

Genotoxic substances (mutagenic)

This article has been translated from WikiSkripta; ready for the **editor's review**.

Genotoxic substances (mutagenic) are substances which, after inhalation, ingestion or skin penetration, can induce or increase the frequency of genetic damage. Mutagenic substances cause a change in the genetic code of cells. Mutation is a permanent change in the amount or structure of genetic material in an organism, which results in a change in the characteristics of the organism. Changes can involve a single gene, a block of genes, or an entire chromosome.

Occurrence of genotoxic substances

These are substances that are contained all around us - *in the air, soil, water, food and our home environment*. Furthermore, the mutagenic effect was demonstrated for a *number of drugs* - antibiotics, cytostatics and disinfectants. They can occur naturally, but more often they are *products of human activity*.

In the *food* can be detected:

- **naturally genotoxic substances:** flavonoids (quercetin, rutin) and tannins (their contribution to damage is minimal);
- **mycotoxins:** (aflatoxin B1 – produced by the fungus *Aspergillus flavus*, paulin, ochratoxin): products of fungi arising from improper storage of food (cereals, nuts, beans);
- **substances of artificial origin:**
 - Nitrates, nitrites and nitrosamines – in meat, sausages and cheeses; pyrolyzates of amino acids are created by inappropriate heat treatment of meat;
 - **polycyclic aromatic hydrocarbons, polyhalogen hydrocarbons** (PCB/TCDD/F), **pesticides** - DDT, HCH (these substances are accumulated in adipose tissue);
- **metals with a genotoxic effect** - arsenic, hexavalent chromium, nickel, cadmium, lead.

In *water* can be detected:

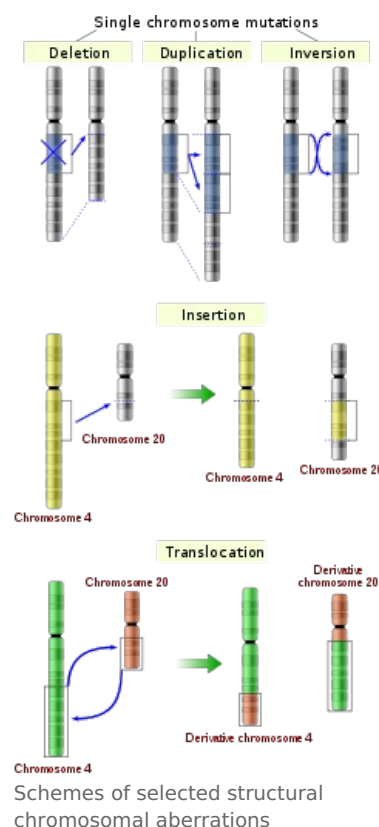
- products for disinfection of drinking water by chlorination (chloroform, dichlorophenols, dichlorobenzene);
- styrene and formaldehyde.

In the *air* we find a number of substances that are bound to local activity:

- **metals and their compounds** (arsenic, chromium, nickel, lead, cadmium);
- **organic compounds** (benzene, formaldehyde).

In the *domestic environment* substances are released from building elements, furniture and textiles:

- formaldehyde, styrene, acrylates, phthalates, vinyl chloride.



Types of mutations and their health significance

- **Gene (point) mutations** - arise by changing the sequence of nucleotides in the DNA molecule. They affect individual genes, are transmitted to subsequent generations of cells and offspring, and represent a serious burden on the gene pool of the population. Gene mutations are not detectable under an optical microscope.
 - congenital metabolic disorders (phenylketonuria, galactosemia)
 - chondrodystrophy, hemophilia
- **Chromosome (chromosome aberrations)** - are changes in the structure of chromosomes. The condition is a chromosome break followed by a faulty connection or the loss of a part of the chromosome. They are usually not passed on to the next generation. They pose a serious risk to the affected individual. They are detectable in an optical microscope.
 - activation of the oncogene at the break point
 - degenerative disease (atherosclerosis)
 - accelerated aging of cells and tissues
- **Genome (aberration of the number of chromosomes)** - this is a change in whole multiples of the haploid number of chromosomes (triploidy, tetraploidy, polyploidy). They are detectable in an optical microscope.
 - syndromes Down's, Turner's, Klinefelter's

Primary prevention of late effects of chemical substances

1. genotoxic activity testing – new genotoxic substances are prevented from entering the environment
2. environmental monitoring - detection of genotoxic substances in the environment (chemical methods, Ames test)
3. exposure monitoring – detection of genotoxic substances and their metabolites in the human body
4. monitoring of the biological effect – monitoring the reaction of the organism to the action of genotoxically active substances (genetic toxicology, immunological, biochemical methods)
5. monitoring the occurrence of genetically determined defects

Links

Source

- ws:Genotoxické látky

Related Articles

- Toxicogenetics

References

- BENCKO, Vladimír. *Hygiene : Teaching texts for seminars and practical exercises*. 2nd revised and supplemented edition edition. Karolinum, 2002. 205 pp. ISBN 80-7184-551-5.
- Czech Republic. Ministry of Industry and Trade. Valid chemical legislation. 2008. Available from <<https://www.mpo.cz/dokument27543.html>>.