

FUNCTIONAL NUTRITION TO SUPPORT THE HEALTH OF THE POPULATION OF UKRAINE UNDER WARTIME CONDITIONS

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Abstract. *The population of Ukraine has been living in conditions of Russian aggression for more than a year. They are in a state of stress due to shelling, uncertainty of the future, risks of loss of life and property, worries for the lives of relatives who are in the ranks of the defense forces or found themselves in territories temporarily not controlled by Ukraine. Under these conditions, the quality of food, drinking water, and the environment deteriorate, with complex negative impacts on people's health. They need particular special nutrition with a full set of necessary essential nutrients, capable of providing physical and psychological endurance, preventing the occurrence and development of somatic, nervous and other types of various diseases. For this, health and functional food products and drinks are needed. They will include a scientifically based selection of physiologically functional ingredients with the necessary medical and biological indicators and directed therapeutic and preventive properties. The research analyses the positive effects of micronutrients that affect physiological processes in the human body during periods of stress and poststress. It is known that in such conditions the metabolism takes place more actively, the consumption of some vitamins and minerals increases, therefore the need for antioxidant vitamins and vitamin cofactors of the body's enzymatic systems increases. There are a number of factors that increase the impact of stress on the human body and, as a result, should be excluded. These include food toxins, alcohol, oxidants, and free radicals. One of the most promising ways to prevent stress and reduce its consequences is to include functional foods and beverages as part of the diet. Their composition should include these functional ingredients, the deficiency of which disrupts the body's adaptive capabilities.*

Introduction. Health is one of the most important priority life values that determine the quality of a person's life; it is a state of the body when it is capable of feeling the most comfortable in physical, mental, social and moral aspects.

The Charter of the World Health Organization states that health is a state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity. Only healthy individuals can form a healthy society, and a healthy society, in turn, is bound to provide sustenance for individuals (Statute, 1946).

The war unleashed by the Russian Federation took the lives of many Ukrainian citizens, both military and civilian. The consequences of the war in Ukraine are assessed by the number of deaths, the scale of economic losses, the destruction of infrastructure and the number of forcibly displaced persons. In addition, war directly affects public health. The population of Ukraine is in a state of stress due to the uncertainty of the future, risks of loss of life and property, fear of shelling, worries for the lives of relatives who are in the ranks of the defense forces or found themselves in territories temporarily not controlled by Ukraine.

Citizens who have remained in the layer zone or temporarily occupied territories can suffer injuries, wounds, contusions. These people are constantly stressed by shelling, fear of losing relatives and housing. Under such conditions, there is a decrease in the quality of food, drinking water, deterioration of the environment, which negatively affects health at the current moment, and will also have delayed consequences (Roberts et al., 2019).

The body's adaptive reserves decrease; the morbidity associated with insufficient natural resistance to adverse environmental factors and the deterioration of living conditions increases. In the future, many Ukrainians could face mental exhaustion, psychological and mental problems, behavioral disorders, increased addiction and exacerbation of some illnesses (Spiegel et al., 2023).

The analysis of the situation experienced by Ukrainian society, which was carried out (Myronyuk et al., 2022), demonstrates that the armed conflict will have negative medical and demographic consequences, which will manifest themselves:

- the increase in the incidence of socially significant diseases, such as malignant neoplasm, tuberculosis, diseases of the circulatory system, diabetes, respiratory diseases, with an increase in the proportion of their detection in advanced stages or due to their complications;
- mental exhaustion of the population with an increase in the level of psychological and mental problems;
- an increase in the number of drug, alcohol and other addictions;
- the threat of an increase in the risk of the population contracting infectious and parasitic diseases, including tuberculosis, HIV/AIDS, acute seasonal viral infections, including vaccine-controlled and epidemic outbreaks of acute intestinal diseases, with an increase in the level of mortality, including premature, and disability of the population due to the lack of appropriate medical assistance;
- a high level of forced population migration to safe living areas and forced resettlement of people, including children, to the Russian Federation.

