KAPITEL 1 / *CHAPTER 1* [1]
SMART-TECHNOLOGIES PRODUCTION OF FOOD PRODUCTS FOR PEOPLE IN CONDITIONS OF CONSTANT STRESS

DOI: 10.30890/2709-2313.2024-32-00-010

Introduction

Chronic stress is called as «silent killer» of the 21st century. Ignoring the signals and delaying the problem until last can lead to numerous deaths or disabilities. To guarantee a person's ability to work in such conditions, it is necessary to ensure the functional reliability of all body systems, stability and reserve capabilities of the body. Optimization of rational nutrition in extreme conditions with special food products for these conditions (biologically complete and balanced in terms of basic food products) is a problem for scientists in this field of activity.

This task can be solved in two ways. The first consists in studying and constantly monitoring the state of health of people in conditions of constant stress, as well as correcting their condition due to the use of food rations based on special culinary products. This approach requires the creation of a system for collecting information, forecasting the state of a person under conditions of constant stress for several periods ahead and long-term work of experts. The result requires significant financial costs and is achieved after a long period of time. However, it allows you to comprehensively study this issue in perspective, find a way out and protect yourself from risks.

Under the influence of chronic stress, the central nervous system becomes vulnerable, which can cause alcohol and drug abuse, malnutrition, overeating, or lead to behavioral changes and social withdrawal. Stress can make things difficult if you have breathing problems like asthma or emphysema. Responding to stress, a person, trying to distribute a lot of oxygen and blood throughout the body, breathes faster. The heart works faster under stress. The blood vessels constrict and, in order to provide the strength for an urgent reaction, direct more oxygen to the muscles. This helps to increase blood pressure. Persistent hypertension increases the risk of stroke and heart attack. In turn, this causes pain throughout the body, because chronic stress keeps the

[1]**Authors:** *Svidlo Karyna Vladimirovna*

muscles in constant tension. In stress the liver produces extra sugar (glucose) to provide us with energy. But sometimes body may not be able to cope with the increased level of glucose if this condition turns into a chronic one. This increases the risk of developing type II diabetes.

Smart-technologies of food products for people in conditions of constant stress, which use dietary plant additives, were scientifically grounded and developed on the basis of theoretical and experimental studies. A scientific concept and possible concepts of its realization are proposed. Optimizing the nutritional composition of special food products for people in conditions of constant stress must be carried out according to the algorithm proposed in the project, which makes it possible to obtain a new food product with specified properties. The task of optimizing product recipes consists in the scientifically based selection of functional ingredients and their ratios, which ensure the maximum approximation of the mass fractions of food substances to personalized norms. Principles of nutrition for people in conditions of constant stress are systematized and nutrient groups to keep them main organism systems active are defined. Biological value of composite dietary plant additives is calculated. Criteria for optimization of food product nutrient compositions which use dietary plant additives are grounded. The model of ensuring the activity of the main body systems of people in conditions of constant stress is proposed. Innovative idea of using plant-based natural complexes in food products for the people in conditions of constant stress are worked out.

Products rich in potassium, zinc, copper, iodine, and selenium, i.e. dietary stress protectors, prolong life and inhibit the spread of stress in society. Ensuring the daily need for chelated metals by the developed diet determines the prevention of oncological pathologies, as well as the antisclerotic, lipotropic, antioxidant orientation of the diet.

1.1. Background

The «silent killer» of the 21st century is called chronic stress, ignoring signals and postponing the problem until the last, sent by the human body, which leads to numerous deaths or disabilities. To ensure a person's ability to work in such conditions, it is necessary to ensure the functional reliability of all body systems, stability and reserve capabilities of the body. Optimization of the diet in extreme conditions due to special food products for these conditions (biologically complete and balanced products in terms of basic nutrients) is an urgent task for scientists in this field of activity.

The central nervous system (CNS) becomes vulnerable under the influence of chronic stress, which can cause overeating, malnutrition, abuse of alcohol, drugs or lead to changes in behavior, social withdrawal. Responding to stress, a person, trying to spread oxygenated blood around the body, accelerates breathing. Stress can make things worse if you have breathing problems such as asthma or emphysema. Under stress, the heart starts to work faster. Blood vessels narrow to give strength for an urgent reaction, to send more oxygen to the muscles. This helps to increase blood pressure. Persistent hypertension increases the risk of stroke and heart attack. In turn, this causes pain throughout the body, because chronic stress keeps the muscles in constant tension. During times of stress, the liver produces extra sugar (glucose) to provide us with energy. But the body may not cope with the increased level of glucose if this condition becomes chronic. This increases the risk of developing type II diabetes [1–2]. A special place in the formation of pathological manifestations and disruption of physiological processes in humans belongs to environmental factors. Stress is a non-specific neuroendocrine component of the mobilizing reaction of the entire body to any given demand (stressor). Stressors:

1) irritants that really threaten homeostasis (for example, pain, hypoxia, hunger, antigenic aggression);

2) the stimuli are unexpected or such as violate the stereotype;

3) stimuli that are potentially dangerous (based on previous experience [1, 3– 4].

Stress as a neuroendocrine process was first described in 1936 by the Canadian

pathophysiologist G. Selye [4]. Stressors of various origins lead to numerous metabolic disorders, which are known as "adaptation diseases". According to modern ideas, the viability of an organism in an emergency situation is higher, the better the cells of vital organs tolerate hypoxia. This applies to all types of homeostasis, reproductive function, differentiation, immunity, growth and development of both humans and animals. At the current stage of the development of medical and biological sciences, an urgent problem is the study of the chelation of metals in cells under the influence of stressful and pathogenic factors and physiological stimuli on the body, as well as the general patterns of changes in cellular metabolism. Study of the nature of cellular reactions to stressors from the point of view of factors, studies of the role of copper, magnesium and zinc, which are involved in many metabolic processes. There is more zinc in the cells of the human and animal body than all other trace elements, besides, zinc ranks 27th among other metals in the earth's crust. Specifically it's participates in gene of transcription, differentiation, growth and development of organisms, reproduction, immune reactions, is part of the active center of proteins (more than 300 enzymes). Their participation in the mechanisms of the general adaptive cellular syndrome and other adaptive processes helps to study the nature of changes in metalloligand homeostasis under the influence of stressors. There are two different pools of metals in human and animal bodies. The first pool is tightly bound to bioligands, it is contained in all cells of the body and is not determined by staining with chelators-chromophores. The first pool affects the stability of biomembranes and is part of most metalloenzymes. The second pool is weakly bound to bioligands, and the term "chelatable" metal is increasingly used for it. This refers to a weakly bound metal, which is detected in cells with the help of chelators-chromophores [5–6].

At this stage, the body is not yet saturated with hormones of the adrenal glands, so the adaptive restructuring of the metabolism is not complete and the resistance to acute hypoxia is not yet increased. At this stage, the body begins to produce stress-regulatory hormones of the adenohypophysis [7].

At the "stage of resistance" a general adaptation syndrome (GAS) is formed. The body is saturated with glucocorticoids and other corticosteroid hormones, as well as

catecholamines. The body is saturated with glucocorticoids and other corticosteroid hormones, as well as catecholamines. As a result of the acute counterinsular effect of stress hormones on metabolism, the acceleration of oxygen and energy substrate transport is ensured, as well as the redistribution of energy resources in favor of organs and tissues (CNS, myocardium, respiratory muscle of the diaphragm, adrenal glands). themselves, gonads), retina, etc.), which contain insulin-independent glucose transporters, glycogenolysis and gluconeogenesis are mobilized.

All this has an anti-shock effect characteristic of stress during acute hypoxia. But lymphoid organs, connective tissue, musculoskeletal system, lipocytes, gastrointestinal tract, vascular wall, etc. are temporarily in a state of energy deprivation. With strong and prolonged stressful actions, the functional resources of the neuroendocrine apparatus may be exceeded. In this case, the stress may reach the "exhaustion stage" (including passing the "resistance stage"). The increased non-specific resistance characteristic of ACS is lost or not formed [7, 9].

Stress that has led to the stage of exhaustion is called "distress". Distress is a risk factor for many diseases ("diseases of impaired adaptation" - atherosclerosis, hypertension, secondary immunodeficiency, obesity, osteochondrosis, arthritis, and many others), which damage organs and tissues and are manifested by stress in conditions of energy deprivation. Antidotes used to bind and remove toxic and radioactive metals from the body are chelators. Compounds with pronounced chelating properties can be formed in the body itself as a result of deep metabolic disorders, questions are increasingly being raised about the possible role of these substances in the development of various diseases, such as diabetes, schizophrenia, epilepsy, Parkinson's and Alzheimer's diseases, etc. Many medicinal substances can bind metals in chelated forms: antimicrobial, antitumor, psychotropic agents.

One of the most important problems of modern physiology and medicine is the study of the regularities of the process of adaptation of the organism to various environmental factors. Under the action of stress of various genesis, the processes of non-specific adaptation syndrome are triggered. The biological essence of any adaptation of the body is formed at the cellular level.

It is known that during the action of adverse factors on the body, general changes develop in the cells of many tissues and organs, which can be characterized as a non-specific adaptation syndrome of the cellular system (NASCS). The data available in the literature indicate the need to study the relationship between zinc and copper, because antagonistic relationships between these metals are possible in the mechanisms of development of NASCS [9, 10].

First of all, human adaptation affects a wide range of general biological laws, so the interests of workers in various scientific fields are related to the self-regulation of multicomponent functional systems. To assess the process of adaptation of athletes, the degree of their fatigue, the level of training and work capacity, it is necessary to determine the functional changes that occur during loads, and is the basis for improving recovery measures. Only on the basis of a comprehensive analysis of the set of reactions of the entire organism, including reactions from the central nervous system, hormonal apparatus, cardiovascular and respiratory systems, analyzers, metabolism, etc.

