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### **Toxins as agents of biosecurity**

*This article analyzed the literature on toxins, their effects, their use as a weapon in bioterrorism and their relationship to the impact of aviation on the environment, as well as methods of dealing with this.*

Biosecurity refers to measures aimed at preventing the introduction and/or spread of harmful organisms (viruses, bacteria, etc.) to animals and plants in order to minimize the risk of transmission of infectious disease. The term includes biological threats to people, including those from pandemic diseases and bioterrorism. The definition has sometimes been broadened to embrace other concepts, and it is used for different purposes in different contexts.

A toxin is a harmful substance produced within living cells or organisms; synthetic toxicants created by artificial processes are thus excluded. Toxins can be small molecules, peptides, or proteins that are capable of causing disease on contact with or absorption by body tissues interacting with biological macromolecules such as enzymes or cellular receptors. Vary greatly in their toxicity, ranging from usually minor (such as a bee sting) to almost immediately deadly (such as botulinum toxin). These are mainly secondary metabolites that often help the body to protect itself.

On a broader scale, toxins may be classified as either exotoxins, being excreted by an organism, or endotoxins, that are released mainly when bacteria are lysed. Exotoxins produced by gram-positive bacteria, are soluble in body fluids, they damage cell membranes of tissue, interrupt metabolic function, and interfere with cellular functions. Endotoxins made of components of bacterial cell wall, are not tissue specific, produced by gram-negative bacteria, made of lipopolysaccharides (LPS).

Toxins differ not only in origin, but also in the nature of the effect on the body, as well as in the localization of the accumulation processes of a particular type of toxin. Each type of toxin accumulates in those tissues that are most susceptible to it.

1. Myoxic poisons attack muscle fibers.
2. Hematic toxins contaminate the blood.
3. Hemolytic poisons break down red blood cell membranes.
4. Nephrotoxins destroy the kidneys and tend to poison the excretory system.
5. Neurotoxins disorganize the central nervous system.
6. Cardiotoxins affect the cardiovascular system.
7. Hemorrhagic poisons break down the walls of blood vessels and provoke hemorrhages.
8. Necrotoxins affect tissues, inhibiting vital processes and causing them to die off.

The term "biotoxin" is sometimes used to provide clear evidence of biological origin. There are classes of toxin-producing organisms such as: viruses (cytotoxins,

lysins); Protozoa (endotoxin, phospholipase, protease); Plants (alkaloids, tannins, cyanogenic glycosides); Higher Animals (fish, insects, snakes, frogs); Bacteria (e.g. endotoxins, exotoxins); Algae (microcystins, ASP, PSP); Fungi (tricothecenes)

Environmental toxins are poisonous substances produced by pesticides, vehicle pollution and industrial waste. Many of these toxins are discharged into the water supply and food chain, where they can be consumed by the general population. Water pollution is a form of pollution in which the water supply is contaminated with environmental toxins. It can be caused by dumping waste from factories, livestock farms or lawn fertilizers. Most of today's food is also full of environmental toxins. This is because the animals and vegetables that you can buy at the supermarket have been soaked in artificial chemicals. These chemicals are used to increase the lifespan of foods and more.

Environmental toxins include naturally occurring compounds such as: lead, mercury, radon, formaldehyde, benzene, cadmium.

Poisoning with toxins can be divided into the following stages:

1. Acute form (is characterized by an abrupt onset, has pronounced symptoms such as: a sharp rise in temperature; diarrhea; vomiting; headache; abdominal pain; convulsions);

2. Subacute form (It is characterized by contact with a less aggressive toxin. Some of the harmful substances are removed by the filters of the body, and some negatively affect health. symptoms: slight increase in the body; lethargy; digestive problems; nausea or vomiting);

3. Chronic form (may not have pronounced manifestations. The state of health gradually deteriorates, the body weakens, the immune system gradually ceases to cope with infections and diseases).

