

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Planet Ecosystem Interrelations' Impact on Food Safety Considering Anthropogenic Factors.

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ABSTRACT

At the present stage of social production development and the pace of scientific and technological revolution, our civilization radically alters the environment and the scale of human activity has become comparable with the effect of global natural processes. In this regard, the increased risk uncontrolled and irreversible environmental changes require resolute practical measures to protect and conserve the nature. However, to develop and implement the effective measures for environmental activities it is necessary to have a clear picture of influence of the planet's ecosystem linkages on food safety, taking into account the human factor, since the food supply, as a part of the metabolism, is connected with the environment. Ecological conditions, nutritional status and health of the population are the leading factors determining the level of strategic security of any state and of all the humanity. In this situation, improving the quality and food safety is one of the most important and priority tasks carried out on the basis of strengthening and improving internal production control, alongside with biological, chemical and physical risks. The most difficult and dangerous factors of food production are biological ones, as the abundance of pathogens have a wide adaptive capacity to unfavorable environmental conditions.

Keywords: ecology, pollution, ecosystems, food safety, milk, raw materials, infections, anthropogenic factors, biocenosis, HACCP

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INTRODUCTION

At the present stage of social production development and the pace of scientific and technological revolution our civilization is changing the environment radically with the scale of human activities covering almost the entire Earth surface and these activities have become comparable with the effect of global natural processes (On Food Quality and Safety: № 29-Ф3, 2000). In this regard, the increased risk of uncontrolled and irreversible changes in the environment and as a result - an existential threat to the living organisms, including the mankind itself, it is necessary to work out some practical measures for the protection and conservation of nature, the legal regulation of the use of natural resources [1]. These measures include the creation of non-waste technology, sewage treatment plants, regulation of the pesticides use, ending production of pesticides that can accumulate in the organisms, land reclamation, as well as the creation of protected areas, centers for breeding rare and endangered animal and plant species for the conservation of the gene pool of the Earth, and the drawing up of the World and National Red Books [2].

The issue of research For the development and implementation of effective measures for environmental protection, which ultimate goal is the preservation of life, health and sustainable development of mankind, it is necessary to have a clear understanding of the planet ecosystem interrelations' influence on food safety, taking into account the human factor, since the foodstuff as part of the metabolism is connected with the environment.

The aim of this study is a systematic analysis of the available information and the creation of a new quality of knowledge, based on the integration of individual components into a single multi-factor system.

MATERIALS AND METHODS

Ecosystem (or biogeocenosis) - a single natural complex formed by living organisms (biocenosis) and non-living (abiotic) components forming their habitat where they are interconnected by dynamic interaction of exchange of matter and energy [3].

Biocenosis - the totality of the plants (phytocenosis), animals (zoocenosis), fungi (mycocenosis) and microorganisms (microbiocenosis) inhabiting a land or water area and characterized by certain relationships between themselves and adapted to environmental conditions.

Autotrophic organisms - plants capable to photosynthesis, and partly - chemosynthetic bacteria that act as producers, that are the first link in the food chain and the creators of organic compounds from inorganic to ensure the existence of all other organisms.

Heterotrophic organisms - all animals, human beings, some plants, most bacteria and fungi acting as consumers that consume a ready organic matter in the food chain, as they are not able to synthesize nutrients from inorganic compounds.

Saprotrophic organisms - many germs, fungi, some invertebrates that act as decomposers of dead organic matter and turn it into inorganic substances which other organisms-producers are able to absorb. Biotic environmental factors - factors of the Nature.

Environmental factors (factors of inanimate nature) - a set of actions of non-living components: water, air, different types of radiation, landscape, the parent rock and related chemical composition of inorganic components.

Biotope - area of land surface (land or water body) with the same type of environmental conditions, occupied by a certain biocenosis.

The lithosphere - the outer sphere of the "solid" earth, including the crust and upper mantle underlying the upper

The parent soil-forming rock - the top layer of rock, that due the influence of biological and chemical processes and human activities forms the soil.

Soil - a natural formation consisting of genetically related horizons formed as a result of the conversion of the surface layers of the lithosphere due the influence of water, air and living organisms; it is fertile and consists of solid, liquid (soil solution), gaseous and live (soil fauna and flora) parts.

Factors of soil formation - the parent rock, climate, flora and fauna, topography, geological age of the territory, human activities whose variability in time and space has led to the formation of a variety of soil types.

