

EVOLUTION AND MUTATION DUE TO CLIMATE CHANGE

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Abstract - Environment plays the principal role in the evolution of the living organisms. Even the two same species grown in different environment condition showed marked differences. The protoplasm of the animal and the plant body is divided into somatoplasm and germplasm. The germplasm consists on nucleic acids and genetic material. The germplasm carry heredity from one generation to another. Now, during the meiotic division of cells the genetic material exchange between chromosomes and variation occurs. The temperature is the main key to the evolution and mutation. Mutation is the change in the genetic material due to various mutagens. The nucleic acids consist of nucleotides and nucleosides. The strands of DNA are having a weak bond i.e. hydrogen bond and can break easily by providing very small amount of energy. Temperature is a natural mutagen which provides minimum enthalpy to break the bond, resulting in the formation of active site on the DNA. The attacking group replaces the nucleotide and as a result the sequence of genetic material changes and it carries further to the next generation. The increased cases of cancer, Parkinson's disease is the outcome of mutations caused by the temperature. Increasing temperature not only causes threats to rising sea level but also having a great impact on human health and genetic material.

Keywords - Mutation, Climate Change, Health, Cancer.

INTRODUCTION

A mutagen is a physical or chemical agent that changes the genetic material, usually DNA, of an organism and thus increases the frequency of mutations above the natural background level. As many mutations cause cancer, mutagens are therefore also likely to be carcinogens. Not all mutations are caused by mutagens: so-called "spontaneous mutations" occur due to spontaneous hydrolysis, errors in DNA replication, repair and recombination.

Mutagen causes changes to the DNA that can affect the transcription and replication of the DNA, which in severe cases can lead to cell death. The mutagen produces mutations in the DNA, and deleterious mutation can result in aberrant, impaired or loss of function for a particular gene, and accumulation of mutations may lead to cancer.

Different mutagens act on the DNA differently. Powerful mutagens may result in chromosomal instability causing chromosomal breakages and rearrangement of the chromosomes such as translocation, deletion, and inversion. Such mutagens are called clastogens. Mutagens may also modify the DNA sequence; the changes in nucleic acid sequences by mutations include substitution of nucleotidebase-pairs and insertions and deletions of one or more nucleotides in DNA sequences. Although some of these mutations are lethal or can cause serious disease, many have minor effects as they do not result in residue changes that have significant effect on the structure and function of the proteins. Many mutations are silent mutations, causing no visible effects at all, either because they occur in non-coding or non-functional sequences, or they do not change the amino-acid sequence due to the redundancy of codons.

Mutagens may be of physical, chemical or biological origin. Physical mutagens consist of the ultraviolet radiation, gamma rays and X rays. Ozone depletion due to climate change causes the more ultraviolet radiation reaches earth surface Ultraviolet radiation (non ionizing radiation). Two nucleotide bases in DNA - cytosine and thymine - are most vulnerable to radiation that can change their properties. UV light can induce adjacent pyrimidine bases in a DNA strand to become covalently joined as a pyrimidine dimer. UV radiation, particularly longer-wave UVA, can also cause oxidative damage to DNA Mutation rates also vary across species. Evolutionary biologists have theorized that higher mutation rates are beneficial in some situations, because they allow organisms to evolve and therefore adapt more quickly to their environments. For example, repeated exposure of bacteria to antibiotics, and selection of resistant mutants, can result in the selection of bacteria that have a much higher mutation rate than the original population (matador strains).

Ionizing radiation increases the risk of certain types of cancer more than others. The thyroid gland and bone marrow are particularly sensitive to radiation. Leukemia, a type of cancer that arises in the bone marrow, is the most common radiation-induced cancer. Leukemias may appear as early as a few years after radiation exposure. Other types of cancer can also result from radiation exposure, although they may take longer to develop (usually at least 10 to 15 years). Some of the other cancers most strongly linked to radiation exposure in studies include:

- Lung cancer
- Skin cancer
- Thyroid cancer
- Multiple myeloma
- Breast cancer
- Stomach cancer

These are not necessarily the only cancer types that may be linked to radiation, however. The types of cancer linked to radiation are also affected by the part of the body that is exposed. For example, people who get pelvic radiation therapy would not be expected to have higher rates of cancers in the head and neck because these areas weren't exposed to radiation.