It is possible to judge the impact of physical and psychological stress on a person. The expressiveness of changes in body functions in response to physical exertion depends primarily on the individual characteristics of a person and the level of his training and stress resistance. Only when considering changes in the functional indicators of the human body relative to the adaptation process can they be correctly analyzed and comprehensively evaluated [2,11]. In the last decade, the problem of stress has become increasingly relevant in various fields of medicine. Despite numerous fundamental and applied studies in this field, the issues of combating the negative consequences of stress remain the most acute and the least resolved. The need to reduce the manifestations of stress, based on its signaling value, remains debatable. Stress, with which the body reacts to an extreme influence that poses a threat to a person's physical existence or his mental status, is a special functional state (FS). Stress occurs as a complex reaction of the body with the involvement of biochemical, humoral, vegetative, behavioral, emotional and other mental processes [12 14]. In this work, we will adhere to the definition of stress as "... the functional state of the body,

which arises as a result of an external negative influence on its mental functions, nervous processes or the activity of peripheral organs" [6, 9]. Adaptation is a biological function of stress, the purpose of which is to protect the body from various threatening, destructive influences (physical or mental). A person "engages" in a certain type of activity aimed at resisting the dangerous effects of the environment, which indicates the occurrence of stress. As stress develops, the body's physical activity and reactions change. This type of activity corresponds to a special FS and a complex of various physiological reactions. Stress is associated with a chain of reactions that begin with the production of adrenocorticotropic hormone (ACTH) by the pituitary gland. This is how stress is described in the neuroendocrine theory of the occurrence and regulation of stress. Through the cortex of the large hemispheres, the stressor signals the hypothalamus that danger has arisen. The mobilization of norepinephrine (NA) occurs in the neurons of the hypothalamus, which begins to activate the noradrenergic elements of the limbicoreticular system and causes the excitation of the centers of the sympathetic nervous system, which in turn enhances the activity of the sympatho-adrenal system and leads to the release of a mixture of adrenaline and NA from the medulla of the adrenal glands into the blood. This process enriches the blood by 80-90% with adrenaline and 10-20% with noradrenaline. Stress hormone (ACTH) does not limit its action to stimulation of corticosteroidogenesis. During an acute response of the body to damage, this hormone exhibits extraadrenal effects that are essential for restructuring the metabolism and physiological functions of organs under stress and are independent of corticosteroids [15–18]: ACTH has a delayed insulinotropic effect on the islet of Langerhans, which indirectly affects the exchange of chelating metals and strengthens metabolic changes during stress turn to the anabolic phase [19]. The hypothalamus is responsible for controlling homeostasis set points. Physiologically, this part of the diencephalon regulates heat transfer and heat production, appetite and satiety, thirst and diuresis, induction of opposite changes in blood pressure [20–22]. At the same time, the content of chelating metals can also change, but these issues have not been investigated, although all these indicators change dramatically under stress [23–24]. According to the principle of compensation for deviations of metabolic

constants from set points, the main controlling effects of the hypothalamus on metabolism are carried out due to the coordinated response of the endocrine and autonomic nervous system [25]. There is every reason to believe that the hypothalamus is the main element of the limbic system, which coordinates biologically appropriate behavior, determines what is pleasant and desirable, and what is unpleasant and disgusting for an individual, in his feelings and behavioral reactions [22, 26-28]. It is here that a lot of chelated zinc accumulates, and the affective component of sensations and reactions in the limbic system is formed. In turn, the hippocampus makes it possible to manage stress reactions in response to various sensory stimuli [27–29]. Reorganization of metabolism and physiological functions, which dramatically increases the survival and resistance of the organism to acute death in extreme conditions, is caused by stress (Fig. 1).

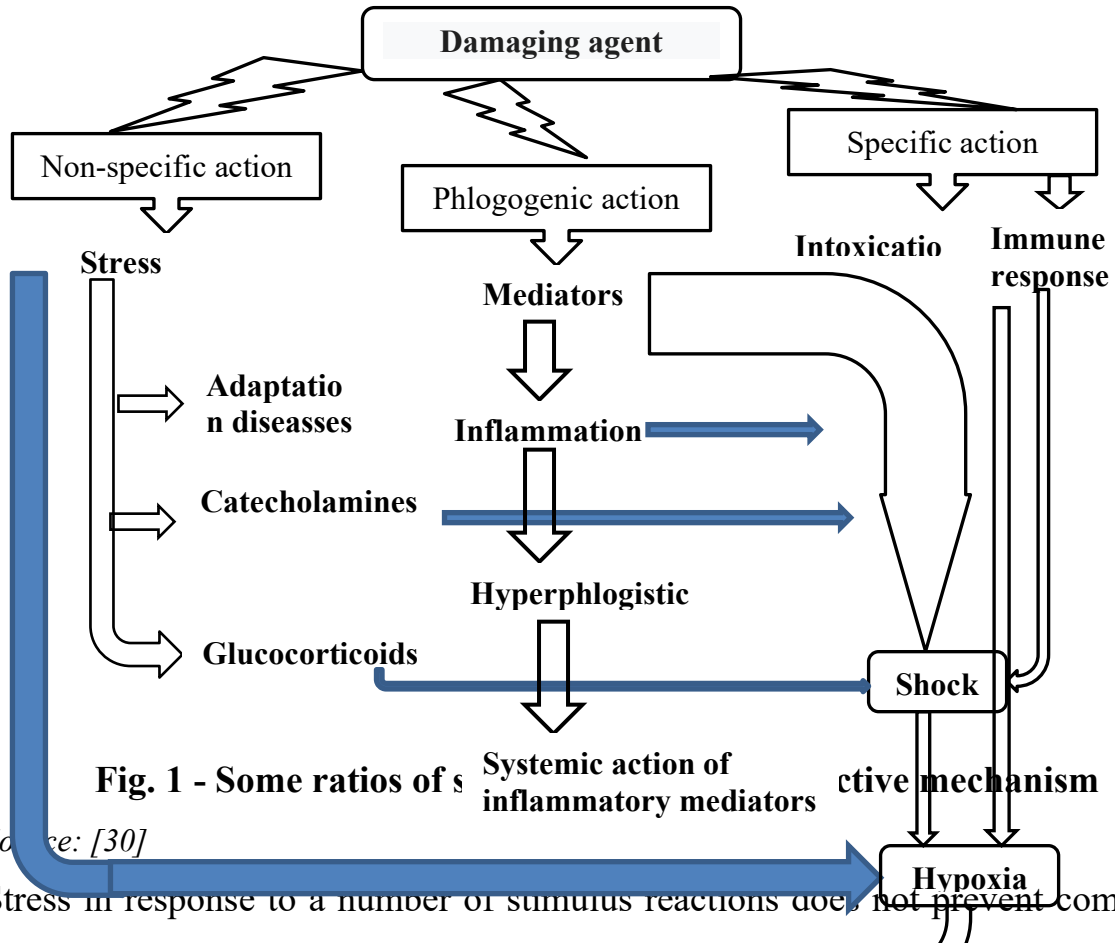

Fig. 1 - Some ratios of s ctive mechanism

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Stress in response to a number of stimulus reactions does not prevent complete deafferentation of the hypothalamus. At the same time, the stress reaction in response to hypoglycemia, endotoxemia, hypoxia, histamine, antigenic stimulation, serotonin is reproduced without changes, the reaction to overheating is partially preserved [21–22].

The dependence of the energy metabolism of cells in different organs and tissues on insulin is not the same. First of all, this applies to carbohydrate metabolism. Glucose entry into different cells of the body is regulated by different carriers. Only some of the carrier proteins are expressed with the participation of insulin, while others are insulin-independent. chelating metals, which contain chelating metals, absorb glucose from plasma without any involvement of mechanisms triggered by insulin [22]. The central nervous system, adrenal glands, gonads, and retina have a special supply of chelating metals, although at the same time, connective tissue, leukocytes, skin, gastrointestinal organs, and bone marrow are highly insulin-dependent organs, tissues, and cells [29, 31], which may mean that they also depend on Zn as an important component of insulin.

To maintain the priority glucose supply, to preserve the protection of organs and tissues from acute danger, acute reversible diabetes-like metabolic changes occur in some aspects of metabolism, which also affects the redistribution of chelated metals, especially zinc [30, 32]. Under stress, hyperglycemia of insulin-dependent consumers is also ensured by the fact that glucocorticoids (and to a lesser extent catecholamines) stimulate gluconeogenesis in the liver (6-10 times), which affects the metabolism of Zn and Cu. This also depends on the increased supply of glucogenic amino acids from skeletal muscle, which also contain Zn and Cu, but not in chelated form [33-35]. The overall metal-ligand homeostasis is affected by changes in organs containing metals in any form [36-37].

Lipid metabolism is influenced by stressors. The activity of phospholipase and the release of arachidonic acid from cell membrane phospholipids are strongly inhibited by glucocorticoids, with the participation of leptin, and thus prostaglandin synthesis, membrane composition and ionic permeability, which requires a decrease in the content of Zn and Mg as membrane-stabilizing factors [24, 30, 38, 39]. Under the influence of glucocorticoids, antioxidant systems are stimulated and membrane lipid peroxidation is blocked, which also requires redistribution of Zn and Mg in the body or intake of these metals from the outside with drugs or food [32, 40-42]. The effect of stress is multifaceted on the immune system, as well as on the blood system and

hematopoiesis.

Platelet formation is enhanced by glucocorticoids. At the same time, there is an increase in the formation of coagulation factors in the liver, in which cationic proteins (defensins) are involved, as a result, stress leads to an increase in the ability to increase the thrombogenic potential of the blood, erythrocytosis and thrombocytosis, which can lead to disseminated coagulation syndrome, which also involves glucocorticoids, and possibly sympathetic nerves, with a sharp change in the content of chelating metals [43-44]. Under stress, lymphopoiesis is suppressed, and myelopoiesis is enhanced. Under stress, leukocytopenia naturally develops. J. W. Thorne proposed it, before the development of direct methods for measuring corticosteroid concentrations, as an indirect correlative indicator of the secretory functions of the adrenal cortex [30, 32, 41, 43].

The functions of the gastrointestinal tract also change under the influence of stress. Short-term anorexia can be caused by catecholamines, but glucocorticoids increase appetite. The hollow organs relax and motility decreases, in particular the stomach, intestines and gallbladder, and sphincters close. Due to vasoconstriction, salivary gland secretion decreases, and gastric and pancreatic juice production, gastric secretion acidity, pepsinogen and trypsinogen expression, and the digestive capacity of duodenal and gastric contents increase dramatically. The result of stress is determined by the behavioral functions of the individual and depends on the hormonal background in the phase of recovery from stress and is largely its result for the individual.

