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COMPLEX APPLICATION OF AMARANTH AND SOYA IN MEDICINE AND FOOD INDUSTRY

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Abstract. Complex processing studies of amaranth and soya were conducted in order to produce new and effective medicines and dietary supplements. Qualitative and quantitative characteristics of biologically active substances (BAS) of 5 regional varieties of amaranth and of 7 varieties of soya, their seeds, meal after oil extraction and phytopreparation (biologically active complex of soybeans) were studied. The presence of 21 amino acids, 12 flavonoids, 7 isoflavonoids, 7 coumarins, 5 phenolcarboxylic acids, tannins, vitamins, polysaccharides, squalen was found in investigated plant material. A comprehensive resource-saving technology for oil, herbal formulation and protein production was developed. The use of amaranth and soy products helps to reduce cholesterol, compensate an energy lost, increase muscle mass, significantly reduces the risk of obesity and cardiovascular disease. It is advisable to include them in the daily diet, which is recommended for chronic diseases of the liver and kidneys, heart and other.

Keywords: amaranth, soy, biologically active substances, meal, resource-saving technology.

Introduction. Nowadays plant raw materials serve as a source of obtaining more than a third of all medicines and almost all biologically active additives (food supplements). High attention to dietary supplements and herbal remedies is caused by the environmental deterioration and, as a result, an increase of intolerance to synthetic drugs and antibiotics expose adverse side and a number of other factors. Investigated in this paper *Amaranthus L.* of the family Amaranthaceae and Soya (*Glycine max* Moench), pea family (Fabaceae) belong to such plant raw materials. Amaranth seed contains 15-17% protein, 6-8% oil, 4-8% fiber and up to 10% squalene. Soybean grains contain a higher protein content (27-47%), fats (19-25), carbohydrates (25-30%), as well as vitamins, enzymes and minerals. According to the nutritional value, the amaranth protein is equivalent to 75 units, and the soy protein to 68 units compare to cow milk (72 units) (Babich, A.O., 2011).

Amaranth and Soya have long been used not only as food and fodder plants, but also in medical practice in America, Europe, Asia for thousand years. Every year, amaranth and soybean production increases in all continents. Special programs for industrial production and use of products from amaranth and soya are developed and implemented in Ukraine. The range of nutritional supplements in Ukraine is small and represented mainly by foreign manufacturers. That is why the development of domestic dietary supplements and gluten-free dietary products based on amaranth and soy is very important (Heywood, V.H. 2001, Saunders R.M., 1984, Chirkova, T.V., 1999).

15 Ukrainian enterprises (Amaranth of Ukraine, Richoil, Mak-Var Ecoproduct, etc.) are engaged in amaranth grain processing, oil, flour and pasta production. The development of the gluten-free bread technology from amaranth ("Cascade", Poltava region) to provide dietary bread to patients with celiac disease is topical issue in Ukraine (Lobachova, N.L., 2015).

Soya and its products (oil, flour, protein, soy protein concentrate, etc.) have been known as nutritive and curative supplements to the diet. These products can be used by military, schoolchildren, athletes; include them in the daily diet of dietary and preventive nutrition for chronic liver and kidneys, heart diseases, etc. (Chirkova, T.V., 1999).

Amaranth and soya products can be offered for use in cosmetology to enhance skin smoothness, hair growth and prevention of alopecia during irradiation.

Material and method. In the current study, we investigated 5 amaranth recognized variety (Kharkivs'kyi, Students'kyi, Sem, Liera, Ul'tra) of 2 amaranth species (*A.hypochondriacus*,

A.hybridus) and 7 varieties of soya (Estafeta, Podiaka, Krynysia, Sprytna, Baika, Mal'vina, Romantycya), which are listed in the state register of plant varieties of Ukraine 2018 (Table 1).

The objects of the study were the green mass, seeds of the above-mentioned plant varieties, as well as the meal after oil extraction from amaranth and soy, and herbal formulation, obtained on the basis of the biologically active soybean complex. Samples of plant raw materials are provided by the Institute of Animal Husbandry of the National Academy of Agrarian Sciences (NAAN, Kharkov).

The extraction of biologically active substances from the investigated objects was carried out by water-ethanol solutions. Adsorption and partition chromatography methods on various sorbents (silica gel, polyamide sorbent, aluminum oxide) were used for separation of biologically active substances. The structure of the isolated compounds was determined by their physicochemical properties using paper (PC) and thin-layer chromatography (TLC) in various systems of organic solvents, UV, IR, and PMR spectroscopy. The protein content was determined by the Folin method using a modified Folin-Ciocalteu reagent. Albumin was used as the standard sample. The presence of amino acids was confirmed by a positive ninhydrin reaction.

