ACUTE TOXICITY

MECHANISMS

Gyan Prakash 2019UBT1096

Rohit Kumar 2019UBT1081

Toxicity

- Toxicity is a relative term generally applied in comparing one chemical with another.

- According to Phillipus,
  " All chemical substances are poisons, there is no chemical substance that is not poison"

- Toxicity of a chemical may be defined as the capability to cause injury in a living organism. A highly toxic substance is that which causes damage to an organism if administered in a very small amount.

- Toxicity can be of two types : Acute Toxicity and Chronic Toxicity

Acute Toxicity

Acute Toxicity is defined as "the adverse effect occuring at any time within the duration of 72 hours after the intake of any drug or as a result of short term exposure to a toxicant".
Newly developed drug, acute toxicology testing may be performed in animals, Data generated from such studies can be used to determine and identify the potential toxicity of a chemical to human.

- The acute toxicity of a chemical is commonly quantified as the **LC50** or **LD50**.

- Acute toxicity of environmental chemicals is determined experimentally with select species that serve as representatives of particular levels of trophic organization within an ecosystem (i.e., mammal, bird, fish, invertebrate, vascular plant, algae).

LD50 and LC50

LD50 : LD stands for **"Lethal Dose"** is the statistically derived single dose of substance I.e., estimated to cause death in 50% of the population of animals who were exposed to that substance.

- Usually expressed as the amount of chemical administered(eg., miligrams) per 100 grams (for smaller animals) or per kilograms (for bigger test subjects) of the body weight of the test animal.

- LD50 can be found for any route of entry or administration but dermal (applied to the skin) and oral (given by mouth) administration methods are the most common.

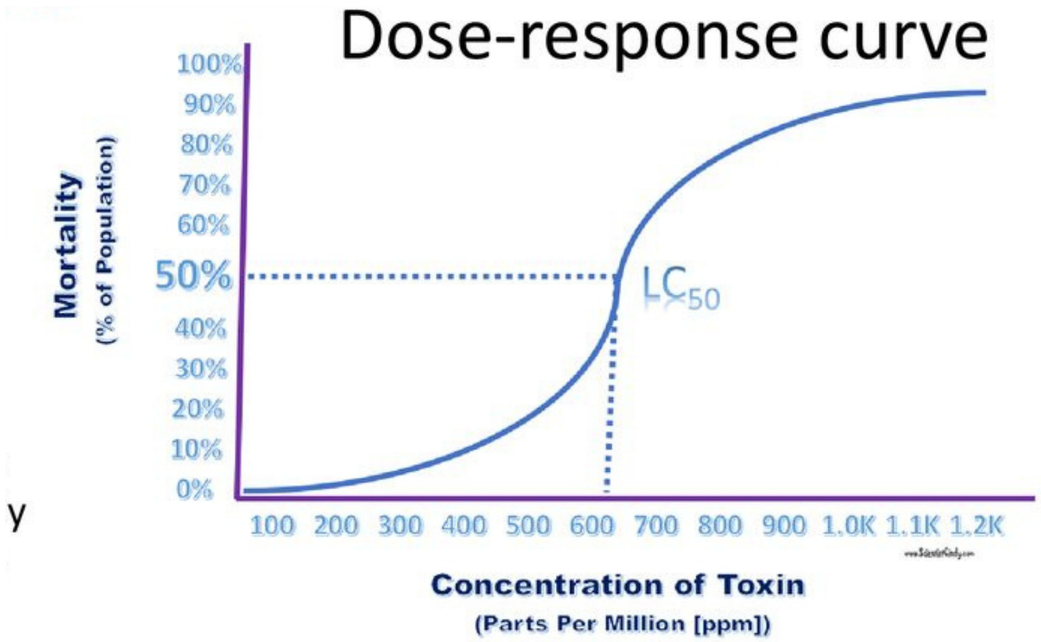
LETHAL DOSE 50 (LD 50)

- Refers to the amount of a substance found to be lethal to 50% of a population, if ingested.

Chemical	Humans	Rats
Carbon monoxide	4 000 ppm	1 807 ppm
Nicotine	0.86 ppm	50 ppm
Table Salt	12 357 ppm	3 000 ppm

LC50 : LC stands for **"Lethal Concentration"** values usually refer to the concentration of a chemical in air but in environmental studies It can also mean the concentration of a chemical in water.

- According to the OECD, guidelines for the testing of chemicals, a traditional experiment involves groups of animals exposed to a concentration for a set period of time (usually 4 hours).
- The animals are clinically observed for upto 14 days
- The concentration of the chemicals in air that kills 50% of the test animals during the observation period is the LC50 value



Mechanisms of Acute Toxicity

Mechanisms that are particularly relevant to the types of chemicals that are more commonly responsible for acute toxicity in the environment at the present time.

- **Narcosis**
- **Simple asphyxiants**
- **Skin Effects**
- **Lungs Sensitization**

Narcosis

- A common means by which industrial chemicals elicit acute toxicity, par- ticularly to aquatic organisms, is through **narcosis**.
- Narcosis occurs when a chemical accumulates in cellular membranes interfering with the normal function of the mem- branes.
- Typical responses to the narcosis are decreased activity, reduced reaction to external stimuli, and increased pigmentation (in fish).
- Chemicals that induce narcosis include alcohols, ketones, benzenes, ethers, and aldehydes.

Simple asphyxiants

- The mechanism of toxicity for inert gases and some other non-reactive substances is lack of oxygen (anoxia)
- These chemicals, which cause deprivation of oxygen to the central nervous system (CNS), are termed **simple asphyxiants**
- In extreme cases (near zero oxygen) unconsciousness can occur in a few seconds. Rescue depends on rapid removal to an oxygenated environment.
- Survival with irreversible brain damage can occur from delayed rescue, due to the death of neurons, which cannot regenerate.

Skin Effects

- Adverse effects to the skin can range from irritation to corrosion, depending on the substance encountered.
- Strong acids and alkaline solutions are incompatible with living tissue and are corrosive, causing chemical burns and possible scarring.
- Scarring is due to death of the dermal, deep skin cells responsible for regeneration.
- Lower concentrations may just cause irritation of the first layer of skin.

Class	Signal words	Acute toxicity to rat	
		Eye effects	Skin effects
I	DANGER	Corneal opacity not reversible within 7 days	Corrosive
II	WARNING	Irritation persisting for 7 days	Severe Irritation at 72 hours
III	CAUTION	Irritation reversible within 7 days	Moderate irritation at 72 hours
IV	CAUTION (optional)	No Irritation	Mild or slight irritation at 72 hours

Lungs Sensitization

- An immune sensitization response is elicited by toluene diisocyanate (TDI), but the target site is the lungs.
- TDI over-exposure in susceptible individuals causes lung oedema (fluid build-up), bronchial constriction and impaired breathing.
- This is a serious condition and requires removing the individual from potential subsequent exposures.
- Treatment is primarily symptomatic.
- Skin and lung sensitization follow a dose response.
- Exceeding the level set for occupational exposure can cause adverse effects.

References

- https://www.iloencyclopaedia.org/part-iv-66769/toxicology-57951/mechanisms-of-toxicity