Insulin plays an extremely important role in the body's hormonal response to stress. Under the conditions of stressful situations or unfavorable environmental factors, several mechanisms of hormonal regulation can be used:

1) a general increase in the production of glucocorticoids,

2) a change in the spectrum of glucocorticoids towards a relative increase in more active compounds,

3) a decrease in insulin production and at the same time its content in the blood,

4) a combination of these mechanisms [3, 12].

Already in the phase of anxiety, according to G. Selye, corticosteroid increment

increases in stressful situations. The content of glucocorticoids in the blood, increased in the phase of anxiety, begins to decrease in the phase of resistance. It can be argued, using the terminology of G. Selye, that insulin characterizes the levels of regulation and plays the role of a "conditioning factor" in the body [4, 24]. The formation of resistance under stress is of great interest. A person in high latitudes can live long enough in conditions of chronic stress, in which a state of resistance is achieved mainly by reducing the insulin content in the blood. It occurs under the influence of potent factors. Such a reaction generally constitutes a stressful state, a general nonspecific adaptive reaction of the body. In this state, the main thing is that a positive background is created for the implementation of specific homeostatic reactions and the body's adaptive and protective capabilities are mobilized (according to G. Selye) [4]. The need to activate the mechanism of general adaptation arises as the intensity of the performed acts of vital activity increases, as well as depending on the increase in strength or duration of the action. General nonspecific adaptive changes, in turn, are closely related to the energy and plastic support of functions by their essence and physiological role. The central nervous system controls adaptive processes. The structures of the hypothalamus, amygdala, reticular formation, and hippocampus, with the participation of various cortical centers, play a major role in this process. The effector part of adaptive reactions, in particular the mechanism of general adaptation, is directly related to changes in the activity of the endocrine ensemble. Any situation in professional activity associated with emotional stress can activate the adrenal function. There is evidence that coaches of hockey teams significantly increase the excretion of adrenaline and norepinephrine during competitions. A similar situation, although not as emotionally intense, occurs when researchers, university professors and management personnel give presentations and lectures. It has been proven in the examination of different groups of managers that the neuro-emotional component of their mental work is expressed in an increase in the excretion of catecholamines, which increases the activity of the sympatho-adrenal system [29, 31, 39].

Lecturing in higher education teachers was accompanied by an increase in the excretion of hormones of the cerebral and cortical layers of the adrenal glands. In

various types of mental work, an increase in adrenaline and norepinephrine in the blood was found. During mental work, the excretion of adrenaline mainly increases, as evidenced by the data on urinary excretion of catecholamines. All this stimulates the functions of the pituitary-adrenocortical system [36, 43]. Professional work can lead to an increase in the activity of a number of endocrine glands due to the presence of muscle work or emotional and mental stress. In turn, these changes depend on external working conditions and the daily rhythm of endocrine functions. The activity of the pituitary-adrenocortical and sympathetic-adrenal systems decreases under the influence of fatigue, both during muscle and mental work.

Monotony of work is also a factor that suppresses adrenocortical activity in workers. Anxiety is the basis of any changes in mental state and behavior caused by stress. Prof. Berezin identified anxiety as an essential element of the adaptation process: 1) a feeling of internal tension - it creates severe discomfort, does not have a pronounced shade of threat, and is only a signal of its approach; 2) hyperesthetic reactions - before neutral stimuli become negative, anxiety increases and irritability increases; 3) anxiety itself - manifested by a feeling of an uncertain threat, the central element of the series under consideration. A characteristic feature: inability to predict the time of the threat, inability to determine its nature. As a result of data processing, an erroneous conclusion is drawn due to a lack of facts; 4) fear - anxiety focused on a specific object. The objects associated with anxiety may not be the cause of it. The subject creates the idea that anxiety can be eliminated by certain actions; 5) an increase in the intensity of anxiety disorders - there is a sense of the inevitability of an impending catastrophe; 6) anxious and fearful arousal - the possibility of purposeful activity disappears and disorganization caused by anxiety reaches a maximum [21, 34].

Aging is the result of all the stresses that the body has been exposed to during its life, a rather interesting hypothesis put forward by Selye. In a sense, aging corresponds to the "exhaustion phase" of the general adaptation syndrome and is an accelerated version of normal aging. Any stress leaves behind irreversible chemical changes, especially those caused by vain efforts; their accumulation causes signs of aging in human tissues and organs. Successful activity, whatever it may be, also leaves behind

the effects of aging, especially the destruction of brain and nerve cells. But, as Selye notes, a person can successfully cope with work and live a long and happy life if they choose a job that is suitable for them [3-4, 6, 24]. A decrease in the concentration of zinc in blood plasma and its redistribution between organs and tissues is observed under stress, infections, and trauma. These changes are regulated by leukocyte endogenous mediator, a special thermolabile factor. This factor causes a rapid intake of iron, zinc, and most free amino acids into the liver, a decrease in the content of iron and zinc in the blood plasma, and, due to increased synthesis of ceruloplasmin, an increase in the level of copper in the blood plasma. In addition, zinc levels in the body can reduce tissue breakdown products formed under the influence of various stressors. These products bind zinc, can increase the content of zinc compounds in the blood and increase their excretion in the urine, primarily amino acids. Stress also leads to an increase in the release of corticosteroids into the plasma, which stimulate the intake of zinc into the tissues. Copper plays an important role in the transmission of nerve impulses. The binding of GABA receptors by GABA receptors is significantly increased in the presence of copper deficiency in rat brain synapses, which may be one of the causes of CNS disorders in copper deficiency. It has been established that the copper content in the human body affects the processes of biosynthesis or release of neuropeptides and their level [12, 18, 33, 38]. The concentration of copper in the blood increases under the influence of various pathological factors, acute and chronic inflammatory processes, and chronic infectious diseases [40, 42].

Such a significant number of hypercapnic conditions have both common, and most likely, specific factors of pathogenesis. Stress is one of the common factors [6, 28, 35]. Magnesium deficiency reduces the body's antioxidant capacity, which has been proven to cause changes in the Mg/Ca ratio in adrenal cortex cells, which leads to increased secretion of mineralocorticoids, which can further stimulate magnesium loss. Thus, scientists prove that stress and magnesium deficiency are interrelated, and the restoration of magnesium in cells increases the body's resistance to stress. Thus, magnesium is considered an anti-stress metal [9, 12, 17]. Pathological changes in magnesium content against the background of increased blood copper concentration

are formed under stress conditions, when neurohumoral regulatory systems are shifted. [22, 35].

1.2. The use of dietary supplements of plant origin in the modeling of food products for people in conditions of constant stress

Based on the analytical research conducted, experts of the scientific and industrial association "Zhytomyrbioproduct" concluded that the use of natural protectors, namely dietary supplements of plant origin made from domestic raw materials, has a positive effect (table 1). They recommend using products made from raw materials that grow in the human habitat. No dietary supplement has been found that would fully satisfy the physiological daily requirement of people under constant stress by 10...50% of the above substances, but the modeled compositions of meal (or fiber) contain the following list of minerals (Zn, Fe, Cu and Mg/Ca). In order to design food product compositions for people under constant stress, we calculated and presented in Table 1 the indicators of the biological value of dietary supplement compositions, namely the content of micro- and macronutrients.

The calculations show that the content of components that are natural antistressors in dietary supplements meets the daily requirement of a person under constant stress in the range of 10% to 50%:

- zinc contains from 3.3 to 35 mg%: when using 5...53 g of wheat germ meal or 72...252 g of pumpkin fiber or in the composition of dietary supplements in food products;

- iron in various dietary supplements - from 8.7 to 26.9 g%: when using 7.5...37.5 g of amaranth meal or 5.4...27.2 g of oat meal, the defined limits of daily requirement are met;

- magnesium - from 40.0 to 210.0 mg%: when using 12.9...67.8 g of amaranth meal or 11.3...58.9 g of pumpkin fiber, or 13.4...71 g of flaxseed meal, it provides the defined limits of daily requirement. In dietary supplements, the content of components

Table 1 - Chemical composition of micro- and macro-elements of dietary supplements of plant origin of scientific and industrial association "Zhytomyrbioproduct"

Element	Concentration of micro- and macroelements мg/100g in dietary supplements of plant origin					
	Амarant h	Vives	Pumpkin	Wheat germs	Spotted thistle	Flax
1	2	3	4	5	6	7
S (Sulfar)	260278,9	153048,1	95187,7	41605,31	90725,78	239456,6
K (Potassium)	304830,4	133198,8	242863,4	360402,2	326701,1	460149,3
Ca (Calcium)	137000	62000	62000	87000	687000	162000
Mn (Manganese)	1450,13	1616,08	1249,97	6107,25	933,39	1066,15
Fe (Iron)	24000	33000	23000	21000	22000	21000
Cu (Copper)	317	552	863	498	708	1260
Zn (Zinc)	3830	11700	13800	66100	6890	4550
Se (Selenium)	63,42	23,9	39,73	80,92	17,57	170,91
Br (Bor)	467,01	192,53	244,06	300,74	556,34	412,20
Cr (Chromium)	11,44	-	-	169,28	-	-
Ni (Nickel)	-	59,25	-	140,32	-	84,27
Co (Cobalt)	-	29,20	32,48	-	-	-
Cl (Chlorin)	103000	54000	46000	161000	124000	11000
Mg (Magnesium)	311000	281000	357000	205000	327000	296000
P (Phosphorus)	660000	620000	980000	920000	670000	870000

Source: [45]

provides the daily human need under conditions of constant stress in the range of 10% to 30%:

- iron in various dietary supplements - from 8.7 to 26.9 g%: when using 7.5...37.5 g of amaranth meal or 5.4...27.2 g of oat meal, the defined limits of daily requirement are met;

- magnesium - from 40.0 to 210.0 mg%: when using 12.9...67.8 g of amaranth meal or 11.3...58.9 g of pumpkin fiber, or 13.4...71 g of flaxseed meal, it provides the defined limits of daily requirement. In dietary supplements, the content of components provides the daily human need under conditions of constant stress in the range of 10% to 30%:

- Calcium - from 50.0 to 360.0 mg% (when using 7.4...52.5 g of milk thistle or 30.9...222 g of flaxseed meal, it meets the defined limits of daily requirement)

- chromium - from 3.0 to 10.5 mg% (if 27.0...92.5 g of amaranth meal or 30.9...374 g of wheat germ meal is used, it meets the defined limits of daily requirement)

copper - from 1.3 to 25.0 μg%, provided that 0.15...2.9 g of pumpkin fiber or 0.105...2.0 g of flaxseed meal provides the defined limits of daily requirement).

