

Chemical Ecology of Food as a Basis of Sustainable Social Development

Andrey Ivankin

Bauman Moscow State Technical University (BMSTU)

Moscow, Russia

E-mail: aivankin@inbox.ru

Angela Zarubina

Bauman Moscow State Technical University (BMSTU)

Moscow, Russia

E-mail: zarubina@mgul.ac.ru

Veniamin Boldyrev

Bauman Moscow State Technical University (BMSTU)

Moscow, Russia

E-mail: veniamin_bk@mail.ru

Anton Ageev

Bauman Moscow State Technical University (BMSTU)

Moscow, Russia

E-mail: ageev@mgul.ac.ru

Marina Baburina

V.M. Gorbатов Federal Research Center for Food Systems

of Russian Academy of Sciences (V.M. Gorbатов FNC

Food Systems)

Moscow, Russia

E-mail: baburina2005@yandex.ru

Abstract—The problem of modern greening of food as the basis for the successful social development of society is discussed. The purpose of the paper is to substantiate the methodology of modern green production and consumption of food for the harmonious and successful active social development of a person. The main determinants that determine the safety and quality of food are identified and described. It is shown that the person's ecological world, which determines the quality of his existence, cannot be complete without taking into account the factors of the presence of food contaminants. The adversities of food systems that largely determine the manifestation of the diseases of the century, cardiovascular diseases, oncology, and diabetes were discussed. It was concluded that it is necessary to obtain organic food without the usage of modern industrial production technologies, in which today are forcedly used unsafe chemical mixtures for humans.

Keywords—greening of food; micronutrients; safety; quality; dangerous components of food

I. INTRODUCTION

The concepts of "ecology", "environmental friendliness", "environmental cleanness" recently accumulate an understanding of the need for a full approximation to nature with the maximum usage of materials created by nature itself. [1] At the same time, the most important component of human life is a food, as a rule, is not considered in this area of environmental concepts. Nevertheless, talking about ecology, environmental cleanliness without taking into account the fact that modern food produced in the enterprises cannot be considered environmentally friendly due to the use

of a large number of additives that are unsafe for the consumer, is an absolutely unacceptable approach to ensuring harmonious and safe human development of the 21st century.

Today there is a situation when "three major diseases of the century" - cardiovascular diseases, oncology, and diabetes affect a significant, especially age-related, part of the population. Mainly this is an unfavorable factor associated with irrational and poor-quality food.

Accelerated development of scientific and technological progress in our day faces us with the most difficult task of successful implementation of long, active and healthy life of each individual. The minds of a large number of scientists are occupied by the issues of prolongation a person's life. The whole system of modern medicine is also aimed at this issue [2] [3].

The purpose of the paper is to substantiate the methodology of modern environmentally safe food consumption for the harmonious and successful active social development of human beings.

II. BEING STATE-OF-THE-ART: THE CONNECTION BETWEEN THE ECOLOGY AND FOOD CONSUMPTION

Modern person, in accordance with his mentality, produces a creative interpretation of new empirical data and in this context develops from the human potential of existing knowledge only certain opportunities [4]. This is directly related to the daily occupation - the consumption of food. However, we do this practically unconsciously, mechanically,

since the food culture is established from childhood and does not depend much on the life experience acquired by an individual. Taste preferences develop over the years based on the practice of previous generations. Today the significant changes made by scientific, technical and industrial progress in this most important area of human existence can be stated.

The structure of modern food systems includes both macro and microcomponents. The complexity of the formation of modern food systems based on natural raw materials consist in necessity of obtaining a food product with satisfactory food flavor and safe for human characteristics, which are largely associated with the component composition [5].

The constituent microcomponents of such systems and products based on them are a variety of chemicals, the pool of which largely determines the main consumer property of food products — its taste [6]. However, some of these elements, which are often found in the matrix of the food system in trace amounts, can be dangerous for humans and be of ecotoxicants nature [7].

