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SECTION 6.
PHARMACEUTICAL SCIENCES

UDC 615.1

COMPARATIVE ANALYSIS OF THE MINERAL COMPOSITION OF AMARANTH AND ARONIA SEED OILS

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Summary. The qualitative composition of mineral substances, as well as a comparative analysis of the quantitative content of macro- and microelements in the amaranth (Amaranthus) and chokeberry Aronia (Aronia melanocarpa) oils was performed by atomic emission spectroscopy. The analysis was carried out in the discharge arc AC with excitation source (PVA-28), followed by the photographic recording of the emission spectrum and measuring the intensity of the spectral lines of the individual elements on the spectrograph DFS-8. As a result of the study, the content of 21 macro- and microelements was determined, which specify characteristics of the studied oils.

Keywords*: amaranth, aronia, microelements, spectral analysis.*

Introduction. Microelements are important for performing number of metabolic functions at all pathways of vital processes. Minerals are of great importance in human life, as they are component of hormones, vitamins, respiratory pigments, form compounds with proteins, accumulate in some organs and tissues of a body, especially in the endocrine glands. Such microelements as selenium, manganese, zinc, copper are included in the structures of active enzyme centers, which provide antioxidant protection of the genetic structure of the cell from the adverse effects of carcinogens [1]. Medicinal plants are natural sources of mineral compounds. The content of biologically active substances determines the value of medicinal raw materials. Plants that have centuries-old use in agriculture and folk medicine deserve special attention of phytochemists [2].

Such plants include amaranth (shiritsa) and chokeberry aronia. These wild-growing and cultivated species are widely used in traditional and scientific medicine, forage production, food industry, as a valuable forage crop, source of protein, pectin and fatty oil, due to the presence of high content of biologically active substances (BAS).

AMARANTH (*Amaránthus L.*) is a genus of annual herbs of the Amarantaceae family. About 65 genera and 900 species of amaranth are known in the world flora, in Ukraine - 5 species. The homeland of amaranth is Central and South America. At the moment it is cultivated in America, Europe, Asia, Africa [3].

Amaranth derives from Greek “amarantos” means a never-fading, eternal flower. It is also known as velvet, aksamitnik, cock’s combs, cat’s or fox’s tail. The most common type of amaranth in Ukraine is the redroot pigweed (Amaranthus retroflexus). These are predominantly annual herbal plants with an upright stem or stretched on the ground branches.

Historically Amaranth was considered a bread of the Aryans and Aztecs. For 8 thousand years, Amaranth was one of the main grain crops of America. The Indians called it the “golden grain of God”, “Aztec or Inca wheat”. The ancient Aztecs used amaranth for feeding newborns and patients, the soldiers took plant seeds with them in difficult campaign as a source of health and strength. Currently, scientists around the world are engaged

in the revival of this ancient culture. The USA, China, India, Australia have special programs for the industrial production and use of amaranth products. All parts of the plant are edibles [4].

The amaranth plant has a unique composition. There are huge amounts of biologically active substances in all parts of the plant: essential and non-essential amino acids, vitamins, polyunsaturated fatty acids, vitamins, carotenoids, bile acids, alcohols, sterides and squalene [5].

Amaranth oil takes a special place in the range of organic vegetable oils, thus it has the most balanced amino acid composition, especially active form of vitamin E and squalene. Amaranth oil has a powerful healing effect on the body and saturates it with oxygen, which has a positive effect on the work of all human organs. Today, amaranth oil is used for the treatment of cardiovascular system, gastrointestinal tract, for the prevention and comprehensive treatment of cancer, accelerates recovery after radiation therapy; as well as for the treatment of the liver and kidneys, dermatological diseases (eczema, psoriasis, lichen, ulcer), tuberculosis and various infectious viral and fungal diseases. The presence of squalene, vitamin E, phytosterols and magnesium in amaranth oil hinders the development of inflammatory processes in the CCC, reduces the risk of blood clots, lowers blood levels of low-density lipoproteins, which provoke the formation of blood vessels of atherosclerotic plaques [6, 7].

ARONIA Aronia melanocarpa of Rosaceae family (Rosaceae Juss.)

Aronia melanocarpa, Aronia melanocarpa (Michaux) Elliot (Greek aronia - the name of a fruit similar to a loquat + Lat. Melanocarpus - aronia), Sorbus melanocarpa Meynhold is a plant of the rose family (Rosaceae Juss.). Chokeberry aronia is widely cultivated in Ukraine as a fruit, medicinal and ornamental plant [8].

The fresh fruits of chokeberry aronia (Fructus Aroniae melanocarpae recentes) are a rich source of biologically active substances (vitamins, phenolic compounds, flavonoids, catechins, anthocyanins, tannins, carbohydrates, in particular mono- and disaccharides, tocopherols, amino acids, terpenoids, etc.).

Extracts, infusions, tablets are obtained from chokeberry fruits. The food industry uses ashberry for the production of juices, jams, jams, kissels, soft drinks, confectionery, syrups, wine, which has medicinal properties.

The fruits of chokeberry are used in traditional medicine in the treatment or prevention of hypertension, atherosclerosis, diathesis, radiation sickness, as well as a multivitamin, capillary-strengthening antihypertensive agent for hemorrhagic diathesis, capillarotoxicosis, hemorrhage, hypertension, atherosclerosis [9].

