

Industrialization issues in the production of specialized products for complex body metabolism support

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Abstract – The article deals with industrialization issues in the production of specialized products. Under the conditions of new industrialization, an innovative formula of a biologically active supplement has been developed for integrated support of metabolic processes. It describes pharmacological characteristics of its ingredients and their synergetic qualities and how they produce prolonged antioxidant body protection. The innovative production technology of the supplement pelletized form allows to release tablet active substances in the certain order. The daily intake of one tablet twice a day provides the following essential nutrients consumption (percentage of dietary recommended intake): B₁ - 67, B₃ - 50, B₅ - 100, B₆ - 100, B₉ - 100, B₁₂ - 33, tocopherol acetate – 133, B-carotene – 140, vitamin C – 111, coenzyme Q10 – 17.

The supplement efficacy and functional properties were confirmed by clinical trials where people with stressful jobs (medical doctors, teachers, middle and top managers) as well as people who work night shifts volunteered to take it. The results of the study are aimed at industrializing the production of a developed specialized product.

Keywords – *Biologically active food supplement, supplement formula, industrialization, innovative technology, quality, safety, efficacy, functional properties.*

I. INTRODUCTION

Specialized products, including biologically active supplements (BAS), are increasingly used to improve nutrition and health in the context of new industrialization. It can be explained both by their availability and positive influence on body metabolism [1-4,8,9,10,12].

One of the strategic trends in the food industry development is healthy foods range expansion. Industrialization of specialized foods production is characterized by particular attention to food supplements as a nutrition factor aimed at alimentary diseases prevention and combination treatment. These products intake is considered the most effective and economically viable way to improve

the ability to work and keep good health. From this perspective Russia’s government set the task to create a greater variety of these products, study their quality characteristics, safety and functional properties. These tasks are set by the program of food and processing industry development and healthy nutrition provision to the population of the Russian Federation [5,6,7].

II. RESEARCH OBJECTIVES

The research objective is to develop an innovative specialized dietary supplement and determine its quality standards.

III. MATERIALS AND METHODS

The materials used are plant raw materials and biologically active substances. The methods used included generally available and specific techniques to examine the quality, safety, efficacy and functional properties of the product.

IV. RESEARCH RESULTS

The innovative specialized nutrition supplement formula has been developed and its quality standards have been determined. The supplement composition has been scientifically grounded. The functional properties depend on pharmacological characteristics and synergetic qualities of its ingredients.

Grapes seeds (extract) contains proanthocyanidins, catechins, essential amino acids, tocopherols. It has antioxidant properties, improves blood circulation and strengthens capillary walls, neutralizes free radicals by preventing their destructive impact on myocardium. This extract also activates the immune system, protects lung and connective tissues.

Peach leaves (extract) is used as a diuretic when heart rhythm disorder and hypochromic anemia are observed. It is characterized by pronounced antioxidant activity and has immunomodulatory effect on all the immune system components by capturing and destroying bacteria and providing cell-mediated and humoral response.

Rhodiola quadrifida (extract) possesses pronounced hemostatic and mild tonic effects. Rhodiola quadrifida roots contain salidroside, anthocyanins, tannins, sugars, proteins, fats, waxes and other minor nutrients. Its chemical composition determines its numerous properties: anti-inflammatory, antibacterial, immunostimulating. The plant also normalizes metabolism and improves energy exchange in muscles and central nervous system. One of its main active substances, glycoside salidroside, promotes the plant cancer protective, anti-inflammatory, anti-infective and adaptogenic properties by fixing endocrine disorders connected with gynecological diseases, thyroid and adrenal gland pathology. Anthocyanins both prevent and cure bacterial, viral and fungal infections.

Selenium is included into glutathione peroxidase structure and is an important element of the body antioxidant system. Selenium is responsible for inactivation of fatty acids hydro peroxides, which are formed by unsaturated lipids cross oxidation. It is vitamins E and B synergist, protects blood, heart, liver and lungs cells.

Zink is a necessary element for immune system functioning and acts as a cofactor of growth chemical processes, which take place in the body. Zink possesses individual antioxidant properties and maintains blood tocopherol level.

Vitamin C has strong antioxidant properties and is many enzymes cofactor. It takes part in collagen synthesis, which is the main connective tissue protein. Vitamin C has detoxic properties and helps clear the body of poisons (from tobacco smoke and carbon monoxide to venom). It is essential for human body protection, especially its lipids and lipid soluble vitamins, from oxygen destructive effect. It also improves iron absorption from intestine by complexation.

Copper is part of caeruloplasmin and superoxidismutasa enzymes, which are essential for the system of antioxidant body protection. It plays an important role in active immunity support.

Quercetin, rutin are plant bioflavonoids that have anti-inflammatory and antioxidant effect, strengthen capillary walls by normalizing their permeability.