Also, in order to design food product compositions for people under constant stress, it is necessary to study the indicators of the biological value of algal additives, namely the content of dietary fiber, vitamins, micro- and macronutrients, which are given in the monograph "Innovative technologies of food products for functional purposes", which are given in table 2.

Thus, the consumption of the proposed dietary supplements of plant origin in the range of 2.0...71.0 g of flaxseed meal guarantees the provision of 10-30% of the daily requirement for copper, calcium and magnesium; in the range of 0.15...58.9 g of pumpkin fiber guarantees the provision of 10-50% of the daily requirement for copper and magnesium; in the range of 5...53 g of wheat germ meal guarantees the provision of 10-30% of the daily requirement for zinc; in the range of 27.0... 92.5 g of amaranth meal guarantees the provision of 10-50% of the daily requirement for chromium and iron; within 5.4...27.2 g of oat meal guarantees the provision of 10-50% of the daily requirement for iron or more in human food products under conditions of constant stress, which is modeled, guarantees the provision of the daily requirement for especially deficient micronutrients containing components that are natural antistressors.

The presented calculations confirm that when modeling human food products under conditions of constant stress, it is advisable to choose compositions of dietary supplements with wheat germ or pumpkin seed fiber in a composition with spirulina, as well as with pectin-zosterin or cystosira to enrich the food composition of Zn, Fe, Cu and Mg/Ca; compositions of dietary supplements with pumpkin, flax and oat seed meal in a composition with cystosira with pectin-zosterine or zoster.

Table 2 - Chemical composition of algae (per 100 g of product)

Substance	Laminaria	Cystosira	Spirulina	Zostera
1	2	3	4	5
Polysaccharides, g:				
manin	10,6	6,8	–	4,9
Alginic acid	28,5	23,3	–	–
zosterin	–	–	–	21,7
Asshines	27–35	22,9	7	13,2
Vitamin, мg:				
carotenoids	211	217	170	245
folacin	0,06	0,08	0,05	0,07
thiamin	5,7	6,1	5,5	5,9
tocopherol	11,3	10,7	19,0	12,7
niacin	11,5	10,9	11,8	11,3
cyanocobalamin	0,14	0,14	0,16	0,12
Mineral substances, мg:				
calcium	1200	1170	118	4240
phosphorus	98	96	828	106
sodium	2400	1070	34	254
мagnesium	400	505	166	829
potassium	620	720	143552,8	696
iron	40–56	31	–	307
manganese	8,9	8,6	–	25
cobalt	2,5	1,1	0,05	0,37
iodine	108–230	75–114	3,3	102
zinc	39	27	–	7,6
copper	4,1	2,2		1,56

Source: [46]

The specific requirements of dietetics for humans under constant stress require a radical change in the idea of developing food compositions and food production technologies for people under constant stress (table 3). For modeling, we selected food technologies that are problematic from the point of view of dietetics. The analysis of the chemical composition of traditional food products (fig. 2) shows a significant discrepancy between the product formula and the requirements of a rational diet. Traditional sweet dishes (plum sambuco, strawberry mousse, vegetable and berry juices with pulp) contain a large amount of mono- and disaccharides, which is unacceptable from the point of view of rational nutrition, the formula of analog

Table 3 - Chemical composition of traditional and developed dessert products per 100 g of products

Food	Protein content, g%	Fat content, g%	Carbohy-drate content,г%	Dietary fiber content, g% (% of dietary needs)	Energy value, kcal/100g	Product formula
1	2	3	4	5	6	7
Plum Elderberry	4,72	0,4	52,4	1,95(4,8)	238,2	1:0,1:11,1
Elderberry «Gift»	3,25	2,51	11,2	6,48(16,2)	72,6	1:0,8:3,5
Strawberry mousse	2,47	0,07	13,1	0,6(1,7)	65,9	1:0,03:5,3
Mousse «Pumpkin»	2,44	2,06	8,6	15,4(38,5)	64,8	1:0,85:3,5
Apple mousse on cemolina	0,9	0,2	20,3	0,5 (1,2)	81,1	1:0,2:22,5
Mousse «Apple»	3,98	1,96	7,87	5,5(13,8)	64,6	1:0,5:2,0
Vegetable smoothie on a yogurt basic	1,0	0,1	2,9	0,7 (1,8)	17,2	1:0,1:2,9
Smoothie «Yogurt»	3,03	2,4	12,5	8,8 (22,0)	86,7	1:0,8:4,1
Grape-raspberry juice	0,6	0,4	12,3	2,0(5,0)	57,7	1:0,6:22,4
Smoothie «Grape-raspberry»	3,2	2,8	13,3	3,4(8,5)	94,3	1:0,9:4,2
Berry juice with pulp and honey	0,8	0,4	15,1	3,08(7,7)	70,2	1:0,5:18,9
Smoothie «Berry»	4,2	3,4	17,5	3,15(7,8)	121,5	1:0,8:4,2
Orange smoothie	1,11	0,17	9,55	2,1 (5,2)	46,7	1:0,15:8,6
Smoothie «Orange Paradice»	3,98	1,96	7,87	5,5(13,8)	64,65	1:0,5:2,0

Author's development

products shows an excess of carbohydrates compared to protein: for whipped desserts

- by 5.3...11.1 times, for smoothie analogs - by 2.9...22.4 times. Therefore, as a result of modeling whipped dessert products, namely sambuca "Dar", mousses "Pumpkin" and "Apple", and drinks - smoothies "Yogurt", "Grape-Raspberry", "Berry" and "Orange", food compositions were obtained that, due to their natural sweetness, allow you to avoid using sugar at all and meet the formula of food products for people under constant stress.

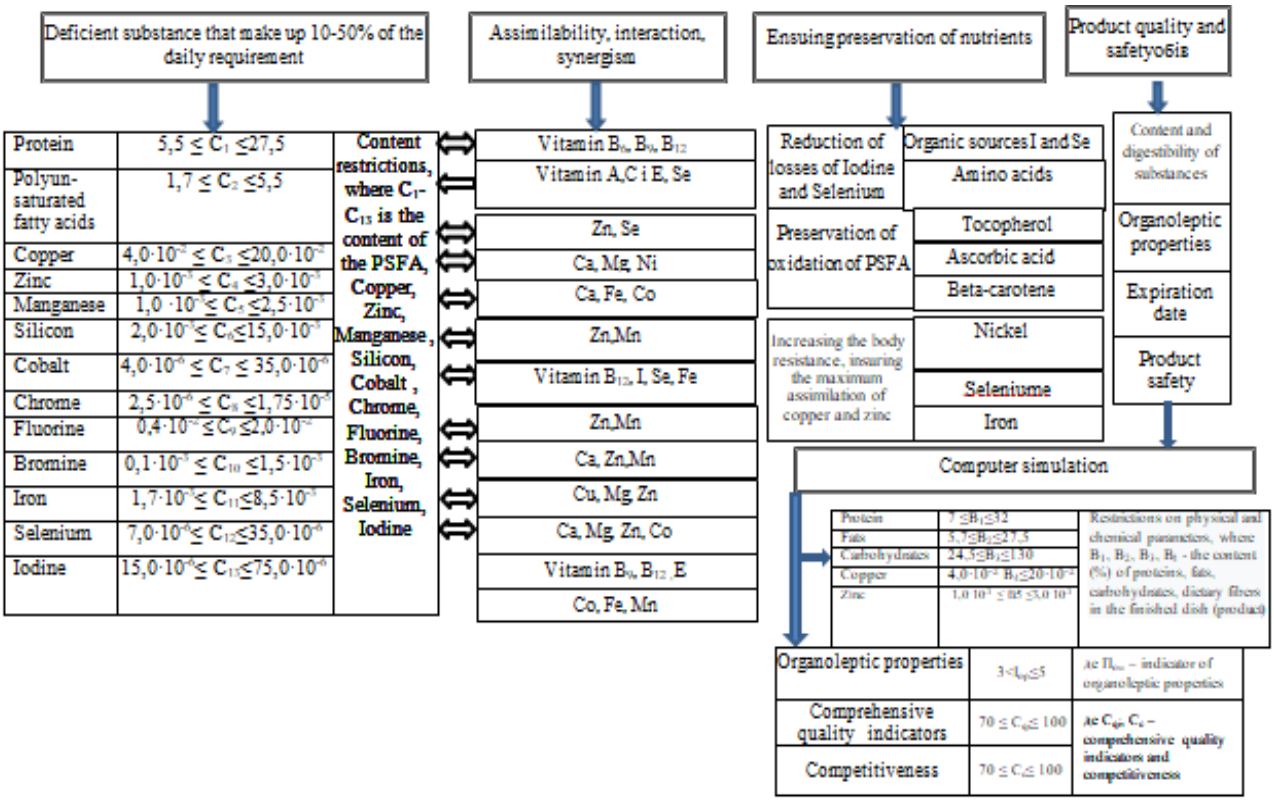

fig. 2 - Modeling the nutritional composition of special culinary products for people in a state of constant stress

Author's development

To prevent the modeling of food compositions containing competing nutrients, a scheme of interaction of nutrients in the modeled food compositions of whipped desserts for people under constant stress was developed (fig. 2). As a result of computer modeling of whipped dessert products for people under constant stress (fig. 3), vegetables (pumpkin, celery), fruits (plum), berries (cranberries, black currants, strawberries), wheat germ meal and pumpkin seed fiber were selected from the list of

food raw materials, spirulina and cystose as a source of vegetable proteins, antioxidant vitamins, dietary fiber and minerals (Zn, Fe, Cu and Mg/Ca), egg white and gelatin as a source of animal protein and collagen. By choosing these raw materials, it becomes possible to change the formula of traditional sambuca (1:0.1:11.1 to 1:0.8:3.5), which makes it fundamentally impossible to use traditional dessert products in the diet of people under constant stress. The selected food compositions provide the content of minerals in whipped desserts at the level of 12.6...54.7% of the daily requirement, while in traditional products the mineral composition, except for calcium, iron and copper, did not exceed 10% of the daily requirement.