Xenobiotics are toxic substances created by man himself. That is, they, unlike standard poisons, do not have natural origin and appeared in the world only thanks to the activities of people. As a rule, almost all xenobiotics contain chlorine. The most common example of this type of toxins today is dioxin - this is a real poison that is found in the cells of a living organism. Its main task is to influence the main part of the cell, on which its life and functioning depend - the nucleus. The ways of getting this substance into the human body are as follows: inhalation of vehicle exhaust gases; inhalation of air contaminated by incineration (usually plastic waste); in the production of dyes (in factories, construction sites, during repairs, etc.); the use of chlorinated water; through smoking [1,2].

The practice of everyday life convinces us that in modern conditions terrorists have the potential to resort to non-traditional methods of committing terrorist acts. The possibility of the unexpected use of weapons of mass destruction (WMD): nuclear, chemical, biological, which no modern state is ready to effectively counter, poses a particular danger. At the same time, the greatest danger from the point of view of easy accessibility, ease of manufacture, storage and transportation, as well as the scale of the consequences of their use, is, in our opinion, biological and chemical weapons.

Some toxins have mechanisms of action and physical properties that make them amenable for use as potential warfare agents. Owing to their high toxicity, ease of production, and ease of dissemination, several toxins are regarded as possible bio-

terror agents. Botulinum neurotoxin is the most potent toxin in nature and the only one included in the CDC category A. *Staphylococcal* enterotoxin B, *Clostridium perfringens* epsilon toxin, and ricin are included in the CDC Category B.

Natural toxins are usually more toxic than chemical agents, have a longer latency period, and they are associated with a lower risk of environmental contamination. The morbidity and mortality rates are lower with toxins since they are not transmitted from person to person, and they will affect only those who were directly exposed to them following dispersion. This, together with their relatively short latency period compared to live pathogens, shortens the potential duration of the event. The non-contagious nature of toxins also reduces the need for neither healthcare surveillance nor using special protective gear by healthcare workers, apart from standard precautions. Since there is no role for prophylactic treatment, there is no need in preparing large-scale points for dispensing drugs, as opposed to other live bio-terror agents.

Toxins cannot be grown in culture or identified by simple genetic sequencing of amino acids, making detection and treatment a more complex challenge. Furthermore, poisoning often presents with nonspecific clinical manifestations.

Toxins that are airborne tend to cause more severe illness than ingested toxins.

A high index of clinical suspicion is especially important in case of Botulinum neurotoxin poisoning; one of the few toxins for which there is an available anti-toxin and early administration is life-saving. In most cases, however, the only available treatment is supportive [5,6].

In aviation, a fairly wide range of use of toxins is possible as a threat to people, pursuing specific goals. For example, planting toxic bombs in an airport or airplane, poisoning the food of planners, spraying air toxins in a specific area or room, applying liquid toxins to handrails, etc.

Aviation itself is also one of the largest air pollutants, its impact on the environment is expressed mainly in the emission of toxins into the atmosphere with the exhaust gases of aircraft engines and the impact of aircraft noise. The following ways of solving this problem are possible: reducing the time of operation of the engines on the ground; reduction in the number of operating engines when taxiing; modernization of engines; development of alternative fuels; administrative activities [3,4].

## **Conclusions**

After analyzing the information, we can conclude that improving the health and well-being of the population are the end results of the functioning of biosafety systems. Toxins are toxic products of microorganisms, natural poisons of animal or vegetable origin or their analogs obtained by methods of chemical synthesis, proteins with high biological activity, and extremely toxic for higher animals (ricin, diphtheria toxin, botulinum toxin, etc.) A type of biological weapon is considered a toxic weapon, the damaging effect of which is based on the pathogenic properties of toxins of various origins, which can be used against humans. And today the environmental problem in the aviation sector is very urgent. Many countries are involved in solving

this problem, controlling emission standards, airlines are teaming up to develop alternative fuels and modernize engines.

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