Umm AL Qura University

MUTAGENS AND MUTAGENESIS

Dr Neda M Bogari
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
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

<table>
<thead>
<tr>
<th>Agent</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carcinogen</td>
<td>Causes Cancer</td>
</tr>
<tr>
<td>Clastogen</td>
<td>Causes fragmentation of chromosomes</td>
</tr>
<tr>
<td>Mutagen</td>
<td>Causes mutations</td>
</tr>
<tr>
<td>Oncogen</td>
<td>Induces tumor formation</td>
</tr>
<tr>
<td>Teratogen</td>
<td>Results in developmental abnormalities</td>
</tr>
</tbody>
</table>
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 (α particles, β 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