Cystine has antioxidant properties. Cystine and Vitamin E combination results in micronutrient antioxidant properties potentization (synergism effect). Increased Cystine intake boosts recovery after surgeries and burns, strengthens connective tissue.

The specialized product includes Sifrol-5 complex, which has a powerful antioxidant effect thanks to its biologically active substances complex. Each substance efficacy increases by far when combined with others. The complex activates the immune system by mobilizing the body defenses, slows down ageing, and prevents different pathologies development. Dihydroquercetin and hesperidin ensure capillary protection activity: they prevent cell, tissue and organ membranes and barriers destruction, strengthen vascular and capillary walls, improve blood properties and circulation, normalize and lower cholesterol and triglycerides levels. Thus Cifrol-5 helps treat diseases accompanied by

increased capillary fragility, i.e. atherosclerotic damage of cerebral, coronary and limb vessels. It reduces brain and heart attack risk, minimizes myocardial scarring area, abates end-organ damage, improves heart contractile function, reduces rhythm disorders, improves conductivity, promotes coronary circulation, and prevents intravascular thrombosis.

Vitamin E has a pronounced antioxidant effect due to lipid oxidation inhibition. Lipids are part of cell membranes and tocopherol prevents their increased permeability, caused by free radicals damaging impact, and improves tissue aeration.

B-carotene is an antioxidant that causes free radicals and carcinogens destruction, prevents heart diseases and brain attacks, reduces cholesterol level.

Vitamin C is an antioxidant that reduces cholesterol level, normalizes blood pressure, prevents thrombosis and has synergetic effect when combined with vitamin E.

Coenzyme Q10 is a vitamin-like endogenous antioxidant substance that encourages more effective oxygen consumption and normalizes blood pressure [11].

Superoxidismutasa has a pronounced immunostimulating effect. It is an enzyme of antioxidant protection and a source of extra energy.

Hibiscus (*Hibiscus sabdariffa*) extract. 30-50% of Hibiscus flowers are represented by organic acids, including citric, malic and tartaric acids, and allo-hydroxycitric acid lactone or hibiscus acid. Hibiscus sabdariffa contains anthocyanins, flavonoids, phytosterols, polysaccharides and pectins. Its active substances complex produces antioxidant, anti-inflammatory, spasmolytic and hypotensive effects, prevents thrombosis, and normalizes blood circulation. Polysaccharides are natural immunomodulators.

Keeping all this information in mind we developed a specialized nutrition supplement formula. One tablet contains (in mg): peach leaves extract – 100, Rhodiola quadrifida extract – 75, Zink aspartate – 45.5, Zink – 8.5, cystine – 30, ascorbic acid – 25, quercetin – 10, rutin – 10, grapes seed extract – 5, copper aspartate – 4.4, copper – 0.7, sodium selenite – 0.11, selenium – 0.05, Cifrol-5 (antioxidant complex) – 200.

The supplement formula ensures prolonged 24 hours' persistent antioxidant protection thanks to Cifrol-5 complex. The pelletized tablet form makes it possible to release tablet active substances in the certain order from the skeleton tablet.

The new innovative production technology of the food supplement tablet form has been developed in the context of new industrialization (Fig.1).

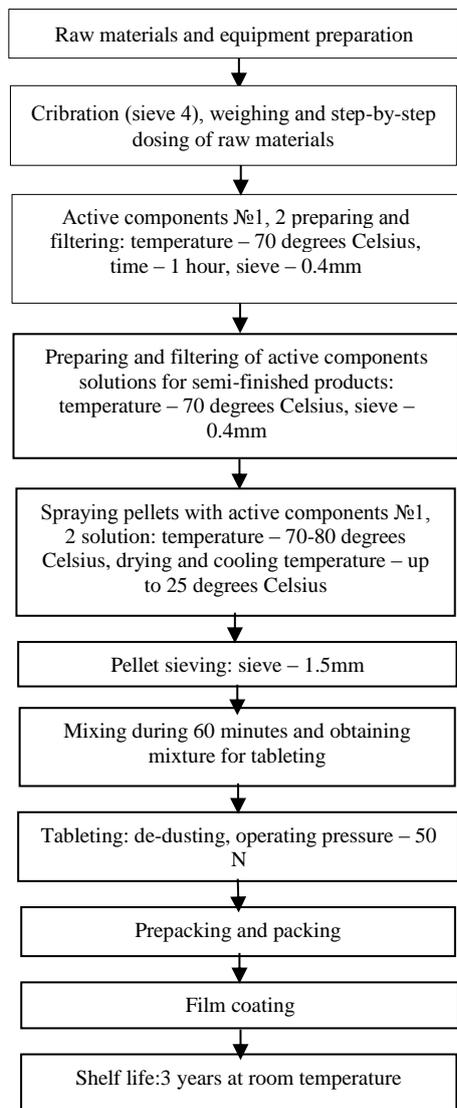


Fig. 1. Manufacturing technology

The innovative technology involves skeleton tableting, which ensures insignificant moisture content and excludes destructive oxidative and hydrolytic processes.