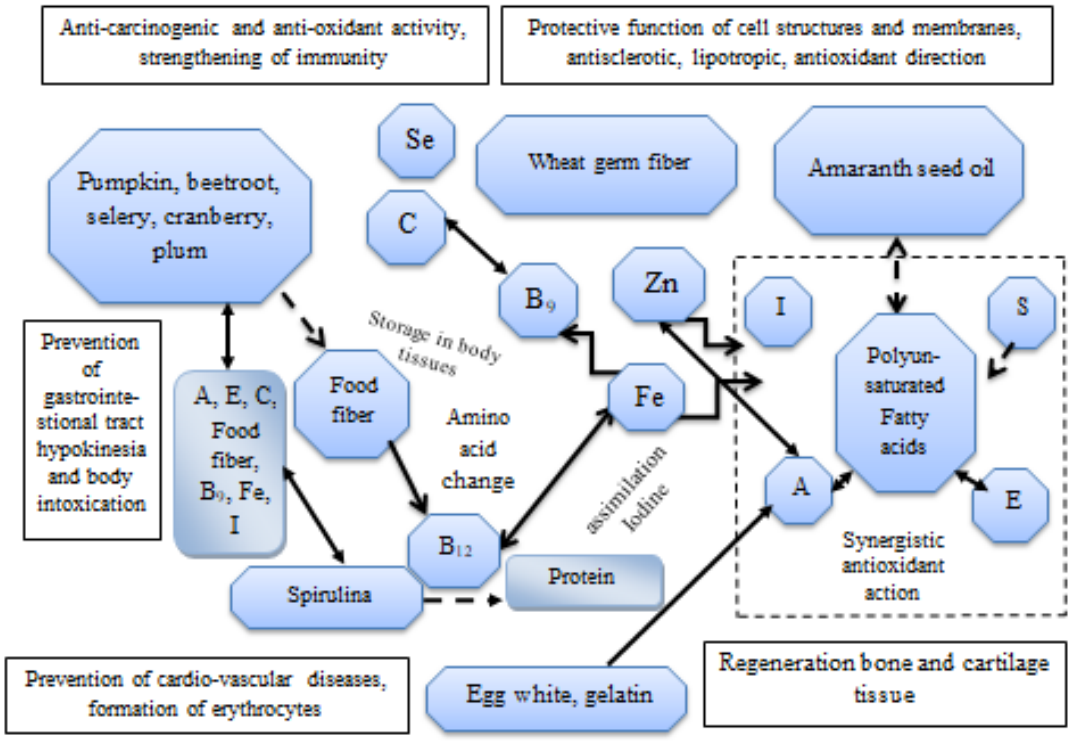

Fig. 3 - Ensuring the interaction of nutrients in whipped desserts for people in conditions of constant stress

Author's development

When modeling the food compositions of the smoothies "Yogurt", "Grape-Raspberry", "Berry-Honey", "Orange Paradise" (fig. 4), yogurt-based vegetable smoothies, grape-raspberry juice, celery and orange juice, and berry juice with pulp and honey were used as the base, respectively, vegetables (green onions, cucumbers,

tomatoes), fruits (oranges), berries (grapes, raspberries, strawberries, kiwi) were selected, spirulina as a source of vegetable proteins, antioxidant vitamins, dietary fiber and minerals (iron, iodine, selenium), yogurt with 1 and 1.5% fat content as a source of animal complete protein, pectin-zosterol, wheat germ meal and pumpkin seed fiber due to its dietary fiber content. A scheme of interaction of nutrients in the modeled food compositions of smoothies was developed (fig. 4).

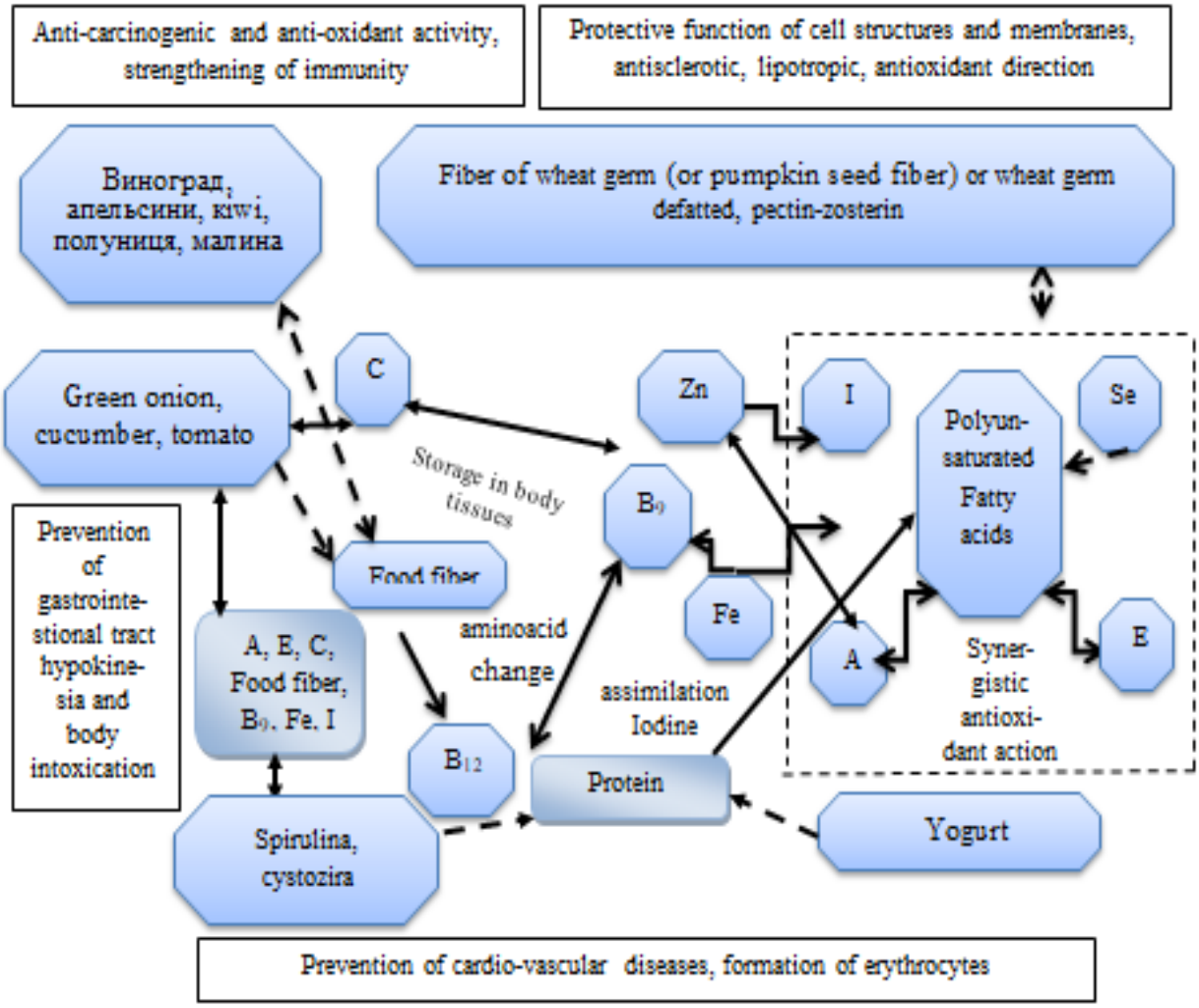

Fig. 4 - Ensuring the interaction of nutrients in smoothies for people in conditions of constant stress

Author's development

The modeled food compositions meet the requirements of rational nutrition for people under constant stress, radically change the product formula compared to the analog product: for Yogurt smoothie (1:0.1:2.9 to 1:0.8:4.1), for Grape-Raspberry smoothie (1:0.6:22.4 to 1:0.9:4.2), for Berry-Honey smoothie (1:0.5:18.9 to 1:0.8:4.2),

for Orange Paradise smoothie (1:0.15:8.6 to 1:0.5:2.0). The content of minerals in the portion of the developed smoothies is provided at the level of 12.7...90.0% of the daily requirement, while in traditional products the mineral composition, except for calcium, magnesium and zinc, did not exceed 10% of the daily requirement. The modeled food compositions meet the requirements of rational nutrition for people under constant stress, radically change the product formula compared to the analog product: for Yogurt smoothie (1:0.1:2.9 to 1:0.8:4.1), for Grape-Raspberry smoothie (1:0.6:22.4 to 1:0.9:4.2), for Berry-Honey smoothie (1:0.5:18.9 to 1:0.8:4.2), for Orange Paradise smoothie (1:0.15:8.6 to 1:0.5:2.0). The content of minerals in the portion of the developed smoothies is provided at the level of 12.7...90.0% of the daily requirement, while in traditional products the mineral composition, except for calcium, magnesium and zinc, did not exceed 10% of the daily requirement.

All fats contained in traditional pates are mostly saturated, and the chemical composition of traditional pate products (table 4,5) shows that the fat component exceeds the protein component by 31 times. Hygienists also state that the growth of age-related pathology in Ukraine is directly related to the amount of dietary fiber, antioxidant vitamins, B vitamins, minerals, and cholesterol content in the diet, which is so rich in these products. The formula of traditional pâté products is unbalanced and has a sharp shift towards the content of animal proteins and saturated fats, which does not meet the requirements for specialty products for people under constant stress. Therefore, it is the design of ground meat and fish products that meet these requirements that is relevant.

When modeling the food compositions of chopped meat products (meat pates), in particular, "Amatory", "Morskoy", and "Kharkiv" pates (fig. 5), the following pate recipes were used as basic ones, respectively: meat pate in a shell - "Belovezhsky", No. 159 "Liver pate", and "Metropolitan" of the highest grade.

To create the food compositions of Amatory, Sea, and Kharkiv pates, meat and offal were selected as a source of animal protein and collagen, vegetables (onions and carrots) and cystose and spirulina, pumpkin seed meal or defatted wheat germ as a source of vegetable proteins, antioxidant vitamins, dietary fiber, and minerals (iron,

copper, zinc, and others); wheat germ fiber or pumpkin seed fiber and pectin-zosterine due to the content of dietary fiber. Obviously, by choosing these raw materials, it becomes possible to balance the fat and protein component of the product in accordance with the requirements of a healthy diet for people under constant stress.