Solar radiation - electromagnetic and corpuscular radiation of the sun, which is the conversion into chemical energy of various organic compounds through photosynthesis, is playing a leading role in the biosphere processes, resulting in a global scale to the formation of organic matter from inorganic, connecting the life on the Earth with the whole Universe and defining all its complexity and diversity.

The hydrosphere (water shell of the Earth) - the set of all water bodies of the world: oceans, seas, rivers, lakes, reservoirs, wetlands, groundwater, glaciers and snow cover. Water (H₂O) - a key factor in determining the geological history of the planet, which is essential to the existence of living organisms, it is an essential component of all processes of food, pharmaceutical, chemical industry and agriculture.

Atmosphere –an air environment around the Earth, rotating with it and consisting of 78.1% nitrogen, 21% oxygen, 0.9% argon, small quantities of carbon dioxide, hydrogen, helium, neon and other gases. At an altitude of 20-25 km there is an ozone layer (O₃ allotropic modification of oxygen), which protects living organisms on the Earth from harmful short-wave radiation. The Earth's atmosphere has an electric field. Its uneven heat contributes to the general circulation of the atmosphere, which affects weather and climate on the Earth surface.

Biosphere - an area of active life, covering the lower part of the atmosphere, hydrosphere, lithosphere and the upper part of which living organisms (living matter) and their habitats are organically connected and interact with each other to form an integrated dynamic system.

The noo sphere - a qualitatively new form of organization of the biosphere arising from the interaction of nature and society, as a result of transforming the world of human creativity, which is based on scientific thought, in which intelligent human activity becomes a decisive factor for its development [4].

The main methodological approach in this study is food safety tasting on the example of raw milk as a complex multi-system containing physical, chemical and biological risks.

RESULTS AND DISCUSSION

The scheme of the planet ecosystem relations with the regard to human factors and adaptation to plant and animal origin products is shown in Figure 1.

As a result of the interpenetration and interaction of the lithosphere, atmosphere, hydrosphere and biosphere the geographic (landscape) shell of the Earth is formed that has complex spatial differentiation. The integrity of the shell is determined by the geographical continuum of energy and weight exchange between land and atmosphere, the World Ocean and organisms. Natural processes in the geographical shell take place due the radiant energy of the Sun and the internal energy of the Earth. Plants are the main primary source of food and energy for all other forms of life on the Earth, they are suppliers of herbal products that create the bulk of the organic matter of the biosphere, maintain the constancy of gas composition in the atmosphere with O₂ and CO₂ content, protect the surface of the Earth from the greenhouse effect and contribute to the formation of ozone screen. Animals provide human with valuable high-protein products of animal origin, such as meat, eggs and dairy products. Decomposers complete the full organic matter cycle in the food chains, returning to the biotope that inorganic material, which was originally taken by producers for photosynthesis. Within the geographical shell the mankind has appeared and having been developing now, taking from the shell all the resources necessary for the existence.

Anthropogenic factors have various forms of impact of the human activity on the environment and can be both positive and negative. One of the negative anthropogenic impacts is the pollution of ecosystems,

which includes a number of factors and can be divided into four groups: ingredient, social, parametric and biocenosis.

Ingredient pollution of ecosystems includes mineral (chemical production wastes, metals, combustion products, accidental discharges, oil production and oil products, pesticides and fertilizers) and organic (wastes of food, processing and microbiological industry, livestock farms, domestic sewage and garbage) components. They act as the main polluters of plant and animal origin products.

Social pollution of ecosystems includes soil erosion, quarrying, road construction, urbanization, land drainage, etc. It primarily affects the biotope changing environment of living organisms.

Parametric pollution of ecosystems includes light, heat, noise, radiation and electromagnetic interference. It complements the effects of anthropogenic influence of abiotic environmental factors on the ecosystem (figure 1).