Traditional food production consists in the use of natural food raw materials, consisting of the main macronutrients: proteins, fats and carbohydrates developed by nature, the content of which in the product makes up its main part [8].

Micronutrients of food systems should include all substances that are part of the product composition, due to the developed formulation. This should include substances formed in the matrix of the product as a result of technological operations, or as a result of the development of biochemical transformations under the influence of the residual activity of the contained components during long-term storage.

The level of such microcomponents is less than proportion of percent and usually insignificant. The influence of microcomponents on health and the whole life of a person can be very significant. It is well known about the existence of traditional medicine and its separate area - homeopathy, which is based on the use of the smallest concentrations of various component compositions. The unequivocal use of submicrogram of matters allows the human body to cope with many diseases without the use of large quantities of conventional treatments. It is generally accepted today that more than one third of UK doctors and quarter of German doctors are homeopathist, i.e. they insert into the human body super-small rate of chemical components. In this case the desired therapeutic benefit is achieved.

And what about the food? Any modern product contains a sufficient list of components at a quantitative micro level, which systematically enters the human body and affects to the quality of life.

The significance of the influence of small rates of chemicals on the processes occurring in living organisms can be demonstrated with the following example. In the body of mammals, and man, in particular, is contained in very small quantities a matter called heparin, which prevents blood clotting. The phenomenon of blood clotting is a common natural protective mechanism of higher organisms' existence

when the skin is damaged. Blood clotting can occur both in the organism itself (in vivo) and in a blood plasma (in vitro). Thrombin clotting time is twenty seconds - i.e. during this time the human blood plasma usually clots in vitro. Thrombin clotting time is almost a constant value under normal environmental conditions. Artificially adding blood anticoagulant - heparin in a quantity of about ten rose to the power of minus eight percent leads to a complete stop of the natural mechanism and the blood does not clot for a long time. Obviously that such effect of just a little rate, including other chemical matters, can also be very significant and even unsafe for humans.

Micronutrients of food consist of different groups of chemicals, most of which are found in raw materials initially in the form of natural ingredient. Recently, a significant part of such ingredient is the result of human industrial activity. They are not only contained in raw materials, but are also found in products as introduced substances during chemical cultivation of agricultural products, such as pesticides, preservatives, stabilizers, and hormonal regulators. Microcomponents also appear as a result of technological operations and related chemical and biochemical transformations that occur as a result of transformations under the influence of microorganisms during long-term storage, for example, the appearance of aflatoxins and heterocyclic amines that are extremely dangerous to human health [9].

Micronutrients of natural origin can also be considered as minor products of macro-components' hydrolysis — free amino acids resulting from protein catabolism, free fatty acids of lipidic origin, simple sugar from carbohydrates, and nucleotides — DNA cleavage products. The total sum of the presence of these ingredients in the native raw material of natural origin is usually thousandths and even hundredths of a percent and does not pose a threat to humans.

Modern technologies of food production very significantly distort the nature of food. Agricultural production and subsequent industrial processing of raw materials into packaged goods solves the problem of human food supply. This also takes into account the purpose of a long-term preservation of products, since trade takes time to sell products. This task is the most important industrial problem and has a complete contradiction with environmental safety, since the only one effective way to solve this problem is the use of various, rather harmful, preservatives. As a result, today in retail chains which are the main suppliers of food products, there are food products that are not ecological. This reality can be traced in almost all groups of food products [10].

Horticulture provides the human need for cereals, vegetables, fruits. However, the use of "harmful chemistry" in this process today exceeds all reasonable limits. Excessive use of fertilizers in the cultivation of plant crops leads to the fact that the food products produced from them contain residual amounts of fluorides, nitrates, sulphates, significantly exceeding their background level in nature. Pesticides are the synthetic poisons, which prevent product decay or contribute to the destruction of excess herbage

during agricultural production, are particularly dangerous. Defoliants used in the technology of cultivation of sunflower, cotton and other forms are constantly found in the final product.

