

Role of Microbiological Monitoring in Ecology

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In the end of the XXth century the humanity realized that the biosphere and its components have limits of self-regulation and self-healing, beyond which irreversible degradation occurs [1].

Current status of the environment may be regarded as ecological crisis which is characterized by chemical pollution of the biosphere and critical depletion of natural resources. According to the sustainable development concept, humanity should not only aim at reducing anthropogenic impact on the ecosystem but also undertake restoration of natural balance.

Among the problems facing modern society, the state of the environment occupies one of the first places not only by the presence of chemical contamination, but also by the presence of a large number of microorganisms. Numerous alien organisms and synthetic chemicals circulate in the In the biosphere. Pollution of the atmosphere, hydrosphere, and soil leads to ingress of harmful substances in food chains, including those in which humans are the end users.

According to the World Health Organization (WHO), by the beginning of the XXIth century, industries and agriculture made use of about 500 thousand chemical compounds, more than 40 thousand of which are harmful to human health, and about 12 thousand are toxic. A considerable part of these substances enters into the atmosphere, soils, and surface and ground waters. Pollutants are delivered to the human body with inhaled air and drinking water. WHO experts believe that the relative contribution of environmental factors to the impact on human health is at least 25%.

At the beginning of the XXIth century, infectious diseases continue to cause significant harm to humans. Biological threat posed by infectious diseases and their pathogens, hangs over the entire planet. In particular,

among the 51 million people who die each year in the world, nearly 17 million die from infection, whereas cardiovascular diseases kills 9.7 million people.

Bacteria constitute the primary and the main reason for biological risks related to food and are everywhere in the environment. Exposure to microbes can be beneficial, harmless, or harmful to human health. Most microorganism species are not harmful to humans, but there are some that can be dangerous and even deadly. In recent years, the number of food poisonings caused by emergent (newly appeared) microorganisms increased.

Therefore, it has become necessary to develop other systematic approaches to ensure microbiological safety. One approach is microbiological risk analysis (MRA). The concept of microbiological risk is a function of the probability of adverse health effect and its magnitude as a consequence of harmful factor (such as microbes or microbial toxin) present in food [2]. Can this health threat caused by environmental pollution be evaluated quantitatively? This is possible by analyzing microbiological risks of all anthropogenic events. Unfortunately, human health problems are rarely considered as important aspects of environmental programs or programs for economic development associated with transformation of nature. In particular, 95% of large development projects funded over the world and 90% of the World Bank projects are carried out outside the health sector. These projects are so significant that their implementation has an impact on the environment, society, and health. Globalization creates new forms of human vulnerability to the “old” threats. At present, the world’s most pressing problem is the illness and premature death caused by biological pathogenic agents present in the environment, air, water, food, and soil, which is a direct consequence of biological pollution. The impact of humans on the environment

depends on the type and amount of consumption of natural resources, the amount of waste they produce and waste treatment. Reduction of non-specific resistance of human organism led to significantly increased frequency of *Staphylococcus spp.*, as well as of yeast and yeast-like microorganisms. Economic development of other countries inevitably raises problems related to recycling of nonrenewable natural resources and anthropogenic pollution of the environment. As the number of large cities increases (urbanization), the natural environment is no longer able to meet biological and social needs. Increased concentration of chemicals in air, water, and soil reduces resistance of humans to pathogens [30].

Strong anthropogenic impacts violate the relationships between microorganisms, which leads to disruption of microbial niches.

Ecosystem is a set of co-existing living organisms (plants, animals, and microbes) belonging to different communities and conditions of their existence. Biocoenosis is an association of different organisms forming a closely integrated community, in particular phytocoenosis is a combination of plant populations (sustainable community of plants), zoocoenosis is a community of animals living together under certain conditions, and microbiocoenosis is a community of microorganisms, which interact with each other within a given environment and form a specific living system. It should be emphasized that bacteria are the most numerous inhabitants of the biosphere. Each organism has a specific habitat or ecological niche with a set of conditions ensuring survival of a given species. Microorganisms never exist in isolation in the biosphere but form microbial communities. Microbial community is a combination of microorganisms related to each other through different trophic relationships [4]. The constant composition of microorganisms in space and time is a condition of their adaptation to environmental changes. The state of micro environment is determined not only by natural conditions but also by variations of the animal and vegetable world.

Powerful nature-modifying potential of human development (raw materials, energy, processing products), which is not isolated from the environment, gives rise to a threat to the environment because of the absence of necessary safety measures. Development of the human community requires implementation of innovative technologies whose volume presents a

safety risk (technological hazards). The situation at the present stage of development requires effective process control measures to ensure safety of people, society, nature. Environmental safety as a condition for living organisms, including humans, is characterized by external factors determining the habitat quality. Parameters of the animal world related to anthropogenic impact are usually considered at the level of zoocoenosis and particular animals. Detailed examination of problems related to the construction of cities and large industrial and agricultural enterprises, as well as of hydroelectric power plants and oil and gas processing plants, should include not only zoocoenosis and phytocoenosis but also microbiocoenosis. Currently, due to considerable increase in tourist flow to various regions of the world, people encountered with many environmental factors that were not familiar to population of Russia previously, and these factors have some impact on people. In particular, humans are involved in contact with a new microbiocoenosis which is characterized by certain qualitative and quantitative compositions in each region visited both in soil and in water and air. Air plays an important role in the daily metabolism in humans, animals, and plants. Parameters of air quality are its physical and chemical properties and microbiocoenosis. Air quality is affected by such factors as altitude, the presence of water surface, and especially human activities. Though living organisms can exist for a long time without food and water, they can live much shorter in the absence of air. The most important condition for a healthy environment is availability of pure and comfortable air. Sharp change in the composition of microorganisms in air, soil, and water was observed in regions near paprin plants (manufacture of fodder yeast from petroleum paraffins). Sharp increase in the yeast concentration in air was detected due to ingress of microorganisms into the air at the stage of fermentation which was carried out under non-sterile conditions and at the stage of spray drying (5–8% of the products released to the environment). The large increase of yeast organisms in the environment was accompanied by significant increase in the disease incidence among the local population and staff, in particular in the upper respiratory tract diseases, allergy, etc.

Unfortunately, monitoring of the environment around industrial enterprises does not include microbiological analysis of air, soil, water bodies, which does not allow time to prepare for changes that will be accompanied by the emergence of new diseases

in the region. We have noted above that microorganisms in the biosphere never exist in pure form. Their vital activity involves complex interactions between different species. These interactions establish over a long period, but nowadays the biosphere sharply changes, especially as applied to microbial community. Therefore, monitoring of the microbial community is necessary to take preventive measures to reduce infections.

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