Results and discussions. The following biologically active substances were identified in studied objects: protein (17-42% depending on the variety), 21 amino acids (10 of them essential), oil (5-23%), carbohydrates (14-33%), fiber, 12 flavonoids (quercetin, kaempferol and their glycosides), 7 isoflavonoids (genistein, formononetin, diadzein and their glycosides), 5 phenilcarbonic acids (chlorogenic, neochlorogenic, ferulic, π -cumaric), organic acids, 7 coumarins (umbeliferon, scopoletin, herniarin, esculetin, isoesculetin, esculin), tannins, 2 catechins, triterpenoids, sterines, phospholipids, carotenoids, chlorophylls, oil- and water soluble vitamins (A, group B, E, K, P), polysaccharides, squalen.

Table1 "Chemical composition of amaranth and soya, % on dry matter"

Amaranth species	Protein,%	Oil, %	Ash, %	Soya species	Protein,%	Oil, %	Ash, %
Amaranthus hypochondriacus				Estapheta	41.3	28.1	5.2
Kharkivs'kyi	20.0	7.6	3.4	Podiaka	38.8	23.4	4.5
Students'kyi	18.6	9.1	3.7	Krynysia	36.7	22.5	4.7
Sem	19.5	6.7	3.6	Sprytna	37.8	21.6	4.6
Liera	20.6	7.0	3.5	Baika	36.7	22.7	4.8
Amaranthus hybridus				Mal'vina	39.1	22.3	4.8
Ul'tra	17.3	5.0	3.2	Romantycya	39.9	23.2	4.9
Meal	28-30	1.5-1.9	3.7-3.9	Meal	45-50	3,5-6.9	6.0-6.3
Green mass	4,2-8.6	2.3-3,4	4.5-5,1	Green mass	6,7-17.1	3,2-8.3	2,6-7.7
				Herbal formulation	10.6	1.7	-

The following amaranth varieties - Kharkivs'kyi, Liera, and soybean varieties - Estapheta and Romantycya were offered for further in-depth pharmacological study and creation effective herbal formulation of a various action based on the conducted studies. The complex resource-saving technology was developed: oil production → herbal formulation → protein.

The treatment of protein-energy deficiency is carried out by hormones and anabolic steroids with inherent side effects. This new plant anabolic, obtained from soya meal after oil extraction, has no analogues abroad. It is recommended as a mean that enhances protein-energy processes, regulates acid-base balance and increases the body's defenses. Therefore, the use of amaranth and soya herbal formulations, which refer to practically non-toxic substances, will provide along with the anabolic effect the absence of undesirable effects even during long-term application. It can be used by adults and children in surgical, nephrological, therapeutic practice as a remedy that affects the metabolic processes and immunity (Baranovskiy, A.U., 2013).

Essential fatty acids (omega-3 and omega-6) improve memory, mood, bone health and contribute to weight loss.

Soya and amaranth oils containing phospholipids, triglycerides and other biological active substances have a regulating effect on the vascular tone and metabolic processes that provide a protective effect in the development of the alcoholic liver diseases, enhance synthesis and prevent protein catabolism, have antioxidant properties, etc. The high quality oil, as well as the favorable combination of fatty acids: oleic, palmitic, linolenic and stearic, allows to use it for the production of

high-quality margarine and other products in the food industry (Baranovskiy, A.U., 2013, Kislichenko, V.S., Levashova, O.L. 2003).

Protein is used as an additive for the enrichment of bakery, confectionery and sausage products, potato products (crisp potato), mayonnaise, soy meat and milk (the composition is close to cow's milk). The use of soy and amaranth products in food allows, on the one hand, to increase the nutritional value of the human diet due to protein, on the other, to give it (or strengthen) the therapeutic and prophylactic orientation. So, consumption of these products contributes to lowering cholesterol level, rapid compensation of lost energy, increase in muscle mass, significantly reduces the risk of obesity and cardiovascular diseases. Soy products due to their nutrition can be used for military, schoolchildren, sportsmen. It is advisable to include them in the daily diet of dietary and preventive nutrition, which is recommended for chronic diseases of the liver and kidneys, heart etc.

Thus, the obtained results confirm the therapeutic and prophylactic properties of biologically active substances of amaranth and soya, and the prospects of their application in the complex therapy of various diseases, the necessity of the development a variety of special directed products for this purpose. Considering the requirement of domestic healthcare in this type of medicine, the availability of raw materials and the simplicity of technology, the development of resource-saving complex use of raw materials is a topical issue. All of the above mentioned is a justification for a comprehensive study of amaranth and soya BAS for creation of effective drugs of different action, dietary supplements, and their application in dietotherapy and cosmetology.

Conclusions.

– The obtained results give an evidence of the therapeutic and prophylactic properties of the biologically active substances amaranth and soybean, and the prospects of their application in the complex therapy for various diseases.

– The complex use of amaranth and soya biologically active substances includes a resource-saving technology of the oil production, a biologically active complex and protein from amaranth and soya, which makes possible to expand the range of effective medicines, dietary supplements, and for their use in dietotherapy and cosmetology.

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