Honey - a product produced by bees and must be environmentally friendly by default. In some cases, when melliferous flowers in the area of honey collecting by insects were exposed to pesticides, harmful to humans substances appear as residues in the product itself.

Seafood and fish, by default, must be an environmentally friendly product. However, this is not the case. Bottom fish, including sturgeon, flounder and other types of fish are the "dirtiest" in the context of the presence of harmful microcomponents. So sturgeon is a fat-containing product and this type of fish during its life is able to accumulate organochlorine and other pesticides, as well as high-density metals, which are well accumulated in adipose tissue, in quantities three to ten times more than other inhabitants of the sea or freshwater habitat. There is a well-known fact of restrictions on cod catching in the Baltic Sea and in regions where hazardous dumping of toxic wastes was carried out. All seafood which was caught near the location of the Fukushima nuclear station in Japan after the accident contained dangerous radionuclides and it is unacceptable to eat it.

The use of preservatives for seafood preservation is one more additional adverse factor in ensuring the safety and quality of seafood. So, soaking in solution of cheap synthetic antibiotic chloramphenicol in China, is a very common method of preserving seafoods. Naturally, during the consumption of such fish, containing residual amounts of chloramphenicol, a person receives unnecessary and hazardous substances, which in the future will harm his health.

The use of technologies in the cultivation of fish in artificial basins, for example, Norwegian salmon, artificial organic pigments to give fish a bright color, is also not useful for humans. Norwegian salmon cannot be attributed to environmentally friendly products, since synthetic organic pigments are tumor marker substances.

The most important sources of proteins are meat and seafood. Meat has been used by humans for thousands of years and our digestive system adapted to it. In the 20th century, man significantly intervened in the evolution process and the structure of meat today is quite different from its original structure [11].

Firstly, modern feeds containing various activators, stabilizers, nutritional ingredients and chemotherapeutic compounds are used for raising of farm animals. Components of feed concentrates provides their high nutritional value and, that is more important, contribute to reducing the animals' diseases. As a result, residual quantities of pharmaceuticals are detected in raw meat, which, through food, already affect humans. Bird flu, which causes enormous economic damage to manufacturers, they are trying to prevent precisely through the usage of chemotherapeutic compounds in feed. As a result, today in

our country a significant part of poultry meat produced contains nitrofurans and other related anti-inflammatory drugs. They all come in food.

Secondly, in a number of countries (USA, China, Brazil, Canada, etc.), the so-called hormonal technologies began to be applied. Farmed animals with feeds, or as injections, receive micro rates of hormonal regulators, such as diethylstilboestrolum, ractopamines, estrogen, and other substances. The use of hormonal regulators allows significantly reducing the time of the animal growth and building -up physique required by the manufacturer. A classic example of such products is the "Bush legs" [12].

The use of veterinary antibiotics, sometimes replaced on penicillin and tetracyclin, to increase the effect, increases the risk of this type of raw meat for humans.

Thirdly, harmful to humans chemical substances are added of meat products according to the manufacturing process. Thus, almost in all meat products sodium chloride which is harmless to humans are used for preservation, but sodium nitrate is a toxic. Nitrate provides long-term preservation of the product's color, as well as its prolonged bacterial preservation. As a result, a person eats microscopic amounts of harmful nitrate along with sausage products.

Fourthly, according to the manufacturing process, in some cases, meat and products based on it become quite harmful to humans. The way of fume smoking of the raw meat over the smoldering wood, which is widely used, leads to the ingestion of very dangerous substances into the human body - benzopyrene and other polyaromatic compounds, which themselves provoke cancer. Therefore, this method of producing food must be limited.

It is also necessary to mention the technological approach used to manufacture meat products by extruding lumpy meat with salt brine of plant-based, mainly soy, proteins. An artificial introduction of these components to the product cannot be a danger to humans, however, considering the fact that almost all soybean is a genetically modified product, food produced using such soybeans cannot be considered environmentally friendly.

