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Is Chemistry only Toxic?

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"All things are poisons; nothing is without poison; only the dose determines whether there is a harmful effect".

This statement has been proven during Covid 19 Pandemic, by application of Chemistry, in many areas. Food is essential component of living beings and so with Humans. In initial stages, human beings use to live in Jungles and use to have natural foods like fruits from trees and meat available from animals.Thereafter as use of fire known to humans,food chemistry came into picture followed by Toxicology. When talking about toxicology it is important to keep a few things in mind. Not everyone will respond to substances in exactly the same way. Toxicology uses the power of chemistry to predict what and how chemicals may cause harm and then shares that information to protect public health. Hence it is important to understand basic chemistry and its role in Toxicology.

Chemistry is an essential part of our day-to-day life. We find chemistry in daily life in the food we eat. Our Food is a mixture of hundreds of Chemicals anyone of which in excess quantity would be harmful to us.However human beings cannot live without, Zinc, Copper,Methionine(a building block) and Vitamin A.It is wrong notion about food that,food should be free from Chemicals.Most of the food components are supposed to be Generally Recognized as Safe(GRAS).Chemistry is the scientific study of the properties and behaviour of matter. It is a natural science that covers the elements that make up matter to the compounds composed of atoms, molecules and ions: their composition, structure, properties, behaviour and the changes they undergo during a reaction with other substances.

Chemistry occupies an intermediate position between physics and biology. It is sometimes called the central science because it provides a foundation for understanding both basic and applied scientific disciplines at a fundamental level. For example, chemistry explains aspects of plant chemistry (botany), the formation of igneous rocks (geology), how atmospheric ozone is formed and how environmental pollutants are degraded (ecology), the properties of the soil on the moon (cosmochemistry), how medications work (pharmacology), and how to collect DNA evidence at a crime scene (forensics).

It is important to distinguish between Toxicity and actual Hazzard.A particular food chemical may or may not be hazardous depending upon the many factors, specifically quantity consumed by a person.

Human civilization began when hunters adopted not only production but also preservation of foods. Once their association and importance in food were proven, efforts were made to understand the basic principles associated with food and microbial interactions. This knowledge was used to control undesirable microbes and effectively use the desirable types.Here the mejor role of Chemistry in Toxicity started.

It is important to note that toxin is a poisonous substance that is a specific product of the metabolic activities of a living organism and is usually very unstable, notably toxic when introduced into the tissues and typically capable of inducing antibody formation.

Toxins Are often Found in Nature

Long before chemists started creating poisons from scratch, humans were employing natural toxins for killing

weeds and insects. For centuries South American tribes have used the toxin curare, extracted from a native vine, to tip their arrows. The garden flower called wolfsbane or monkshood is the source of aconite, an extremely potent toxin. The common flower known as jimsonweed contains the deadly poison scopolamine. And the castor-oil plant yields the almost unbelievably poisonous toxin called ricin.

Today we hear health advisers of all kinds talk about ridding the body of toxins; but they're usually pretty vague about which ones they mean, and most of these "toxins" wouldn't be called that by biologists.

Toxaemia- The Presence of Poisonous Substances in the Blood.

Almost all heavy metals are serious toxicants as carcinogens. Although several heavy metals, including copper (Cu) and zinc (Zn), serve as enzymes that are essential for intracellular processes and have DNA-binding domains, almost all heavy metals induce various cancers and diseases. Oxidative stress caused by reactive oxygen species (ROS) is a well-known mechanism of heavy metal-induced damages. Despite such serious toxicity, heavy metals are utilized in various industrial products; they are found in batteries, paints and vehicle emissions. Furthermore, heavy metals are used in pigments that are then used in consumer products like children's jewelry and toys. Electronic waste from heavy metal-containing batteries is an important source of heavy metal contamination in the environment through erosion by rain and groundwater flow to soil, rivers and the sea. Dissolved forms of toxic heavy metals can be magnified via circulation in the bio-system, including the food chain and finally end up in very high concentrations in humans.

Arsenic (As), cadmium (Cd), chromium (Cr) and nickel (Ni) are category 1 heavy metals according to the International agency for Research on Cancer. Various reports have found that exposure to these compounds leads to disruptions in tumor suppressor gene expression, damage repair processes and enzymatic activities concerned in metabolism via oxidative damage. Some studies have indicated that the risk of heavy metal exposure is interrelated with the contamination source. For example, recent studies found an increased risk of occupational disease and cancer in workers in heavy metal-using industrial areas.

Since prehistoric times, chemicals have been added to foods to perform special functions. As foods are processed for conversion into a variety of products, an increasing number of additives Chemistry has created and are generally used.

Today, more than 2500 different additives are intentionally added to foods to produce a desired effect. The use of these additives is a well-accepted practice but is not without controversy of Toxicity.

Additives can be divided into six major categories: 1. Preservatives, 2. Nutritional additives, 3. Flavoring agents, 4. Coloring agents, 5. Texturizing agents, 6. And miscellaneous additives.

Antimicrobials play a major role in extending the shelf-life of numerous snack and convenience (useful) foods and have come into even greater use in recent years as microbial food safety concerns have increased. The use of several antimicrobials is known to prevent food poisoning (Toxicity) from various bacteria and molds.