Low impact production technology provides high quality characteristics of the developed product and preserves its biologically active substances, which determine the product nutrition value and functional properties.

Consumer properties of the developed product were studied during production and storage processes. The product was stored for 38 months at room temperature in sealed plastic jars certified for contact with food.

The following properties were examined during the study: organoleptic properties - appearance, average tablet weight, weight variation, tablets color, their taste and smell; physicochemical characteristics- disintegration time, tensile strength, friability strength; nutritive value characteristics, which describe the supplement functional properties, as well as safety standards that meet the regulatory documents requirements [6].

The results of microbiological research done after the expiration date are given in table 1.

TABLE I. HYGIENE INDICATORS AND MICROBIOLOGICAL CRITERIA OF THE FOOD SUPPLEMENT SAFETY

Criteria	Reference value	Actual value	
Mesophilic aerobic and facultative anaerobic microorganisms, CFU/g maximum	5·10 ⁴	400	
Yeasts and molds, CFU/g, maximum	100	minimum 10	
Product mass (in grams), which must not contain	E. coli per 1.0 g	prohibited	not found
	Pathogenic microorganisms, including salmonella per 10.0 g	prohibited	not found
	Coliform bacteria per 0.1 g	prohibited	not found

The supplement shelf life is three years at room temperature, the conditions of packaging and transportation being observed. Time allowance is two months. Quality standards are shown (table 2).

TABLE II. ORGANOLEPTIC AND PHYSICO-CHEMICAL CHARACTERISTICS OF THE FOOD SUPPLEMENT

Characteristic	Description
Appearance	Oval tablets with transparent coating, contain pellets
Tablet average weight, g	1.2 g
Weight variation, g	From 1.08 to 1.32
Color	Pink-brown, with blue, brown and yellow pellets
Taste and smell	Peculiar
Disintegration time, minutes, maximum	30
Tensile strength, H, minimum	90
Friability strength, %, minimum	97

The authors recommend to take the biologically active supplement twice a day with or after food. This dose provides the necessary intake of declared nutrients (% of the recommended daily value). Table 3.

TABLE III. NUTRIENTS CONTENT IN RECOMMENDED DAILY INTAKE

Vitamins and nutrients	mg	% DV
B ₁ (thiamine)	1	67 (1,5)
B ₃ (niacin, PP)	10	50 (20)
B ₅ (pantothenic acid)	5	100 (5,0)
B ₆ (pyridoxine)	2,0	100 (2,0)
B ₉ (folic acid)	0,4	100 (0,4)
B ₁₂ (cyanocobalamin)	0,001	33 (0,03)
Tocopherol acetate	20	133 (15)
B-carotene	7	140 (5,0)
C (ascorbic acid)	100	111 (90)
Coenzyme Q ₁₀ (ubiquinone)	5	17 (30)
Hesperidin	80	80 (100)
Dihydroquercetin	20	80 (25)
Quercetin	20	60 (33)
Rutin	20	60 (33)
Magnesium	30	8 (400)
Zink	17	70 (12)
Selenium	0,1	60 (0,06)
Copper	1,4	140 (1,0)
Superoxidismutasa	200 ЕД (U)	

Physiological dosage of active substances prevents addiction and side-effects.

The product is certified, received a sanitary - epidemiological conclusion and certificate of state

registration. It is produced at the enterprises of Artlife Company (Tomsk) in accordance with the requirements of the international standards of the ISO 9001: 2000 series and GMP rules, which ensures competitiveness, stability of quality and safety of the products under development.

V. RESEARCH RESULTS

The use of the innovative specialized product in a specified dosage improves metabolism and microcirculatory function, normalizes homeostasis, increases the efficiency of energy processes, reduces hypoxia, promotes recovery after long-term diseases, and improves the quality of life under conditions of high psycho-physiological stress. The BAS efficacy and functional properties under the conditions of new industrialization have been confirmed by field observations [14] where volunteers with stressful jobs (medical doctors, teachers, middle and top managers) as well as people who work night shifts took it. The intake of the biologically active supplement resulted in lipid peroxidation products reduction and fewer signs of impaired microcirculation proved by rheoencephalographic research. It also led to improved quality of life in terms of the coefficient dynamics, which reflects the degree to which health status can limit exercise. The authors also considered the possible mechanism of biologically active substances complex influence on the body metabolism under the conditions of high psycho-physiological loads. This mechanism creates conditions for cell membranes stabilization, the immune system activation, oxygen deprivation prevention and energy metabolism stabilization. The results of the study are aimed at industrializing the production of a developed specialized product.

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