Considering dangerous trends in the production technology of meat products, one should also point out the latest achievements of the scientific and technological revolution - the growing of animals with genetically modified characters [13]. Such artificial meat, of course, does not correspond to the product obtained in the process of natural evolution and can hardly be considered as an "eco-friendly" product that is necessary for a healthy person.

III. THE MOST IMPORTANT COMPONENTS OF SAFE AND ECOLOGICAL FOOD

As noted, considering issues of food safety and quality, many of products contain inclusions that cannot be classified as environmentally friendly. Its identification and quantitative assessment should be carried out within the framework of national certification.

In accordance with the decision of the Russian government, non-obligatory, voluntary certification operates on the territory of our country. In such a system, the decision about carrying out of the quality control of food products in analytical laboratories belongs to the manufacturer or the seller.

The main existing documents regulating the safety and quality of food today are: "Public health requirements for catering arrangement, manufacturing and conveyance in it of food and food raw materials Sanitary Rules and Norms 2.3.6.1079-01", "Hygienic requirements to safety and the nutritional value of food Sanitary Rules and Norms 2.3.2.1078-01", "Hygienic requirements for the quality and safety of food raw materials and food Sanitary Rules and Norms 2.3.2.560-96". Recently, uniform documents have been accepted by the countries of the Customs Union: "Technical Regulations of the Customs Union TR TS 021/2011 - About Food Safety" and "Technical Regulations of the Customs Union TR TS 034/2013 - About Safety of Meat and Meat Products".

The presence of the statutory framework allows monitoring the safety and quality of food products produced at industrial enterprises, but the lack of obligatory certification makes this work senseless. In recent years, tendencies of widespread use of cheap substitutes, preservatives and stabilizers in the food industry in the Russian Federation make a significant share of the products produced quite unsafe for humans.

Recently, a number of manufacturers are trying to rectify the situation by producing the so-called pure "organic" products, produced without chemical fertilizers and preservatives. However, the share of such food products is insignificant. And now the issue of long-term preservation of such products is considering.

IV. CONCLUSION

Understanding the real state of issues related to the quality of modern food leads to the realization that, food products grown in private farms according to old and ecological methods of production are the only possible source of "environmentally friendly". In private subsidiary farms, modern chemistry is not used. Following the rules of hygiene, such products, should be "ecological". However, unfavorable environmental conditions in this case should also be taken into account [14].

The location of private subsidiary farms in unfavorable environmental conditions, for example, close to the development of mineral resources (oil, gas, ores of polymetals and radioactive elements) or near thoroughfares which unfortunately are quite common does not allow obtaining the environmentally friendly products. Real eco food will ensure sustainable social development of the population [15].

The problem of obtaining high-quality food that is environmentally friendly for a person in mass production is the most important problem of the national government, the

solution of which should be supported by the main resources of the country.