The antioxidants,are used to prevent lipid and/or vitamin oxidation in food products. • They are used primarily to prevent autoxidation and subsequent development of rancidity. • Antioxidants, used to prevent the development of off-flavors, also prevent the formation of potentially toxic autoxidation products and maintain the nutritional value of vitamins and lipids.

Autoxidation The unsaturated fatty acids present in the lipids of many foods are at risk to chemical breakdown when exposed to oxygen. The oxidation of unsaturated fatty acids it proceeds by a free-radical chain reaction. The antioxidants vary from natural substances such as: vitamins C and E to synthetic Chemicals Such as Butylated Hydroxy Anisole (Bha) and Butylated Hydroxy Toluene (Bht). Toxicology uses the power of chemistry to predict what and how chemicals may cause harm and then shares that information to protect public health. Hence it is important to understand basic chemistry and its role in Toxicology.

Toxicological problems resulting from the long-term consumption of additives is related to: 1. Cancer 2. and reproductive problems. Hence Artificial additives to be avoided. Toxic Oil Syndrome (TOS) a disease outbreak in Spain in which denatured industrial oil was sold

commercially as rapeseed oil, causing disabilities and hundreds of deaths,due to Toxicity.

Toxoplasmosis- a potentially fatal disease caused by the parasite toxoplasma that is carried by animals, capable of causing encephalitis and hydrocephalus.

Chemical hazard- a health risk posed by chemical traces in foods, e.g. pesticide residues

Toxicity of a pesticide is its capacity or ability to cause injury or illness. The chronic toxicity of a pesticide is determined by subjecting test animals to long-term exposure to active ingredients.Therefore products are categorized on the basis of their acute toxicity.

Acute toxicity is measured as the amount or concentration of toxicant-the a.i.-required to kill 50%of animals in the test population.This measure is usually expressed as LD50(lethal dose) or LC50(lethal concentration 50). Additionally,the LD 50 or LC 50 values are based on a single dosage and are recorded in milligrams of pesticide per kilogram of body weight(mg/kg)of the test animal or in parts per million(ppm).LD50 and LC50 values are useful in comparing the toxicities of different active ingredients and different formulations containing the same active ingredient.Lower the LD50 or LC50 of a pesticide product,the greater is its toxicity to humans and animals. Pesticides with high LD50 are the least toxic to humans if used according to the directions on the product label.

The four routes of exposure are dermal(skin), inhalation(lungs), oral(mouth) and eyes.Acute Toxicity is determined by examining the dermal toxicity and oral toxicity of test animals.

Chlorine Dioxide (ClO_2)

ozone & thyme essential oil has been found to be effective in reducing pathogens, including Escherichia coli. The efficacy of these sanitizers are being used on shredded lettuce and baby carrots. Samples sprinkle inoculated with mixed strains of E. coli and then treated with different concentrations of disinfectants and exposure time. BUT if doses exceed then Toxicity results.Sterile deionized water washing resulted in reduction of E. coli after 10 min washing of lettuce & baby carrots.

Substantial reduction was obtained using aqueous ClO_2 (10.0 mg/L for 10 min) ozonated water (9.7 mg/L for 10 min) or thyme oil suspension (1.0 mL/L for 5 min) on lettuce and baby carrots. Of the three sequential washing treatments used in this study, thyme oil followed by aqueous ClO_2/ozonated water or ozonated water/aqueous ClO_2 were significantly more effective in reducing E. coli, on lettuce and baby carrots, respectively. The results obtained from this study indicate that sequential washing treatments could achieve 3–4log reduction of E. coli, on shredded lettuce and baby carrots.

Foodborne diseases are threats to health and economies of many countries. It is estimated that more than70% of the approximate 1.5 billion episodes of diarrhea that occur in the world annually are caused by biological or chemical contamination of foods. The high incidence of diarrhoeal diseases, particularly among children are estimated at 3.3 to 4.1 episodes per child per year is an indication of the magnitude of the problem.

What is Medical Toxicology?

Medical Toxicology is a field of medicine dedicated to the evaluation and treatment of poisoned and envenomated patients. This also includes adverse health effects of medications, occupational and environmental toxins and biological agents.

What Are Some Examples of Problems Evaluated by Medical Toxicologists?

- Unintentional and intentional overdoses of such agents as:
- Therapeutic drugs including antidepressants, cardiac medications and many others
- Over-the-counter medicines
- Drugs of abuse
- Exposure to industrial chemical products and environmental hazards such as:
- Pesticides
- Heavy metals
- Household products
- Toxic gases
- Toxic alcohols
- Other industrial and environmental agents, including radiation exposures
- Drug abuse management including:
- Inpatient care for acute withdrawal states from addictive agents such as alcohol and drugs of

abuse

- Outpatient addiction medicine treatment
- Diagnosis and management of exposures such as:
- Snake, scorpion and spider envenomations
- Marine toxins
- Ingestion of food-borne toxins
- Ingestion of toxic plants.

Thus, Chemistry & Toxicity can go hand in hand if proper care has not been taken.

Ref: www.cdph.ca.gov/hesis