In the conditions of today, when the war forced many citizens of Ukraine to experience mental trauma, face depression or post-traumatic stress disorder, learn the difficult experience of moving to foreign cities and countries, it is especially important to ensure the triad of health: physical, mental and social. Considering the relationship between a person's state of health and the structure of his diet, proven by official medicine, it is possible to purposefully influence the improvement of the adaptation capabilities of the population of Ukraine by correcting the nutritional status and using modern food products of the new generation, adequate to the nutritional needs of the body in extreme conditions (Levy et al., 2022).

Nowadays, it is known that the health of a person who is under the influence of a complex of unfavorable environmental factors can be improved through the use of a special diet with a full range of necessary essential nutrients capable of ensuring physical and psychological endurance, counteracting the influence of negative exo- and endogenous factors, preventing emergence and development of somatic, nervous and other types of diseases (Rabbi et al., 2023). Healthy and functional foods and beverages provide such effects.

Physiologically functional food products and drinks require a guaranteed content of a certain functional ingredient in amounts from 10 to 50% of a person's daily need for it, therefore they are adequate to the nutritional needs of a person (Teklić et al., 2021). Consumption of such products allows you to adapt to the conditions of the external environment, prevent the appearance of diseases, accelerate recovery processes, and prevent premature aging.

Modification of the recipes of functional food products and drinks due to the transformation of the initial components, the introduction of functional fortifiers into the recipe has a positive effect on such physiological processes as increasing physical endurance, strengthening immunity, improving digestive functions and regulating appetite, normalizing metabolic processes, compensating for the deficiency of essential macro- and micronutrients (Granato et al., 2020).

The purpose of the work: based on the analysis of literary data and the results of personal theoretical and experimental research, determine directions for correcting the nutritional status of the population of Ukraine through regular consumption of functional products, adequate in terms of component composition to extreme conditions of life.

Materials and Methods. Based on a systematic approach, the bibliosemantic method and the method of structural-logical analysis were used during the conducted research. The research materials were data from scientific literature and personal practical experience in the development of technologies for functional food products with improved nutrient composition and a targeted impact on the health of consumers.

Results and Discussion.

Characterization of vitamins as functional ingredients that have a positive effect on the state of the human body in stressful and post-stress periods.

The key aspects in the creation of functional food products are the scientifically based selection of physiologically functional ingredients with the necessary sanitary-hygienic, medico-biological indicators, aimed at therapeutic and preventive properties as well as the development of new technological solutions that allow to significantly influence not only the organoleptic and physico-chemical indicators of raw materials and finished products, increasing their biological value, and also provide them with defined functional properties (Stetsenko et al., 2021).

Currently, special attention should be paid to the psycho-emotional state of our society. For over a year the majority of the population is in a state of stress or even distress that is maladaptive stress, which requires additional biochemical resources to overcome. If one's own resources are not enough, it is worth influencing this by consuming foods and drinks with a sufficient content of nutrients, which in a state of stress undergo increased costs. Since the content of nutrients in drinks is not significant, we will characterize the action of micronutrients that affect the state of the human body in stressful and post-stress periods.

In extreme situations, with changes in energy metabolism, increased physical exertion, and inhalation of polluted air in adverse environmental conditions, the formation of free radicals is happening, negatively affecting the body. The key links of the body's protective systems include: the antioxidant protection system, the enzyme detoxification system, and the state of the membrane apparatus of cells.

In order to improve the condition of the human body under such conditions, a sufficient amount of vitamins is needed, which participate in the metabolism, mainly regulating certain biochemical and physiological processes. First of all, they are necessary to ensure the mechanisms of enzymatic catalysis, normal metabolism, maintenance of homeostasis, biochemical support of all vital functions of the body. During stress, the metabolism is more active than in a normal state, the consumption of some vitamins and minerals increases, as a result of which the need for an increased supply of vitamins-cofactors for the most important enzyme systems of the body increases (Young et al., 2019). Table 1 provides a list of vitamins with anti-stress properties, as well as the mechanisms of their positive action.