Table 4 - Chemical composition of traditional and developed meat and fish minced products per 100 g of products

Food	Protein content, g%	Fat content, g%	Carbohy-drate content,r%	Dietary fiber content, g% (% of dietary needs)	Product formula
1	2	3	4	5	6
Meat pate «Belovezhsky»	5,5	0,2	3,6	0,5(1,3)	1:0,03:0,7
Pate «Amatorsky»	12,2	11,4	5,4	1,9(4,8)	1:0,9:0,4
Liver Pate (№159)	1,6	21,8	4,3	1,7(4,0)	1:13,6:2,7
Pate «Sea»	12,8	10,9	14,7	9,7(24,3)	1:0,9:1,1
Pate «Capital» highest grade	1,5	46,6	5,0	3,0(7,5)	1:31:3,3
Pate «Kharkiv»	14,1	11,1	14,1	9,5(23,8)	1:0,8:1
Fish slices № 1.247	17,1	33,6	11,3	1,0(2,4)	1:2:0,7
Fish slices «Pearl»	21,7	19,6	14,7	4,6(11,5)	1:0,9: 0,7
Zander samples	12,1	7,4	12,1	1,4(0,8)	1:0,6:1
Fish samples «Spicy»	14,6	12,9	12,4	8,9(22,3)	1:0,9:0,9

Author's development

Thus, the formula of "Belovezhsky" pate on Ukrainian bread is 1:0.1:3.5, while for the developed "Amatorsky" pate on Ukrainian bread it is 1:0.8:3.6, which fully complies with the principles of special nutrition for people under constant stress. The content of vitamins and minerals in a portion of the developed pate, for example,

Amatorsky pate on Ukrainian bread, is provided at the level of 14.1...37.1% of the daily requirement, while in traditional products the mineral composition ranges from 0 to 15.8% of the daily requirement. A scheme of interaction of nutrients in the modeled food compositions of pates was developed (fig. 5).

Table 5 - The content of mineral substance is relative to the daily requirement in meat and fish minced products per 100 g of products

Food	The content of mineral substance is relative to the daily requirement,%						
	zinc	iron	calcium	magnesium	copper	silicon	selenium
1	2	3	4	5	6	7	2
Meat pate «Belovezhsky»	0,28	2,5	25,5	23,3	5,6	0,07	0,001
Pate «Amatorsky»	0,302	5,1	77,9	36,9	47,9	9,08	25,0
Liver Pate (№159)	0,28	2,5	25,5	23,3	5,6	0,07	0,001
Pate «Sea»	58, 2	5,71	60,5	48,0	54,3	12,8	35,0
Pate «Capital» highest grade	0,28	2,5	22,5	9,5	5,6	0,07	0,001
Pate «Kharkiv»	48, 2	15,1	40,5	36,3	43,3	22,8	27,0
Fish slices № 1.247	2,6	3,9	9,6	7,4	5,6	0,07	0,001
Fish slices «Pearl»	12,5	7,8	23,9	24,5	27,8	32,7	28,6
Zander samples	3,4	1,0	2,67	2,8	5,6	0,07	0,001
Fish samples «Spicy»	18,7	16,7	45,8	23,9	34,6	28,2	33,05

Author's development

The modeling took into account the interaction of nutrients in the modeled food (pates) of the special food for people under constant stress of the composition of fish cuttings and developed a scheme for ensuring the interaction of nutrients (fig. 6). The modeling of the basic food composition of fish cuttings "Pearl" was carried out on the basis of the analog formulation "Ukrainian fish cuttings No. 1.247"; the formula of traditional products is shifted towards fats, their amount exceeds proteins twice, which, from the point of view of special nutrition for people under constant stress, needs to be

adjusted. Therefore, when modeling the nutritional composition of fish cakes "Pearl", pike perch fillet and chicken egg were selected as a source of animal protein, zoster, vegetables (onions, carrots, parsley) and pumpkin seed meal as a source of vegetable proteins, antioxidant vitamins, dietary fiber and minerals.

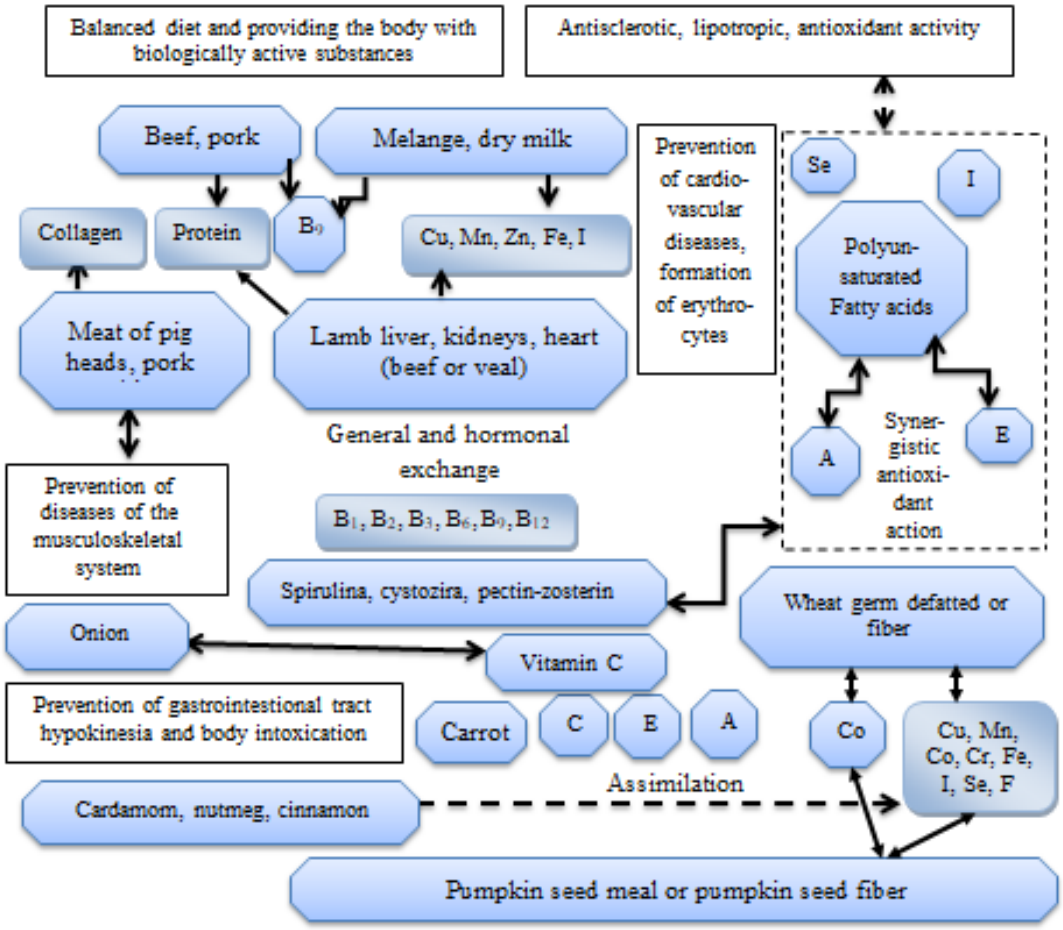

Fig. 5 - Ensuring the interaction of nutrients in minced meat products for people in conditions of constant stress

Author's development

The formula of the developed fish cutlets is 1:0.9:0.7, i.e. the carbohydrate component can be balanced by adding a carbohydrate garnish, such as boiled rice, in which case the formula of the dish will be 1:0.9:3.5.

The amount of flour recommended for use in special nutrition diets for people under constant stress is limited to 40-60 g/day, although flour dishes and products (dumplings, pancakes) are traditionally Ukrainian dishes. The chemical composition

of traditional flour products, both culinary and confectionery (table 6,7), demonstrates an imbalance in the direction of carbohydrates, both starch and mono- and disaccharides.

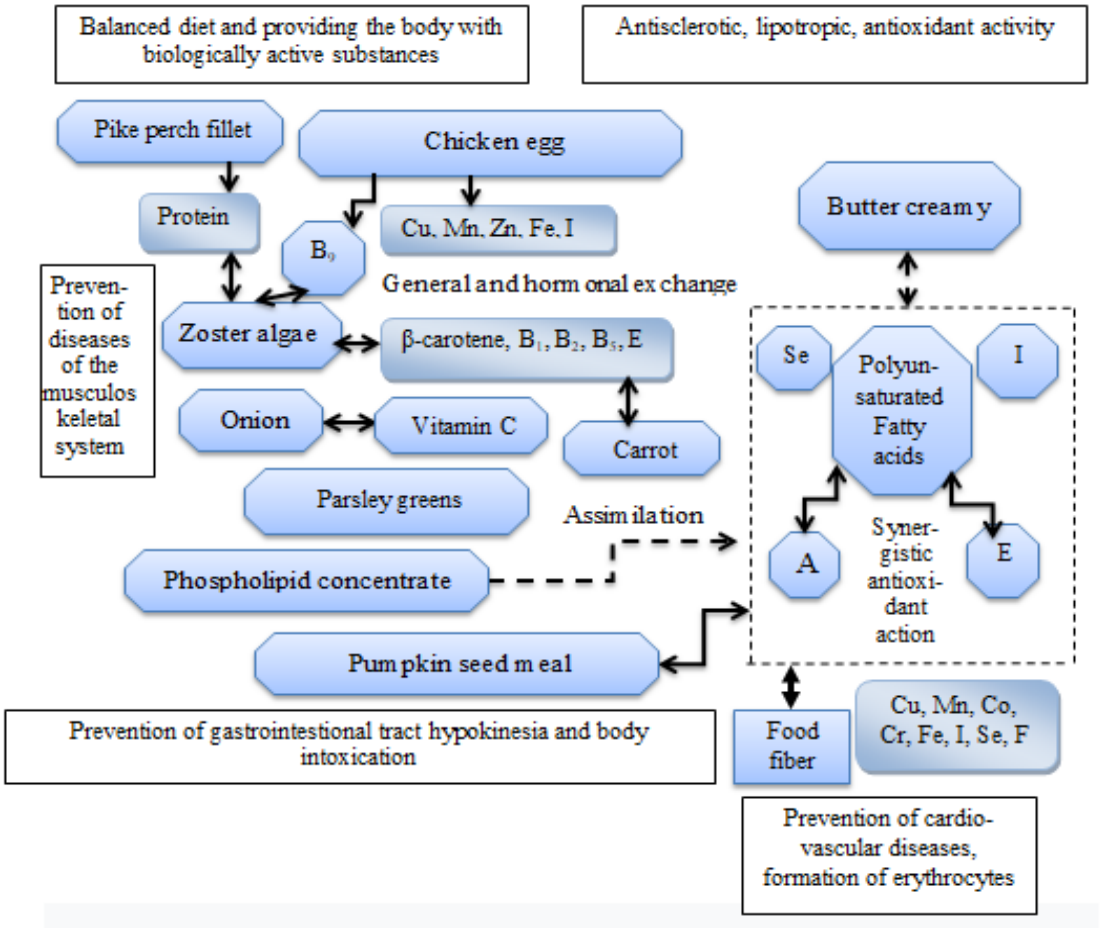

Fig. 6 - Ensuring the interaction of nutrients in minced fish products for people in conditions of constant stress

Author's development

The energy value of traditional flour products is 2 times higher than the permissible limit of 200 kcal recommended for people under constant stress. Moreover, the content of the fat component is somewhat underestimated, for example, for dumplings it is 20% of the protein component, while carbohydrates exceed proteins up to 6 times, which means that the consumption of traditional flour products is not recommended in terms of rational nutrition for people under constant stress. Thus, it is necessary to design flour products that are nutritionally adequate to the needs of people under constant stress. Modeling of the nutritional composition of flour products

allowed us to create nutritional compositions of Cheese dumplings, Cheese pancakes, and Charivnytsia muffins. The recipes of "Cheese dumplings", "Cheese pancakes" and "Cheese muffins" were used as the basic ones.