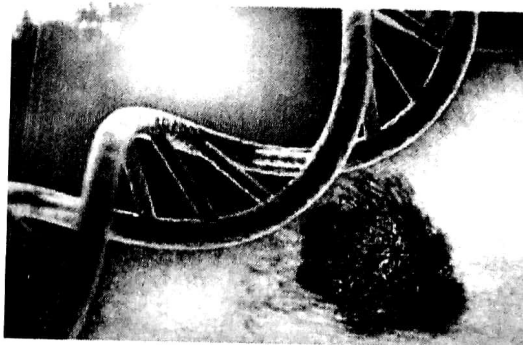


Figure 1. Cancer Type

Other factors may also play a role in how likely a person exposed to radiation is to develop cancer. Age is one such factor - children's growing bodies are more sensitive to radiation than adults. A person may also have gene changes that make their cells more vulnerable to radiation damage, which might in turn raise their risk more than in someone without these gene changes.

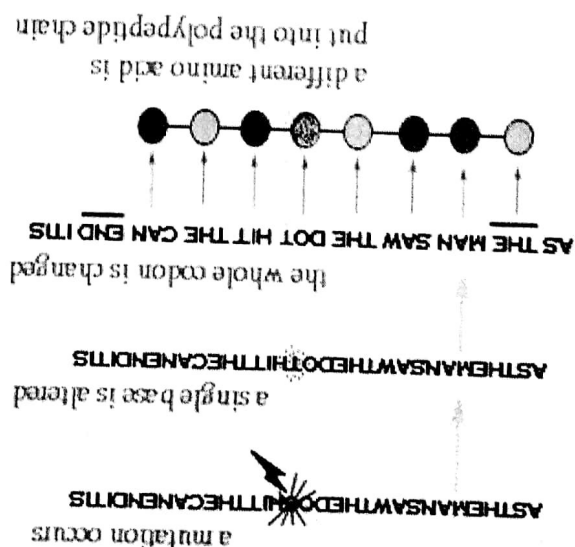


Figure 2. Gene Change

SOLUTION TO THE PROBLEM DEFINED

Antioxidants are important groups of anticarcinogenic compounds that may help remove ROS or potentially harmful chemicals. These may be found naturally in fruits and vegetables. Examples of antioxidants are vitamin A and its carotene precursors, vitamin C, vitamin E, polyphenols, and various other compounds. B-Carotene, the red-orange colored compounds found in carrots, tomatoes and other fruits and vegetables have been shown to be effective in cancer prevention. Vitamin C may prevent various cancers by inhibiting the formation of mutagenic N-nitroso compounds (nitrosamine). Flavonoids such as EGCG in green tea have also been shown to be effective antioxidants and may have anti-cancer properties.

Other chemicals may reduce mutagenesis via other mechanisms, although for some the precise mechanism for their protective property may not be certain. Selenium, which is present as a micronutrient in vegetable, is a component of selenoproteins which are important antioxidant enzymes such as glutathione peroxidase. Many phytonutrients may counter effect of mutagens, for example, sulforaphane in vegetables such as broccoli has been shown to be protective against prostate cancer. Others that may be effective against cancer include indole-3-carbinol from cruciferous vegetables and resveratrol from red wine

An effective precautionary measure an individual can undertake to protect themselves is by limiting exposure to mutagens such as UV radiations and tobacco smoke. In Australia where people with pale skin are often exposed to strong sunlight, melanoma is the most common.

cancer diagnosed in people aged 15-44 years. In 1981, human epidemiological analysis by Richard Doll and Richard Peto indicated that smoking caused 30% of cancers in the US. Doll and Peto also estimated that diet may cause perhaps around 35% of cancers. Mutagens identified in food include mycotoxins from food contaminated with fungal growths, such as aflatoxins which may be present in contaminated peanuts (prevalent in Southern China) and corn, heterocyclic amines generated in meat when cooked at high temperature, PAHs in charred meat and smoked fish, as well as in oils, fats, bread, and cereal, and nitrosamines generated from nitrites used as food preservatives in cured meat such as bacon (ascorbate, which is added to cured meat, however, reduces nitrosamine formation). Excessive alcohol consumption has also been linked to carcinogenesis, the possible mechanisms for its carcinogenicity include formation of acetaldehyde which may be mutagenic, and the induction of cytochrome P450 system which is known to produce mutagenic compounds from promutagens.

REFERENCES

- Bertram J (2000). "The molecular biology of cancer". *Mol. Aspects Med.* **21** (6): 167-223. doi:10.1016/S0098-2997(00)00007-8. PMID 11173079.
- Kozmin S, Slezak G, Reynaud-Angelin A, Elie C, de Rycke Y, Boiteux S, Sage E (September 2005). "UVA radiation is highly mutagenic in cells that are unable to repair 7,8-dihydro-8-oxoguanine in *Saccharomyces cerevisiae*". *Proc. Natl. Acad. Sci. U.S.A.* **102** (38):13538-3. doi:10.1073/pnas.0504497102. PMC 1224634. PMID 16157879
- <http://www.skincancer.org>