



Umm AL Qura University

MUTAGENS AND MUTAGENESIS

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MUTAGENS

- Naturally occurring mutations are referred to as spontaneous mutations and are thought to arise through chance errors in chromosomal division or DNA replication.
- Environmental agents which cause mutations are known as mutagens
- These include natural or artificial ionizing radiation and chemical or physical mutagens

Mutation can be ...

- Inherited.
- Induced.
 - ▶ Chemical
 - ▶ Physical
 - ▶ Biological
- Naturally Occurring (Spontaneous)
 - ▶ Errors in chromosomal division
 - ▶ Errors in DNA replication
 - ▶ Faulty in DNA repair

CHEMICAL MUTAGENS

➤ Mutagenic **chemicals in food** contribute to **35% of cancers**

1. **Base analogues** (A to T & C)

2. **Intercalating agents** (VG & ethidium bromide)

3. **Agents altering bases** (nitrous oxide)

4. **Agents altering DNA structure**

PHYSICAL MUTAGENS

- ➔ Can be **Natural & Artificial** sources
- **Radiation**
- **Non-ionizing**
- **Ionizing**
 - ▶ X-Rays
 - ▶ Ultraviolet (UV)

NATURAL OR ENVIRONMENTAL AGENT

Agent	Effect
Carcinogen	Causes Cancer
Clastogen	Causes fragmentation of chromosomes
Mutagen	Causes mutations
Oncogen	Induces tumor formation
Teratogen	Results in developmental abnormalities

UV (260NM)

- Absorbed by bases of DNA and RNA
- Forms pyrimidine dimers
- 2 adjacent bases (CC or TT) are covalently joined
- Insertion of incorrect nucleotide at this point likely
- During replication Skin cancer, sterilization of equipment
- Poor penetration

IONIZING RADIATION

- Ionizing radiation includes **electromagnetic waves of very short wavelength** (X-rays and gamma rays), and **high energy particles** (alpha particles, beta particles and neutrons).
- X-rays, cosmic rays, gamma rays
- **More powerful than UV**
- **Penetrates glass**
- **Water ionizes**: mutagenic effect
 - **free radicals** e.g. OH-
 - **inactivate DNA**
 - **cell death**

BIOLOGICAL MUTAGENS

- Insertion of a transposon within a gene
 - Disrupts the reading frame
 - loss of function
- Jumping genes- transposable elements move to different positions in the chromosome. Transposon carries other genes with it.
- Antibiotic resistance

MUTAGENESIS

- A process by which the **genetic information of an organism is changed** in a stable manner, either in **nature** or **experimentally** by the use of **chemicals** or **radiation**

CAUSES OF SPONTANEOUS MUTATIONS

- Error in DNA replication
- Faulty DNA repair e.g. mismatch
- Natural mutagens