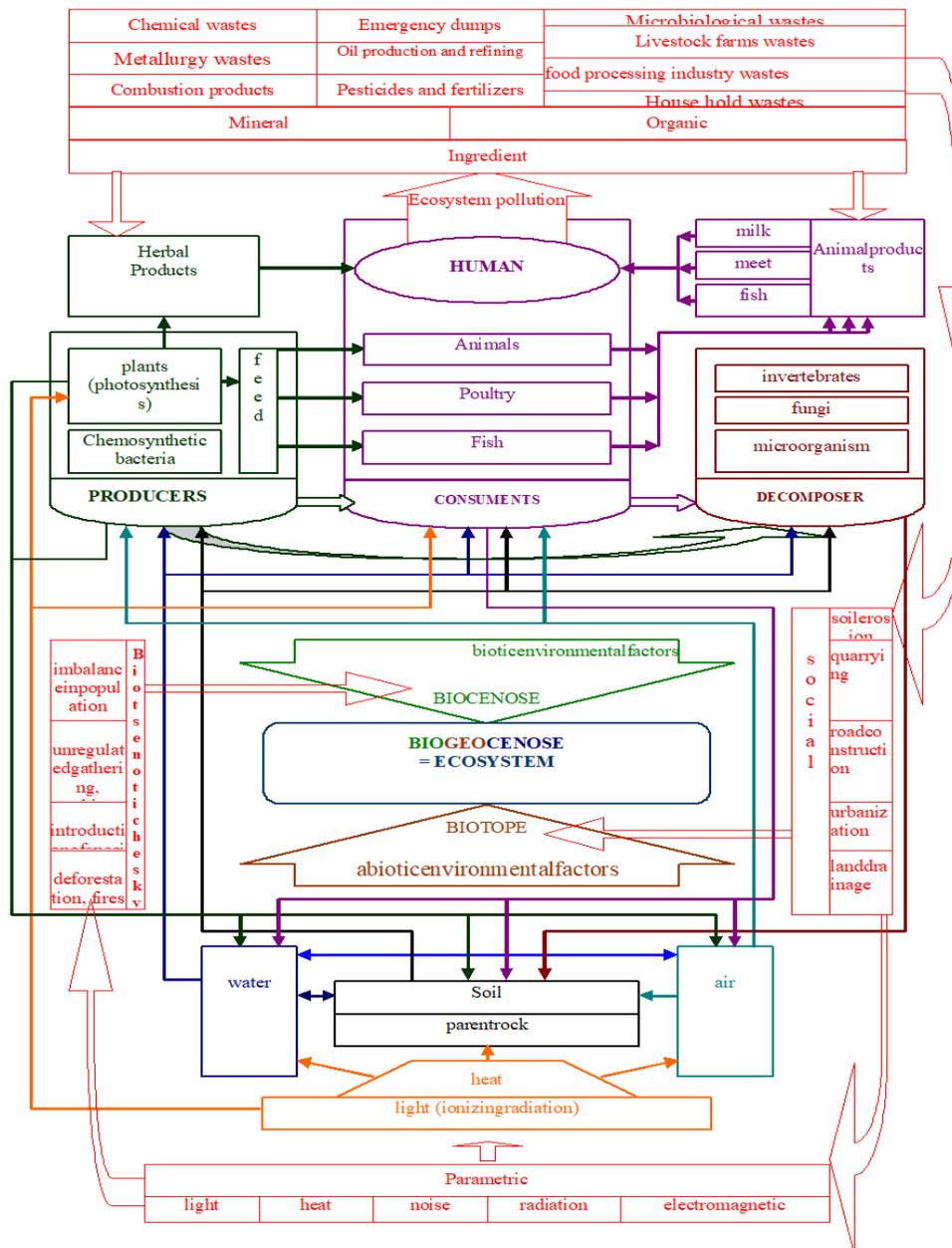


Figure 1: Planets ecosystem interrelations' impact considering human factor and adaptation to plant and animal origin products

Biocenosis pollution of ecosystems involves population imbalance as a result of unregulated grass gathering, hunting or animal trapping, spontaneous species introduction, deforestation and fires. All these radically affect the dynamic balance of matter and energy flow in the food chain.

Described above cyclic processes of matter transformation and movement in Nature maintain the cycling of matter in the world, which is composed of the individual processes of the water, gases and chemical elements circulation. All living organisms also play a huge role in the circulation of substances (circulation of oxygen, carbon, hydrogen, calcium and other nutrients that are a constant part of any organism and perform some important biological functions). Global influence on the cycling of matter has a human activity, that resulted both in starting of new and changing of existing ways of matter migration in the Nature.

