose on a daily basis also leads to liver toxicity, and this holds good for those old couples drinking it on a regular basis in above-average doses, thinking it's good for their gut health; but it

stresses their liver. Drinking regularly under a certain dose is okay, but the problem is when that threshold is broken.

OTHER DAY-TO-DAY EXAMPLES

Several commonly consumed foods, spices, herbs and beverages illustrate how the effects of familiar substances can vary with the amount consumed (Figure 1). Fenugreek, known for its ability to aid in digestion and relieve constipation. People eat it by dipping their banana in it for each bite. A few grams soaked in water overnight does the job. Overdose may cause hypoglycaemia (Shabil et al., 2023) and miscarriages in pregnant women if they are unaware. Nutmeg, is commonly used in sweet and cookie preparation in limited quantities`. It actually promotes good sleep when used in very small quantities along with milk. Higher consumption can produce hallucinations, dizziness and other neurological effects. Red chilli powder, adds both flavour and spiciness to your food but it also increases the burning sensation in your stomach and intestines, causing ulcers, emesis, and burning diarrhoea. It is due to the effect of the active compound capsaicin.

Figure 1. Commonly used food, spices, herbs and beverages that may exhibit beneficial or adverse effects based on the quantity consumed

Holy Basil (Tulsi), they are holy for your rituals, but if you take too much, then your blood may not clot properly, leading to blood loss at times of injury. At proper doses it is good against colds and asthma and also boosts your immune system. Lemon Juice, is a great summer detox, but frequent consumption of high quantity can erode the tooth enamel (Grando et al., 2009), worsen acid reflux in stomach, and also rarely contribute to kidney stones. Tea (Black/Green), drinking over-brewed tea frequently in short intervals may seem as a good refreshment, but the iron levels will be hampered in the body. Tea is a good antioxidant and an excellent stimulant. Tannins in the tea can stop iron absorption (Zijp et al., 2000), and excessive caffeine leads to anxiety, palpitations, and gastric upset. Garlic usually has cardioprotective functions and antimicrobial properties in appropriate doses. Indiscriminate consumption can lower your blood pressure and also cause blood thinning, which may prolong the bleeding time in case of an injury. Bananas, our all-time favourite fruit has also made this list. It is a healthy snack but too much quantity in empty stomach must be avoided. Bananas are rich in potassium, and extremely high consumption levels cause hyperkalaemia (increased blood potassium level) (Tazoe et al., 2007) leading to irregular heartbeats. Although the risk is quite low in healthy adults, it is a risky business for people with kidney problems, as their kidneys are unable to effectively remove the excessive potassium from the blood. Moreover, bananas are rich in natural sugars, and eating several bananas at once causes a sudden spike in blood glucose levels, making it a high-risk fruit for people with diabetes.

COMMON MISCONCEPTIONS

There is this most important misconception that anything that is natural in origin has no problem, but this is a misleading assumption, as most of the famous toxins are also of natural origin, like cyanide from apple seeds and ricin from castor beans. Another misunderstanding is that “If it's a vitamin, the more the better." However, it doesn’t work

like that. The reality is that all the fat-soluble vitamins accumulate in our body, unlike the water-soluble vitamins, and higher accumulation leads to toxic conditions. Like vitamin A, for instance, its accumulation causes liver damage and birth defects in pregnant women too. Another important marketing gimmick that people believe is “The label says herbal, so it is risk-free." But no, many herbal and ayurvedic preparations cause harm in excess quantities. Take, for instance, liquorice roots, which are commonly used in many ayurvedic preparations cause potassium loss in excess doses, which ultimately leads to hypertension. “More” doesn’t mean faster. Many people still believe that the more doses you take, the faster the recovery is. One more paracetamol tablet won’t hurt under expert supervision, but ten tablets over the counter consumption may lead to liver failure and ulcers. Traditional home remedies may be useful in certain contexts, but they are not inherently free from risk.

WHY IS THIS SIGNIFICANT NOW?

The spread of health misinformation has become increasingly rapid through social media. Most of the youngsters and older people believe what they are being told on such platforms, and they often don’t do a fact check of what’s been told to them. Think about the people following suggestions like consuming vitamin D or vitamin C for 365 days; teenagers having high-caffeine energy drinks on a daily basis; adults mixing a couple of painkillers for a mild headache; adding turmeric to everything you eat, etc. Most of these suggestions are unverified advice from sources without appropriate scientific or clinical expertise. People often ignore reading the dosing info on the labels and the importance of proper drug use and doctor consultation. Do not fall for these traps.

CONCLUSION

I want to convey the most important information that anything can turn toxic if you overdo it. The world is not actually divided into “safe natural” things and “scary chemicals." We often misunderstand that poisons are exotic or intentional in nature, but most real-life toxicity comes from good things taken the wrong way. Thus, always have it in the back of your head to take rational and conscious decisions in such matters before consuming anything. Read the labels, trust the science, and maybe just stop at that third banana. Ultimately, the body's ability to process a substance does not make unlimited consumption safe**.** Being cautious isn’t boring, it's just smart survival.

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