

Macro-and microelement composition of dry extract of *Brassica oleracea* var. *italica* Plenck

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Abstract. Thus, our research significantly expands information about the chemical composition of raw materials from plants of the genus *Brassica Oleracea* and provides theoretical justification for the possibility of complex use of medicinal plants, taking into account environmental factors. In the studied sample of broccoli inflorescences, 29 elements were identified and their quantitative content. Based on the study, we can conclude that broccoli – *Brassica oleracea* L. var. *italica* Plenck is not only a valuable food crop, but also a medicinal plant – a source of macro- and microelements. The object under study is of interest for an in-depth study of its chemical composition in order to create regulatory documentation for plant raw materials.

1 Introduction

Broccoli (*Brassica oleracea* var. *italica* Plenck) is an annual, herbaceous crop belonging to the Brassicaceae family, which is related to Brussels sprouts, cabbage, cauliflower and kale. The name "broccoli" comes from the Italian "broccolo", meaning the flowering top of the cabbage [1,2,3], and has more divided and petiolate leaves. The main head consists of clusters of fully differentiated flower buds arranged less densely on longer stems. Sprouting forms of broccoli bear many small flower heads. It grows, reaching 400 mm in the vegetative phase and 1–2 m at the end of the flowering period [4]. The development of broccoli heads is an important factor determining their phytochemical composition, as significant changes occur at this stage [5].

Both macro- and microelements are not the least important phytochemical compounds in broccoli. The content of macro- and microelements in food is very small - milligrams or micrograms, but their amount in the body must correspond to the physiological needs of a person. They are not sources of energy, but are involved in the absorption of food, regulation of functions, and implementation of the processes of growth, adaptation and development of the body [6,7].

In plants, minerals are either in the cell sap in a dissolved state, or they are associated with organic compounds. In medicine, plants containing macro- and microelements are used as medicines, because a number of diseases are associated with a lack of one or another

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element in the body. Minerals perform a plastic function in human life processes, participating in the metabolism of almost any human tissue, but their role is especially great in the construction of bone tissue, where elements such as phosphorus and calcium predominate. Minerals participate in the body's most important metabolic processes - water-salt, acid-base. Many enzymatic processes in the body are impossible without the participation of certain mineral substances, because they are part of enzymes and active organometallic compounds [7,8].

Among the mineral salts, macro- and microelements in broccoli, potassium should be noted, which removes excess salts and water from the body; calcium and phosphorus, which ensure the functioning of bone and brain tissue; iron, copper, cobalt, which take part in hematopoiesis; iodine, which prevents thyroid disease. This plant also contains a large amount of macroelements (sodium, potassium, calcium, magnesium, phosphorus) and microelements (iron, aluminum, manganese, copper, molybdenum, nickel, zinc, silicon). Broccoli is especially rich in carotene (provitamin A), which is not found in cauliflower. In terms of the amount of carotene, it is second only to carrots. In the human body, carotene is converted into retinol, which promotes the growth and development of the body, normalizes metabolism, increases the body's protective properties against infectious diseases, improves the condition of the skin and mucous membranes, and the retina. Broccoli also contains vitamins B1, B2, C, PP, B6, E. In terms of vitamin C content, broccoli is second only to lemon, although it is much sweeter than the latter. In addition, cabbage contains vitamin C not in the form of ascorbic acid, but in the form of its precursor - ascorbigen, which is not destroyed during storage. B vitamins have a beneficial effect on the nervous system [1,2,9,10,11,12,13].

2 Purpose of the study

Study of the content of macro- and microelements in dry broccoli extract for their further standardization.

3 Materials and methods

The objects of our study were the grass *Brassica Oleracea* var. *Italica* Plenck (supplier of the farm "YAKKA-BURGUT", Samarkand region, Jambay district), assembled in November 2022.

The raw materials were dried at room temperature in a well-ventilated area for ten days [14,15] and stored in paper bags. Using the maceration method, a dry aqueous extract of broccoli herb was obtained by 3-fold extraction with distilled water in a ratio of 1:10 at room temperature and steam-dried to a dry residue.