As a result of anthropogenic impacts on the environment in the food raw materials appear and accumulate foreign substances and bacteria that come into food products [5]. This leads to biological, chemical and physical risks and requires a special approach to the organization of the food production system based on HACCP (Hazard Analysis and Critical Control Point), which provides “systematic identification, estimation and maintain dangerous factors affecting significantly the product safety [1, 6]. This organization is recognized in the world and its activity is approved by authoritative organizations [7].

Biological risks, which are usually caused by bacteria, can lead to food poisoning (toxicosis or food poisoning), and infectious diseases [8]. Infectious (communicable) diseases are differ from other human and animal diseases that are caused by living creatures - microbes. Food toxicosis (intoxication) is acute poisoning connected with the consumption of foods containing exotoxin accumulated as a result of pathogenic microorganisms (pathogenic staphylococcus, streptococcus, the causative agent of botulism and toxigenic fungi). Nutritional diseases are acute intestinal disease of humans resulting from consumption of foods containing large amounts of live pathogens (diseases caused by Salmonella bacteria group and germs: Escherichia Coli, Proteus, Perfringens Bacillus, Cereus, Enterococci etc.). Acute intestinal infection of humans are differ from food poisoning by the small number of live bacterial cells that due to their high pathogenicity are able to reproduce in the body and cause specific pathological process (typhoid, paratyphoid, salmonellosis, dysentery, cholera and others). The causative agents of these diseases - bacteria Salmonella, Shigella, Vibrio. In addition, the agents of acute intestinal infections may get in the human body not only with food, but through water, infected dishes, dirty hands, etc. [9]. Mankind itself activates the process of adaptation of microorganisms: the world of microbes produces evolutionary some mechanisms to preserve its life forms in terms of increased unfavorable effects (antibiotic resistance, thermo resistance, toxin production as a kind of microbial antagonism) (table 1) [10].

Table 1: Preventive action to biological risks (HACCP, 2003)

Pathogen	Preventive action and control measure
Bacillus cereus	Establishing the correct mode of storage and cooling of foodstuffs; heat preservation treatment products a long shelf life
Campylobacter jejuni	Establishing the correct mode pasteurization or cooking of food; prevention of infection / contamination when contacting tools and pieces of equipment; freeze; Use of atmospheric packaging
Clostridium botulinum	Heat treatment for canning food extended shelf life; adding nitrite salt or meat is processed; freeze perishable meat products, packaged and vacuum packaging; acidification to PH values below 4.6; lowering the water activity to 0.93 or below
Clostridium perfringens	Establishing the correct mode of storage and cooling of foodstuffs; establishing the correct duration of the preparation of food and proper mode of heat treatment; the establishment of proper procedures for the preparation of food and the prevention of infection through contaminated or dirty industrial equipment
Listeria monocytogenes	Establishing the correct mode of heat treatment; thorough implementation of sanitation programs; separation of raw materials and finished products, moving to production processes that use raw materials and the finished product
Salmonella spp	Establishing the correct mode of heat treatment; separation of raw materials and the prepared products; establishment and compliance with the rules of

	sanitation and hygiene for the personnel of the enterprise; control of fermentation processes; decrease in water activity; cessation of feeding animals before slaughter; avoid contact with the external side of the carcasses when removing the skin; the use of antimicrobial washing; the use of scalding procedures; disinfection of knives
Staphylococcus Aureus	The establishment and compliance with the rules of sanitation and hygiene personnel of the enterprise; establishing proper procedures for fermentation and control of PH values; establish the correct mode of heat treatment, the establishment of proper procedures for handling of food after the completion of the processing; decrease in water activity
Yersinia Enterocolitica	Establishing the correct mode of heat treatment and freezing; control of the addition of salt; the prevention of infection by contact

Chemical risks also can cause human disease related to the use of food, but in a smaller scale. Chemical hazardous factors are substances used in animal husbandry and crop growing, industrial chemicals, natural toxicants, substances that pollute the environment, and some substances used in the food industry [11]. The main sources of chemical agents are chemicals used in agriculture (pesticides, herbicides, medicine for animals, fertilizers, nitrates, etc), industrial chemicals (cleaners, sanitizers, lubricants, paints, pesticides), natural toxins (results of plants, animals or microorganisms metabolism, such as aflatoxins), chemicals used in food industry (preservatives, acids, food additives, sulfites), environment polluters (inorganic salts of copper, zinc, lead; cadmium, mercury, arsenic, etc.) [11].