REFERENCES

- [1] S.A. Lebedev, *Methodology of Scientific Knowledge*, Moscow: Prospect, 2015.
- [2] I.S. Potaptev, V.V. Bushueva and N. N. Bushuev, "Analysis of the main factors determining the appearance of discoveries and inventions in science and technology", *Science and Education: a scientific publication of BMSTU*, no. 4, pp. 398–415, 2014.
- [3] B.N. Zemtsov and T.R. Suzdaleva, "Ecological Law of Russia: Milestones of Formation," *Proceedings of the International Conference on Contemporary Education, Social Sciences and Ecological Studies (CESSSES 2018)*. Series "Advances in Social Science, Education and Humanities Research", vol. 283, pp. 329-332, 2018. DOI: 10.2991/cesses-18.2018.74
- [4] N. I. Gubanov and N.N. Gubanov, "The role of mentality in the development of society: sociocultural hypothesis," *Vestnik slavianskikh kultur – bulletin of slavic cultures-scientific and informational journal*, vol. 43, no. 1, pp. 38-51, 2017.
- [5] N.L. Vostrikova, O.A. Kuznetsova, A.V. Kulikovskii and M.Yu. Minaev, "Formation of the scientific basis of meta-data associated with estimates of "onco-" risks linked to meat products", *Theory and practice of meat processing*, vol. 2, no. 4, pp. 96–113, 2017. DOI:10.21323/2414-438X-2017-2-4-96-113.
- [6] A.N. Ivankin, A.B. Lisitsyn, N.L. Vostrikova, and A.V. Kulikovskii, "Mass-spectrometric identification of chemical components of the flavor-aromatic range of meat products", *Theoretical and practical aspects of food technology management in the context of increasing international competition*. Sat. doc. 17th International. scientific-practical. Conf. memory Gorbatova Dec. 11 2014. Moscow, VNIIMP, pp. 77–80, 2014.
- [7] R.A. De Wijk, V. Kooijman, R.H.G. Verhoeven, N.T.E. Holthuysen and C. De Wijk. "Autonomic nervous system responses on and facial expressions to the sight, smell, and taste of liked and disliked foods". *Food quality and preference*, vol. 26, no. 2, pp. 196–203, 2012.
- [8] M.A. Nikitina, A.N. Zakharov, V.V. Nasonova and A.B. Lisitsyn. "Modeling as a method for scientific cognition of complex meat systems". *Theory and Practice of Meat Processing*, vol. 2, no. 3, pp. 66–78, 2017. doi.org/10.21323/2414-438X-2017-2-3-66-78
- [9] A.N. Ivankin, G.L. Oliferenko, V.A. Belyakov, V.A. Kochetkov, A.S. Kuleznev, A.N. Zenkin, M.I. Baburin and A.V. Kulikovskiy, "Problems of formation of food systems based on animal raw materials", *Meat Industry*, no. 1, pp. 14–18, 2019.
- [10] V.Yu. Ivlev and M.L. Ivleva, "Philosophical Foundations of the Concept of Green Economy," *Proceedings of the International Conference on Contemporary Education, Social Sciences and Ecological Studies (CESSSES 2018)*. Series "Advances in Social Science, Education and Humanities Research". vol. 283, pp. 869-873, 2018. DOI: 10.2991/cesses-18.2018.192
- [11] M.B. Oseledchik, M.L. Ivleva, V.Yu. Ivlev, "A new paradigm for analysing knowledge transfer processes," *Proceedings of 4th International Conference on Education, Language, Art and Intercultural Communication (ICELAIC 2017)*. Series "Advances in Social Science, Education and Humanities Research", vol. 142, pp. 766-770, 2017. DOI: 10.2991/icelaic-17.2017.177
- [12] A.N. Ivankin and N.L. Vostrikova. "Biochemical transformations of lipide and carbohydrate-protein nano complex in liquid foodstuff". *International Journal of Food Science and Nutrition Engineering*, vol. 2, no. 3, pp.27 – 32, 2012. DOI: 10.5923/j.food.20120203.03.
- [13] N.N. Gubanov and N.I. Gubanov, "Mental Responses to Risks in Modern Society," *Proceedings of the International Conference on Contemporary Education, Social Sciences and Ecological Studies (CESSSES 2018)*. Series "Advances in Social Science, Education and Humanities Research", vol. 283, pp. 1003-1007, 2018. DOI: 10.2991/cesses-18.2018.220

- [14] M.B. Oseledchik, M.L. Ivleva, V.Yu. Ivlev, "The fractal nature of implicit knowledge," Proceedings of the 3-rd International Conference on Arts, Design, and Contemporary Education (ICADCE 2017). Series "Advances in Social Science, Education and Humanities Research", vol. 144, pp. 673-676, 2017. DOI: 10.2991/icadce-17.2017.163
- [15] N.I. Gubanov and N.N. Gubanov, "Criminal behavior: biological, social and personal conditionality," Vestnik slavianskikh kultur – bulletin of slavic cultures-scientific and informational journal, vol. 48, no. 2, pp. 53-66, 2018.