An accurate sample of 0.0500-0.5000 g of the test substance is weighed on an analytical balance and transferred to Teflon autoclaves. Then the autoclaves are filled with the appropriate amount of purified concentrated mineral acids (nitric acid (h/h) and hydrogen peroxide (h/h)). The autoclaves are closed and placed on a Berghofc microwave digestion device using the MWS-3+ software or a similar type of microwave digestion device. Determine the decomposition program based on the type of substance under study, indicate the degree of decomposition and the number of autoclaves (up to 12 pcs).

After decomposition, the contents in autoclaves are quantitatively transferred into 50 or 100 ml volumetric flasks and the volume is adjusted to the mark with 0.5% nitric acid.

The determination of the substance under study is carried out using an ISPMS device or a similar optical emission spectrometer device with inductively coupled argon plasma. In the

determination method, the optimal wavelength of the micro or macroelements being determined is indicated, at which they have maximum emission.

When constructing a sequence of tests, indicate the amount in mg and the degree of its dilution in ml. After receiving the data, the true quantitative content of the substance in the test sample is automatically calculated by the device and entered in the form of mg/kg or µg/g with error limits - RSD in%.

4 Results and discussions

The results of determining the elemental composition of the herb and dry extract of broccoli (*Brassica Oleracea* var. *Italica* Plenck) are presented in Table 1.

Table 1. Elemental composition of broccoli dry extract.

№	Element	Measuring range def. elements	Item content in (g/t)
			Dry aqueous extract of broccoli
1	Li	0,05-4000	12,0
2	Be	0,05-4000	0,011
3	B*	0,10-4000	160
4	Na*	0,004-11%	5900
5	Mg*	0,004-11%	9900
6	Al*	0,002-20%	520
7	P*		58000
8	K*	0,008-30%	100000
9	Ca*	0,005-28%	10000
10	Sc	0,10-4000	0,120
11	Ti*	0,0006-9%	24,0
12	V	0,20-4000	0,310
13	Cr	1,0-4000	0,520
14	Mn	0,002-10%	76,0
15	Fe*	0,008-30%	87,0
16	Co	0,10-4000	0,570
17	Ni	1,0-4000	2,80
18	Cu	1,0-4000	3,80
19	Zn	1,0-4000	74,0
20	Ga	0,10-4000	0,130
21	As	0,10-4000	2,00
22	Se	0,50-4000	0,310
23	Rb	0,10-4000	79,0
24	Sr	0,10-4000	26,0
25	Nb	0,005-4000	0,013

Continuation of Table 1.

26	Mo	0,10-4000	1,70
27	Ag	0,05-10,0	0,860
28	Tb	0,01-4000	< 0,01
29	Pb	0,1-4000	1,10

Note: Elements marked with “*” (Mg*, Na*, Al*, K*, Ca*, Ti*, Fe*) – exceeding 1% have a semi-quantitative determination. Results for elements marked with “*” (P*,) have informational value, because are not indicated in the used MVI.

The methodology used made it possible to determine the quantitative content of 5 macro- (K, Na, Ca, P, Mg) and 24 microelements (Fe, Mn, Al, Pb, Sr, Zn, Ni, Mo, Cu, Co, Cd, As) in the studied raw materials). Among the most important essential elements are iron, cobalt, manganese, copper, molybdenum, zinc. A more detailed idea of the differences in elemental content in the studied samples is given by the results given in Table 1.

The prospects for using medicinal plants in medical practice are usually assessed by their chemical composition and pharmacological properties.

5 Conclusion

Thus, our research significantly expands information about the chemical composition of raw materials from plants of the genus *Brassica Oleracea* and provides theoretical justification for the possibility of complex use of medicinal plants, taking into account environmental factors. In the studied sample of broccoli inflorescences, 29 elements were identified and their quantitative content. Based on the study, we can conclude that broccoli – *Brassica oleracea* L. var. *italica* Plenck is not only a valuable food crop, but also a medicinal plant – a source of macro- and microelements. The object under study is of interest for an in-depth study of its chemical composition in order to create regulatory documentation for plant raw materials.

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