Nowadays aronia oil due to the high content of iodine, is used in iodine deficiency and thyroid diseases. Oil is used with a therapeutic and preventive purpose in pathological conditions, accompanied by increased permeability and fragility of the blood capillaries; in hypertension, atherosclerosis, kidney disease (glomerulonephritis), diabetes mellitus, radiation sickness, etc. It is effectively used for healing cracks and scratches on the skin; it has a powerful nutritional effect on the sensitive skin both independently and in complex cosmetic preparations. In addition, aronia oil is used separately and as one of the ingredients in the manufacture of natural soap. It is added to tonics, ointments, rubbing, massage mixtures [10].

The purpose of this research was a comparative study of the qualitative composition and quantitative content of macro- and microelements of amaranth and aronia oil.

The objects of the study were amaranth oil and aronia oil, obtained by cryogenic extraction by a chladone, which is completely removed when heated to room temperature. The obtained oils have high nutritional and healing properties.

Materials and methods

Determination of the quantitative content of macro- and microelements was carried out by atomic emission spectroscopy, based on the evaporation of plant ash in an arc discharge, photographic recording of the emission spectrum and measuring the intensity of the spectral lines of individual elements.

The samples were evaporated from graphite electrode craters in an AC arc discharge with a force of 16 A at 60 s exposure. IVS-28 was used as a source of the spectra excitation. The spectra were recorded on a photographic film using a DFS-8 spectrograph with a diffraction grating of 600 ppm/mm and a three lens illumination system. Nitric acid was used to dissolve copper and vanadium. For the analysis of other elements were used reagents qualify “chemically pure” and twice purified water. Photometric lines of the spectra line at a wavelength from 240 to 347 nm in samples compared to standard samples of a mixture of mineral elements corresponding to the composition of herbs, with the help of the microphotometer MF-4. The relative standard deviation (for five parallel measurements) did not exceed 20% when determining the

Table 1.

The content of mineral substances in the amaranth and aronia oils (n = 5)

Element	Concentration of minerals, μg/100 g	
	Amaranth oil	*Aronia oil*
K	35000	15000
P	19000	170
Ca	13200	210
Mg	9000	140
Na	3300	350
Zn	900	50
Mn	500	30
Fe	150	40
Si	220	3500
Cu	30	20
Al	20	210
Sr	40	7
Pb	<0.03	<0.03
Ni	<0.03	<0.03
Mo	<0.03	<0.03
Co	<0,03	<0,03
Cd	<0,01	<0,01
Se	<0,01	<0,01
As	<0,01	<0,01
Hg	<0,01	<0,01
Ti	<0,01	<0,01

multiple values of element concentrations.

For each element, the differences in the blackening of the line and the background ($S = S_{l+f} - S_f$) for the spectra of the samples (Sin) and the calibration samples (GO) (S_{cs}) were calculated from the photometric results. The calibration graphs in the range of the measured concentrations of the elements were constructed using standard samples of metal salt solutions (ISORM-23-27) in the following coordinates: mean value of the difference in the blackening of the line and the background (SD) versus the logarithm of the content of the element in GB (lgC), where C is shown as a percentage to the denominator. According to this graph, the content of the element in the ash (a%) was found.

The content of the element in the oil (x,%) was found from the following formula:

$$x = \frac{a \cdot m}{M}$$

where **a** is the content of the element in the ash (%), **m** is the mass of the ash (g), and **M** is the mass of the raw material (g).

In the amaranth and aronia oils the content of 15 macro- and microelements was determined (Table 1). The content of heavy metals in the investigated oils is within the limits of the acceptable concentrations for food products.

As shown by the conducted studies, both oils are characterized by a high content of potassium. Providing the body with potassium is one of the most important strategies for protecting against cancer and heart disease. People with high blood pressure need to monitor their diet rich in potassium, if they do not suffer from kidney disease. Potassium ions play an important role in maintaining the osmotic pressure and cell volume, acid-base balance, regulation of enzyme activity. In addition, potassium maintains the right concentration of magnesium in the body and provides its functions. It is necessary for the work of the nervous and muscular systems. As part of a complex of vitamins E, C and minerals magnesium, potassium, zinc is an effective tool for treating such chronic diseases as osteoarthritis.

The content of phosphorus, calcium, magnesium, sodium, zinc, manganese and iron is significantly higher in amaranth oil. Phosphorus helps to increase the elasticity of the walls of capillaries and reduce their permeability, promotes better absorption of vitamin C by the body and its fixation in the spleen, kidneys and adrenal glands. Magnesium has a beneficial effect on the work of the nervous system. Calcium performs many important functions in the body. It actively

participates in the process of cell growth and activity, in the assimilation of nutrients, in the process of blood clotting, in the immune defense of the body. It blocks the absorption of saturated fats in the gastrointestinal tract. One of the most important role of calcium is an ability to neutralize many acids and normalizes the acid-base balance.

Conclusions. 1. The atomic-emission spectrographic method with photographic registration in amaranth oil and aronia oil determines the content of 21 macro- and microelements. The content of heavy metals is within the limits of the requirements of maximum allowable concentrations for food and plant raw materials.

2. Comparative analysis showed that the content of macro- and microelements in amaranth oil exceeds (for some elements in several times, for example, phosphorus, calcium, magnesium, sodium, zinc, manganese and iron) the content of similar elements in aronia oil.

3. Analysis of the experimental data showed that both investigated oils are characterized by

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