Table 6 - Chemical composition of traditional and developed flour and cheese products per 100 g of products

Food	Protein content, g%	Fat content, g%	Carbohy-drate content,г%	Dietary fiber content, g% (% of dietary needs)	Energy value, kcal/100g	Product formula
1	2	3	4	5	6	7
Varenyky with cheese	14,1	3,3	30,5	2,2(8,7)	257,1	1:0,2:2,2
Varenyky «Cheese»	8,9	7,4	24,0	2,3(9,0)	204,2	1:0,8:2,7
Fritters	4,8	7,0	25,0	1,5 (3,8)	187,9	1:1,5:5,2
Fritters «Cheese»	7,3	6,4	23,0	1,9 (4,8)	184,7	1:0,9:3,2
Cheese muffins	8,4	16,7	51,0	1,3(5,2)	399,2	1:2:6,1
Muffins «Charivnytsa»	11,6	10,3	30,2	2,2(5,5)	267,8	1:0,9:2,6
Cheese pudding	13,9	9,6	20,1	1,4	224,0	1:0,7:1,45
Pudding «Cheese delight»	17,3	26,4	27,8	7,1 (17,8)	418,0	1:1,5:1,6
Cheese casserole	17,6	4,2	14,2	0,4	168,0	1:0,2:0,8
Casserole « Cheese delight»	11,6	16,2	23,2	0,4	168,0	1:1,4:2,0

Author's development

The food compositions include fermented dairy products (sour cream 10% fat, sour cottage cheese 4% fat, kefir 1% fat, mélange and spirulina as a source of animal and vegetable proteins, B vitamins and minerals (calcium, phosphorus, magnesium, potassium and iron); kiwi and dried apricots as a source of antioxidant vitamins, dietary fiber and minerals; wheat germ and pumpkin meal for their dietary fiber and mineral

content. Such a set of raw materials made it possible to balance the formula of special products for people under constant stress: dumplings 1:0.8:2.7, pancakes 1:0.9:3.2 and muffins 1:0.8:2.7 and 1:0.9:2.6, which is significantly different from the formula of analog products: "Dumplings with cottage cheese" (1:0.2:2.2); pancakes (1:1.5:5.2); muffins (1:2:6.1).

Table 7 - The content of mineral substance is relative to the daily requirement traditional and developed flour and cheese products,%

Food	The content of mineral substance is relative to the daily requirement,%					
	zinc	iron	calcium	magnesium	copper	silicon
Varenyky with cheese	4,1	6,0	0,3	6,5	5,6	1,5
Varenyky «Cheese»	12,2	55,0	58,9	6,6	37,1	14,8
Fritters	3,9	4,0	0,9	5,6	2,0	2,9
Fritters «Cheese»	11,1	29,3	12,9	6,0	12,1	8,3
Cheese muffins	7,7	7,3	0,2	3,0	6,2	2,9
Muffins «Charivnytsa»	8,5	26,7	10,0	4,3	15,3	8,6
Cheese pudding	3,7	6,9	13,0	23,6	7,5	3,5
Pudding «Cheese delight»	21,8	32,3	25,9	36,0	42,1	18,3
Cheese casserole	5,9	16,5	11,3	23,0	12,0	7,9
Casserole «Cheese delight»	25,3	32,5	17,8	26,3	32,4	28,6

Author's development

A scheme of interaction of nutrients contained in the modeled food compositions of flour products was developed (fig. 7).

To create the food compositions of cottage cheese pudding and casserole "Cheese Delight", sour cottage cheese and chicken eggs were selected as a source of animal protein, vegetables (carrots) and cystose and spirulina, pumpkin seed meal or defatted wheat germ as a source of vegetable proteins, antioxidant vitamins, dietary fiber and

minerals (iron, copper, zinc, etc.); wheat germ fiber or pumpkin seed fiber and pectin-zosterine due to their dietary fiber content. By choosing these raw materials, it becomes possible to balance the side-fat component of the product in accordance with the requirements of a rational diet for people under constant stress. For example, the formula of curd pudding is 1:0.7:1.45, while for the developed pudding "Cheese Delight" it is 1:1.5:1.6, which fully complies with the principles of special nutrition for people under constant stress. The content of vitamins and minerals is provided at the level of 18.3...42.1% of the daily requirement, while in traditional products the mineral composition ranges from 3.5 to 23.6% of the daily requirement.

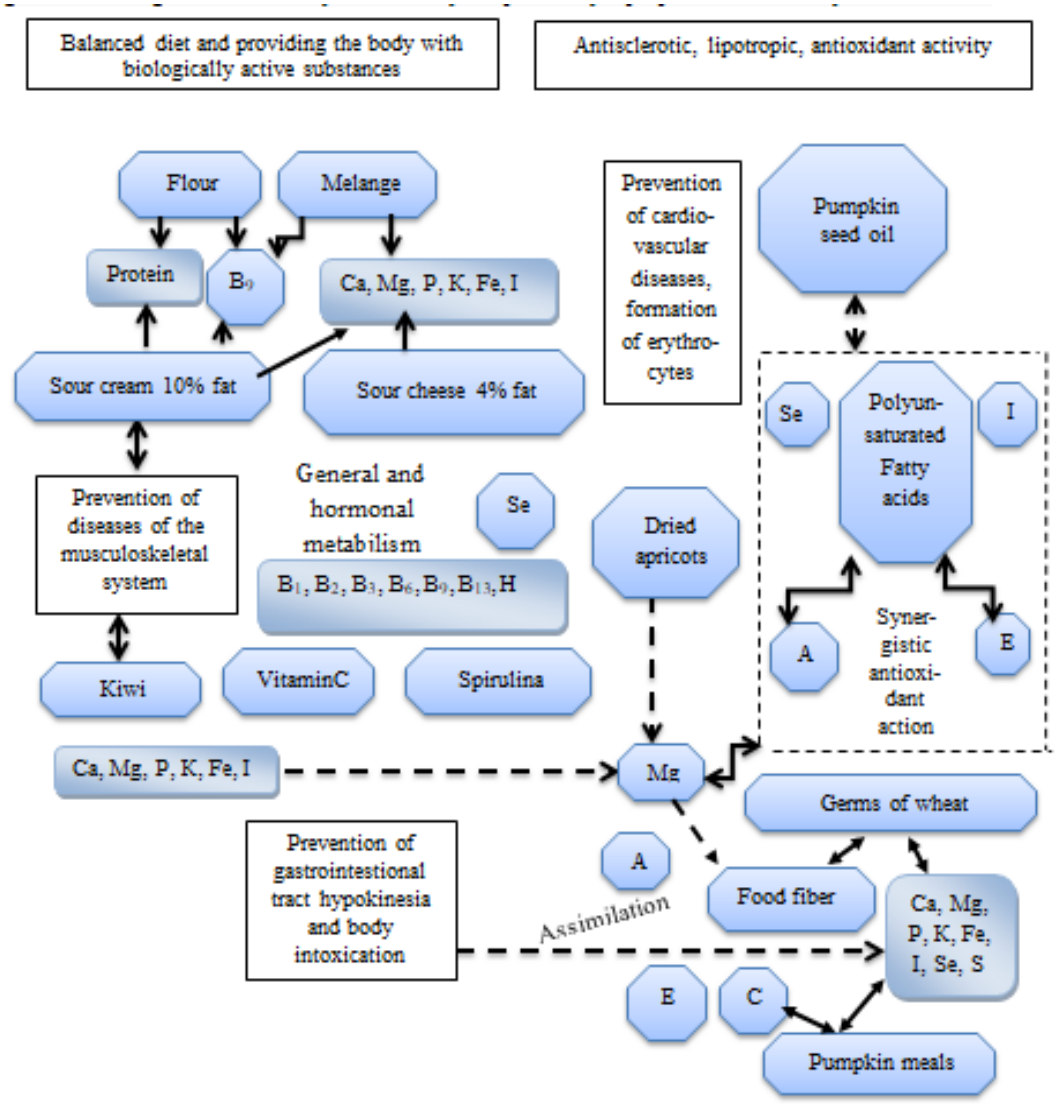

Fig. 7 - Ensuring the interaction of nutrients in flour products for people in conditions of constant stress

Author's development

The formula for the portion of the developed casserole "Cheese delight" is 1:1.4:2.0, for the traditional casserole "Cheese" – 1:0.2:0.8, the content of vitamins and minerals is provided at the level of 17.8...32.4% of the daily requirement, while in traditional products the mineral composition ranges from 3.6 to 23.0% of the daily requirement.

1.3. Modeling the daily food ration for people under conditions of constant stress

Able-bodied Ukrainians consume approximately, according to the Government's Resolution of October 11, 2016, No. 780 No. 780, 44 kg of meat, poultry and lard, 13 kg of fresh, frozen and salted fish, more than 7 kg of various cereals, about 4 kg of pasta, almost 2 kg of legumes, 95 kg of potatoes and the same amount of other vegetables, as well as about 60 kg of various fruits and berries, which together amounts to a consumption of more than 650 kg of various foods per year and almost 55 kg per month.

