

Environmental Biochemistry

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- **Pollutant**

- Any substance present in the environment which may produce abnormality in metabolism or alter the well being of organism is called environmental pollutant

- **Poison**

- Substance which causes death or harm if introduced in the living body or brought into contact with parts of body

Air Pollution

- The major components of air include nitrogen (78.1%), oxygen (20.93%) and carbon dioxide (0.03%), along with water vapor and suspended particles.
- Sources
 - Industries
 - Urbanization
 - Smoking
 - motor vehicles
 - Volcanic eruption
 - Forest fires
 - Dust storms

- **Major constituents**

- Sulfur dioxide
- CO₂ and
- Oxides of nitrogen,
- Hydrocarbons
- SPM (Suspended Particulate Matter- 1-10 um)

- **Smog**

- Mixture of
 - Smoke
 - Fog
 - Air
 - Other chemicals

- **Acid rain**

- SO_2 and SO_3 in presence of atmospheric water vapor, become sulfurous and sulfuric acids, respectively.
- This is the precursor of acid rain

- **Clinical**

- Bronchitis
- Chronic respiratory disease
- Heart disease
- Decrease visual threshold
- Neurological disturbance
- COPD, cancer- Cigarette smoking

Poisons

- **Cyanide**

- Cyanide causes tissue anoxia by chelating the ferric ions of the intracellular respiratory enzyme, cytochrome oxidase.
- Due to
 - suicidal attempts
 - Industrial- hydrocyanic (prussic) acid or with KCN
 - Amygdalin- kernels of certain fruits (apricots, almonds, peaches, apple) is also a common cause.
- 1 mg/kg body weight is lethal dose
- Antidote
 - Dicobalt edetate
 - sodium nitrite and sodium thiosulfate intravenously.

Heavy metal poisons

- **Lead Poisoning**

- Most common environmental poison in India (30% population)
- Dispersed into air, food, soil, water
- Sources
 - Paint (in India cheap paint may contain upto 30% lead, Toys)
 - Exhaust of vehicles- now unleaded fuel
 - Air, water and vegetables

- Lead pipe
 - In water
- Newspaper (Ink)
- Cigarette smoke
- As adulterant in curcumin
- Battery
- Soldering
- Signs and symptoms
 - Cumulative poison
 - 90% in bone, 9% in blood and 1% in brain and kidney
 - Upto 10 mg/dl in blood is tolerated

- Can pass through placenta and milk
 - Miscarriage, still birth and premature birth
- Neurological
 - Cerebral palsy, optic atrophy
- Children
 - MR, learning disability, behavioral problems hyper excitability and seizures
- Anemia, abdominal colic and loss of appetite

- >70 mg/dl
 - Acute toxicity
 - Encephalopathy
 - Convulsion
 - Mania
 - Neuropathy
 - Abdominal colic
 - Severe anemia
 - Kidney damage
 - Discoloration and blue line of gums

- **Lead inhibits heme synthesis.**

- Basophilic stippling of red cells
- Lead inhibits delta amino levulinic acid (ALA) synthase and ALA-dehydratase
- Lead also inhibits the enzyme ferrochelatase.
- Life span of RBC is shortened.

- **Treatment**

- Antidotes
 - Calcium dodecyl edetate
 - Penicillamine
 - Dimercaprol (BAL)
 - Dimercaptosuccinic acid

- **Mercury poison**

- Most common industrial poison

- **Sources**

- **Elemental**

- From inhalation
- Thermometer and sphygmomanometer
- Acute poison
 - Pulmonary edema
 - Encephalopathy

- Chronic
 - Triad known as Erethism
 - Oral (gingivitis, salivation and stomatitis)
 - Tremor
 - Psychological (Insomnia, shyness, emotional instability and memory loss)
- **Inorganic**
 - Plastic industry
 - Topical medicine
 - Acute-
 - Gingivitis, gastritis, vomiting and pulmonary edema
 - Chronic- Erethism

- **Organic**

- Paint, fungicides and cosmetics
- From mercury slat waste, bacteria form methyl mercury which enters fish
- Minamata disease (Bay at Japan)
 - Triad of dysarthria, ataxia and visual field constriction
 - Severe- toxic encephalopathy, sensory neuropathy, intention tremor, hearing loss and spasticity

- **Treatment**

- Dimercaprol
- D-penicillamine
- N-acetyl cysteine

- Aluminum toxicity
- Arsenic poison
- Pesticides and insecticides
 - DDT
 - OP poison

Toxic substances in food stuffs

- **Normally present in plants**

- Protease inhibitors

- Soybean, corn and potato
- Contain trypsin inhibitor

- Goitrogens

- Cabbage (Thio-oxazolidone)
- And mustards (thiocyanates, isothiocyanates)

- Antivitamins

- Orange peel (Citral)- Inhibits A
- Linseed oil (Lineticin)- Pyridoxine
- Black berries(thiaminase)- B1
- Raw eggs (Avidin)- Biotin

- Favism

- Broad bean (*Vicia fava*)
- Hemolytic anemia
- Cooking will remove toxins

- Alkaloids

- Mushrooms
- Nausea, vomiting, diarrhea.
- Liver necrosis

- **During cultivation**
 - Pesticides and insecticides
- **Storage contamination**
 - **Fungal infection**
 - Aspergillus flavus
 - Aflatoxins
 - Hepatotoxic and carcinogenic
 - **Ergot**
 - In moist food grains
 - Ergotism
 - Painful cramps
 - Gangrene
 - Convulsion

- **During food processing**

- Mineral oil

- **During food preparation**

- Mono sodium glutamate (MSG)
- Food additive
- Not suitable for <5 yr age

- **Adulterants**

- **Lathyrism**

- Lathyrus sativus (Khesari dal)
 - Neurotoxins
 - Exaggerated knee jerk
 - Ankle clonus
 - Scissor gait
 - Spastic paralysis
 - BOAA (Beta Oxalyl Amino Alanine)
 - Inhibit lysyl oxidase
 - Reduce cross linking of collagen
 - Removed by hot water

- **Argemone oil** (with mustered oil)
 - Argemone Mexicana
 - Sanguinarine
 - Epidemic dropsy
 - Vomiting, diarrhea, CCF and edema

Thank You