Table 2: Preventive actions for chemical risks (HACCP, 2003)

Risk	Preventive action
Natural chemicals	Providing supplier warranty documents confirming the quality of raw materials; availability and performance of the program verify that the quality of the incoming raw material supplier to the values specified in the warranty documents received from this supplier
Introduction of dangerous chemicals	Have detailed specifications for each type of raw materials and ingredients; providing supplier warranty documents confirming the quality of raw materials; visit suppliers to monitor; requirement for a provider, and the performance of the HACCP plan; software testing to confirm the absence of chemical residues carcasses
The chemicals used in the process of food preparation	Definition and documentation of all used direct and indirect food additives and dyes; check for permission to use for each chemical; proper use of each chemical; documenting cases of use of each ingredient banned

The physical risks are a group of factors that can be defined as any physical material that is not a normal part of the food and can cause disease or injury to a person who uses it as food. Physical factors are a set of materials that can be define as “foreign material” or “foreign matter or object”. Various foreign matters may come in the food at any stage of production [11]. It can be any sharp objects that could cause injury; solid objects dangerous to the teeth; objects blocking the breathe and cause choking. The main natural hazards for the food industry include glass, metal, stone, wood and plastic.

Table 3: Preventive actions for the physical risks

Risk	Preventive action
The foreign objects in the feed	The presence of the HACCP plan provider; use of specifications, letters of guarantee; The examination of the supplier and its certification; use of magnetic devices; Use Screeners, traps and filters; internal verification of raw materials after his admission to the enterprise
The foreign objects in the packaging	The presence of the HACCP plan provider; use of specifications,

material, the presence of detergents and cleaning agents, etc.	letters of guarantee; The examination of the supplier and its certification; internal verification of raw materials after his admission to the enterprise
Foreign objects trapped in the product during manufacturing operations or as a result of non-compliance with the rules of the company's employees.	Using metal detektor; visual inspection of products; the correct execution of the equipment maintenance; frequent inspections of technical condition of the equipment

There is a connection between the hazards and critical control points. Hazard analysis, defining the critical process parameters and taking preventive measures are the ways to ensure a safe product [12].

CONCLUSION

1. The scale of human activities, covering almost the entire geographical shell of the Earth, have become comparable with the effect of global natural processes, giving rise to new and changing existing migration routes in the nature of substances, new substances. In this regard, the increased risk of uncontrolled and irreversible changes in the environment and as a result - an existential threat to the world of living organisms, including mankind, require some practical measures to protect and conserve the nature.

2. The environmental situation, the state of nutrition and health are the leading factors determining the level of strategic security of any country and all the mankind. In this situation, improving the food quality and safety is one of the most important and priority tasks carried out on the basis of strengthening and improving internal production control.

3. The most difficult and dangerous factors of food production are biologically, as the abundance of pathogenic micro-organisms have high adaptive capacity to change environmental conditions. The microbiological safety of food has become a new priority due to the rapid change in the epidemiology of infectious diseases. New pathogens with increased aggression and altered biological properties are appearing and they can cause pathological process in the digestive system. That is why we pay special attention to the microbiological aspects of food production technology.

4. In the framework of global changes in environmental conditions increases the susceptibility of people to infectious agents, due to the demographic and general biological processes in the modern style of life, that leads to a deterioration in health. The globalization of trade enhancing the geographical distribution of pathogens, as well as the integration and consolidation of agricultural and industrial production leads to the risk of the spread of a single source products from a large central enterprises and can cause mass food poisoning. Increased shelf life of products causes the appearance of unfavorable for people biological properties of microorganisms capable to reproduce, accumulate and store the pathogenic material and factors of aggressiveness even in the cool conditions or oxygen restrictions.

5. As a result of work of the creative team of authors in large-scale research of the real ecological community environment impact on natural focal infections, which is reflected in publications, and specifically designed scientific and methodological recommendations [13] allowed to find solutions for the reduction of microbial contamination of raw milk before its processing biotechnology. Some studies were carried out on the directed and controlled process of soft heat treatment of raw milk and whey [14]. A method of heat treatment of raw cow milk with the aim to improve its microbiological and technological properties with extended storage life for its further use in industrial processes [15]. The number of mesophilic aerobic and facultative anaerobic microorganisms of the raw milk reduced to the European Economic Community and the World Trade Organization requirements. The method is implemented in standard technical documentation and adapted to the HACCP system through the analysis of control critical points.

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