The generalized data on the nutritional composition of the food rations of Ukrainian military personnel show that the proportions of the main nutrients are practically not taken into account when preparing the rations, the formula of the rations practically does not coincide with the recommended one, i.e., the fluctuations in nutrients compared to the recommended norms of rational nutrition were up to 50%. Thus, the results of the study of the diet of Ukrainian military personnel suggest that their nutrition requires significant changes in both the set of products and the principles of daily menu preparation, including the development of a model for the distribution of energy value between food groups in the daily diet of special purpose, taking into account the development of a general formula for the diet of people under constant stress.

In accordance with the conclusions, we have developed and proposed a model for the distribution of energy value between food groups in the daily diet for special purposes (fig. 8). In accordance with the proposed model, an exemplary diet for people

under constant stress was developed for specialized institutions engaged in the rehabilitation of military personnel, which includes special-purpose food products for people under constant stress using dietary supplements of plant origin, which made it possible to balance the general formula of the food ration and take into account the requirements of rational nutrition for the content of dietary fiber, cholesterol, minerals, antioxidant vitamins, etc.

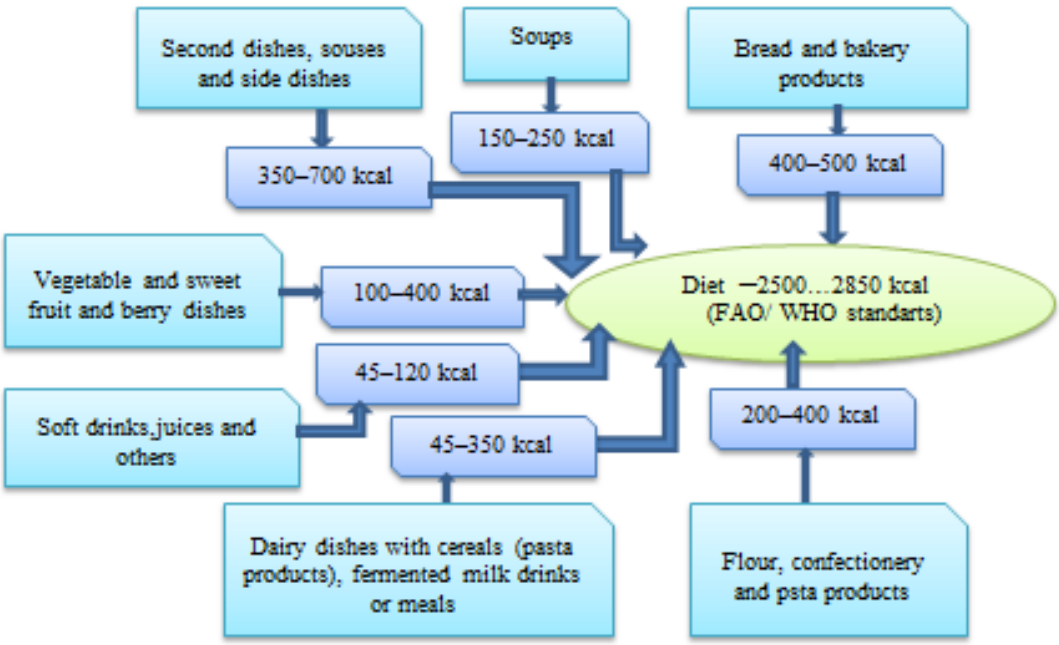

Fig. 8 - Distribution of energy value between groups of food products of special purpose for people in conditions of constant stress

Author's development

The proposed food ration for special purposes includes the developed products and was tested in the Territorial Rehabilitation and Social Service Center of the Ulyanovsk District of Kirovograd Region.

The characteristics of the proposed food ration for special purposes are given in table 8. The energy value of the developed and proposed two-week diet, which is recommended for people under constant stress, varies from 2537.3 to 2829.9 kcal/day, the average energy value of the studied diet is 2699.6 kcal, which for men exceeds the requirements of FAO/WHO by 1.25 to 1.38 times and practically meets the requirements of Ukrainian scientists (2790.8 kcal/day); it significantly exceeds the

Table 8 - Characteristics of the special purpose food ration

Energy value, daily (kcal)	Nutrient content, g							Diet formula proteins:fats:carbohydrates
	proteins		fats		carbohydrates		Cholesterol, мg	
	General content	including irreplaceable AA	General content	including polyunsaturated fatty acids	General content	Including food fiber		
2924,9	60,2	42,5	138,5	28,8	349,2	45,9	127,0	1:2,3:5,8
2808,0	59,4	54,7	130,7	40,1	338,6	41,8	149,4	1:2,2:5,7
2657,2	54,7	51,0	125,8	33,5	317,3	32,0	177,7	1:2,3:5,8
2569,3	53,5	44,1	117,7	31,4	314,8	27,6	169,3	1:2,2:5,9
2633,6	54,2	46,2	124,7	39,0	314,4	34,8	117,7	1:2,3:5,8
2827,1	59,8	47,6	131,6	39,8	340,9	35,4	166,6	1:2,2:5,7
2594,0	53,4	49,6	122,8	47,2	309,7	42,4	267,3	1:2,3:5,8
2537,3	51,8	45,8	119,1	35,7	305,6	41,0	165,2	1:2,3:5,9
2584,1	54,2	36,1	119,2	20,6	314,4	44,4	208,8	1:2,3:5,8
2817,2	59,6	57,2	131,1	41,4	339,7	33,6	112,8	1:2,2:5,7
2611,3	53,3	38,8	122,6	38,2	314,5	28,0	279,0	1:2,3:5,9
2718,0	57,5	51,9	126,5	35,5	327,8	34,5	231,7	1:2,2:5,7
2813,1	57,9	37,6	133,2	31,9	335,8	33,0	126,0	1:2,3:5,8
2827,7	58,2	35,9	133,9	28,4	337,6	35,4	185,2	1:2,3:5,8
2708,8	**56,3**	**46,4**	**127,0**	**35,1**	**325,7**	**36,4**	**190,5**	**1:2,3:5,8**

Author's development

requirements for women: FAO/WHO - by 1.51...1.67 times and practically meets the

requirements of Ukrainian scientists. The limit of the energy value of the diet according to FAO/WHO recommendations is: for men - 2050 kcal/day and for women - 1700 kcal/day.

The characteristics of the developed food ration meet the requirements of rational nutrition; on a daily basis and on average for a two-week diet, they are as follows

- protein component in the energy value of the diet - 8.4...8.7%;
- content of essential amino acids to total protein - from 61.7 to 96.0%;
- the amount of lysine methionine + cysteine phenylalanine + tyrosine in the daily diet is not less than 5.5:3.5:6.0 g
- fat component in the total caloric content is not more than 41.2...42.6%, with vegetable fats - from one fifth to one third, polyunsaturated fatty acids - 20.7...38.4% of the saturated fatty acid content;
- carbohydrate component is 48.9...50.2% of the total caloric content;
- dietary fiber should be in the range of 27.6...44.4 g/day.

The protein content in the proposed diet, namely 51.8...60.2 g/day, exceeds the established norm according to the requirements of Ukrainian scientists (52.0...58.0 g/day for women) and is consistent with the requirements for men (54.0...65.0 g/day), but is less than the requirements of FAO/WHO (63.8...76.9 g/day).

The average daily amount of protein in the proposed diet is 56.3 g/day, which does not meet the FAO/WHO requirements and is 3.7% higher than the level of requirements of Ukrainian scientists for women and is the same as for men. It is known that complete proteins, in addition to plastic and energy functions, play an important protective role, increasing the body's resistance to various infections, toxic agents, as well as neuropsychological stress and stressful situations. With sufficient protein content in the diet, the biological qualities of other nutrients (fats, vitamins, minerals) are most fully manifested.

The fat content in the diet, namely 41.2...42.6 g/day, is within the normal range according to the requirements of Ukrainian scientists and 37.4...45.6% less than the requirements of FAO/WHO (56.7...78.3 g/day).

The average daily amount of fat is 127 g/day, which is 55.4% higher than the

requirements of FAO/WHO experts. The share of fat in the total caloric content is reduced to 41.2...42.6%, and the content of vegetable fats is from 1/5 to 1/3 of the total fat. Increasing the amount of fat in the diet of people under constant stress due to the consumption of polyunsaturated fats will help prevent cardiovascular disease and enhance the synergistic antioxidant effect of the diet.

The carbohydrate content in the proposed diet is in the range of 314.4...349.2 g/day, which exceeds the FAO/WHO requirements by 20.0...25.6.0% (233.8...281.9 g/day) and is 23.7% less than the lower limit of the requirements of Ukrainian scientists for women and 2.6% less than the upper limit for men (240.0...270.0 g/day for women and 270.0...300.0 g/day for men). The average daily amount of carbohydrates in the proposed diet is 325.7 g/day, which is 28.3.0% more than the requirements of FAO/WHO experts, 7.9% more than the requirements of Ukrainian scientists for men, and slightly higher for women - by 13.4%.

When developing food rations for people under constant stress, who have diseases of the gastrointestinal tract, cardiovascular system and diabetes, one should strive to reduce the total carbohydrate content in the daily diet, as this helps to reduce the excitability of the autonomic nervous system and increase the content of non-digestible polysaccharides.

An analysis of the mineral and vitamin composition of smoothies introduced into the diet showed that their consumption fully covers the daily requirement for Zn, Fe, Cu and Mg/Ca, as well as vitamins A, C and E. Antioxidant vitamins are essential for the prevention of age-related diseases. Foods rich in potassium, zinc, copper, iodine and selenium, i.e. nutritional stress protectors, extend life expectancy and slow down the spread of stress in society. Providing the developed food ration with the daily requirement for chelated metals leads to the prevention of cancer, as well as the antisclerotic, lipotropic, and antioxidant effects of the food ration.

Conclusions.

Thus, the developed diet can be used in organized groups, in particular in rehabilitation centers, boarding houses and health centers, and recommended for the prevention of the spread of stress in society.

A comparative analysis of the studied and developed food rations based on quality models was carried out. The complex quality indicator (CQI) of the developed and studied special-purpose diets covers the following indicators of two-week and separate daily diets: energy value, amount of proteins, fats and carbohydrates, ratio of nutrients, cholesterol content.