Table 1.

Mechanism of positive action of vitamins with anti-stress properties

Vitamin A (retinol)	A	Antioxidant, protects brain cell membranes, which contain a large amount of fat and can be damaged by free radicals
Vitamin D (calciferol)	D	Strengthens immunity, improves the state of the nervous system, improves the assimilation of calcium, magnesium, and zinc
Vitamin E (tocopherol)	E	A powerful antioxidant that protects intracellular structures and membranes of brain cells from damage by free radicals
Vitamin C (ascorbic acid)	C	Antioxidant, participates in all types of metabolism, increases stress resistance, ensures the production of anti-stress hormones and interferon, and activates cells of the nervous system.
Vitamin B ₁ (thiamine)	B ₁	Participates in the processes of nervous regulation, contributes to the improvement of the work of the nervous system, improves cognitive and mental activity
Vitamin B ₂ (riboflavin)	B ₂	Supports and normalizes the functions of the central nervous system, and regulates the processes of excitation and inhibition in the nervous system, therefore it is especially necessary for people with significant mental and physical stress
Vitamin B ₅ (pantothenic acid)	B ₅	Helps cope with stressful situations, increases concentration, reduces depression and anxiety, activates mental activity, reduces fatigue
Vitamin B ₆ (pyridoxine)	B ₆	Anti-stress factor, necessary for the synthesis of neurotransmitters serotonin and dopamine, necessary for the functioning of the central and peripheral nervous system
Vitamin B ₉ (folic acid)		Has a positive effect on depression and anxiety states, has an anti-stress effect
Vitamin B ₁₂ (cyanocobalamin)		Has a positive effect on the central nervous system, supports metabolism in nervous tissue, reduces irritability, improves memory and concentration
Vitamin PP (nicotinic acid)		Helps improve memory, protects the body from stress, participates in energy metabolism
Vitamin H (biotin)		Contributes to the normal functioning of nervous tissues

Essential nutrients for the anti-stress diet of the population of Ukraine

In addition to vitamins, an anti-stress diet should also include a group of vitamin-like compounds. L-carnitine participates in energy exchange and provides transmembrane transport of fatty acids in mitochondria. A deficiency of this nutrient leads to a significant decrease in the body's energy potential and increases the effects of stress (Virmani et al., 2022).

Coenzyme Q₁₀ (ubiquinone) carries out energy exchange, and stimulates the improvement of heart muscle contractions. Important for consumption during times of stress, as it is one of the most effective antioxidants (Cirilli et al., 2021).

The group of mineral components most important in stressful conditions includes zinc and selenium. Zinc is a structural element of more than 300 enzymes that regulate the metabolism of proteins, fats, and carbohydrates, and is also involved in the expression of a number of genes. Zinc deficiency during stress leads to secondary immunodeficiency and contributes to liver cirrhosis and sexual dysfunction (Chasapis et al., 2020).

Selenium is an irreplaceable trace element necessary for the functioning of the body's antioxidant system, and is involved in the regulation of a number of hormones. Selenium deficiency contributes to the development of osteoarthritis (disease of bones and joints) and myocardiopathy.

Additions of succinic acid to the diet of the population will be appropriate. Succinic acid in the body has a multifaceted therapeutic effect. Its universal antihypoxic, hepatotropic and antistress effect has been proven (Saxena et al., 2017). The adaptogenic effect of succinic acid during heavy physical exertion has been established, there are data on the stimulating effect of succinic acid on protein synthesis, hemoglobin, glucose absorption and glycogen synthesis in the liver.

Antioxidant protection is provided by various components of food products (bioflavonoids, food indoles, and isothiocyanates). These compounds, not having energy and plastic value, control detoxification processes and protection of body systems from toxic effects. Their low content in the diet leads to a significant increase in the risk of developing chronic non-infectious diseases (Stetsenko et al., 2021).

Prospects for the use of herbal medicinal and spicy-aromatic raw materials for maintaining the health of the population of Ukraine

One of the most promising sources of natural biologically active substances is herbal medicinal and spicy-aromatic raw materials, which should be considered both as a physiologically active additive and as a multifunctional recipe component capable of significantly improving the organoleptic, food and consumer characteristics of new products and beverages. Raw materials can be used in the form of water and water-alcohol extracts, thickened and pasty concentrates, powders, CO₂ extracts, essential oils, etc. Complexes of compounds contained in plants act in a variety of ways, stimulating various body systems or compensating for their insufficient function (Varshney et al., 2021). This usually prevents the occurrence of allergic diseases and complications. In addition, medicinal plants have an antioxidant effect and the ability to remove toxic substances and metabolic products, and some compounds affect the enzyme activity of the body.

Medicinal and spicy-aromatic raw materials contain a wide range of biologically active substances in fairly significant quantities, capable of exerting a versatile influence on all functions and systems of the human body. For example, to increase the body's defenses against the influence of various harmful factors (small doses of radioactive radiation, stress, the destructive action of free radicals, physical and psycho-emotional overloads, non-specific infectious diseases, etc.), to have an antioxidant, general strengthening effect. The use of medicinal plants in the field of food technology requires careful control and compliance with the requirements for their quality and safety.

Factors that lead to increased consumption of essential nutrients

At the same time, in stressful conditions, a number of components that increase the consumption of essential nutrients should be excluded from the diet. Alcohol should certainly be classified as a toxic substance. Under conditions of stress, the enzymes alcohol dehydrogenase and aldehyde dehydrogenase, which oxidize ethyl alcohol, are spent on the utilization of endogenous alcohol, which is synthesized in increased quantities in connection with the transition of the body to work in emergency mode. Exogenous alcohol will be almost completely transformed into

acetaldehyde and acetic acid. The acetic acid that is formed causes, in particular, metabolic acidosis - it lowers the pH of the blood and thus neutralizes the electrokinetic potential of erythrocytes, which leads to their clumping.

Destabilization of the colloid system of blood leads to deterioration of blood flow, increase in its viscosity, increase in hydraulic resistance in blood vessels, especially in capillaries. The presence of toxins in the blood reflexively leads to the narrowing of capillaries, which in turn sharply worsens the metabolism of xenobiotics present in body cells in excess in the post-stress period. Thus, the effects of stress only increase.

Similar consequences are also caused by smoking, which is associated with the formation in the alveoli of the lungs of a protective reaction of their narrowing to reduce the toxic concentration of tobacco products in the blood. The consequence of this is a decrease in the efficiency of the biotransformation of xenobiotics and the evacuation of the products of their biochemical rearrangement.

Increased consumption of fermented milk products with probiotics, containing live cultures of lacto- and bifidobacteria, as well as prebiotics, in the form of dietary fibers of vegetables and fruits, will significantly enhance the productive processes of metabolism with the transformation and removal of toxic substances arising as a result of experienced stresses.

Conclusions. A properly constructed diet during stressful situations caused by the full-scale invasion of the troops of the Russian Federation into Ukraine can be an effective tool for preventing the development and transition to maladaptive stress. In the case of maladaptive stress, the diet should be considered as one of the main tools for overcoming the effects of stress and bringing a person out of the post-stress state as quickly as possible.

The need for constant search and development of new effective means of protecting the health of the population of Ukraine requires the development and introduction into the production of special food products, the composition of which will be scientifically based and experimentally tested. The range of such products can be very diverse, as they are created on traditional food bases, and multifunctional fortifiers are natural biocomplexes of agricultural and medicinal raw materials with proven physiological effects.

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