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Element Analysis of Some Varieties of Soft Wheat - Triticum aestivum L.

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Abstract
Today, with the increasing demand for food, the demand for natural and quality products obtained from local raw materials is increasing day by day. This encourages all scientists to conduct scientific research in the field of food. In this study, the productive varieties of soft wheat - Triticum aestivum L., considered the main food source for many people of the world, were selected. Wheat grains of Alekseyev, Bobur and Antanina varieties planted in the field experiment area of the Agrobiotechnologies and Biochemistry Scientific Research Institute were taken and their element composition, micro, macro and harmful heavy elements were analyzed. The composition of the obtained samples was checked spectrometrically on an Avio200 (ICP - OES) device. The elemental analysis of Alekseyev, Bobur and Antanina varieties of wheat, considered important for food, industry and animal husbandry, compared potassium (360.08mg/100g), phosphorus (701.08mg/100g) and magnesium (219.3mg/100g).) was found to be significantly higher in Babur wheat, iron (7.62mg/100g), zinc (9.24mg/100g), copper (0.935mg/100g), manganese (5.61mg/100g) and boron (7.54 mg/100g) and important micronutrients were found to be the highest in Alekseyevich variety. Especially, iron and zinc elements are significantly higher compared to Babur and Antanina varieties, while manganese (3.96mg/100g), zinc (94.92mg/100g) and copper (0.643mg/100g) elements were taken for analysis in Antanina variety was found to be less.

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INTRODUCTION

Microelements affect the main physiological processes of living organisms and perform the main tasks in the implementation of important enzymatic reactions. The requirement of micronutrients in plant organisms is very low or measured in milligrams per kilogram or biomass or hectare of soil. Trace elements are present in small amounts in soil, water, air, and organisms such as microorganisms, plants, animals, or humans (Alloway, 2012).

Plants also collect nutrients mainly from the soil through their roots and leaves. Accumulation of micronutrients through leaf uptake may be important for some elements (Dalenberg & Van Driel 1990). When measuring and comparing the concentration of trace elements, the residues in the atmospheric air should not be neglected. Nevertheless, the supply and absorption of micronutrients from the soil is essential to meet the needs of plants, and it is noteworthy that many important studies have been carried out in this regard (Hamnér, 2016).

Table 1: The main trace elements and their functions

Elements	The main functions of elements in the body	Daily amount
Zn	- Participates in enzymatic reactions, - helps to produce hemoglobin, - activates antioxidant enzymes, - increases immune function	11 mg
Fe	- A component of the main enzymes, - the main element of hemoglobin, - affects antioxidant enzymes, - takes an active part in the synthesis of DNA, amino acids, neurotransmitters and some hormones, - is essential for normal immune function.	8 mg
I	- A component of thyroid hormones	150 mkg
Mo	- Helps in the metabolism of proteins, DNA and toxins	45 mkg
Cr	- Helps insulin action	35 mkg
Cu	- It helps to produce energy and absorb iron - Actively participates in neurotransmitter synthesis - Ensures integrity of connective tissues - Helps antioxidant enzymes	0,9 mg
Mn	- The main composition of antioxidant enzymes - Improves bone development - Participates in the formation and breakdown of glucose and proteins.	2,3 mg

Common wheat cultivars (Triticum aestivum L.), which are currently considered high-yielding, are usually characterized by a decrease in essential nutrients and trace elements (Fan et al., 2008). The concentration of micronutrients and vitamins important for the human body decreases continuously with the increase of harvest, which leads to negative consequences, including "hidden hunger" (Cakmak et al., 2010). In addition to common wheat, triticum species have attracted a lot of interest due to their nutritional and dietary value, as well as their unique taste characteristics (Abd-el-Aal et al., 1995; Stallknecht et al., 1996). Furthermore, the expanding trend of organic farming and greater consumption of healthy food items have sparked interest in chosen wheat among producers and consumers (De Vita et al., 2006). Triticum dicoccum L., Triticum spelta L., and Triticum monococcum L., often known as emmer, spelt, and einkorn, were popular in the Roman Empire. These historical wheats have rarely been employed in current breeding processes. As a result, they are seen as more "natural" and are farmed by a large number of organic farmers. They have poor agricultural output, are adapted to marginal ground, compete well with weeds, and have a great potential for producing healthful food. Consumer desire for healthier meals and wheat variations, along with a significant influence on food, has resulted in the introduction of species like as spelt, emmer, and einkorn into our diets. However, nothing is known about the variations in chemical structure, nutrient content, and yield quality of cultivars under development (Abd-el-Aal et al. 1997). Ekholm et al. discovered that cultivars, conditions of the soil during development, fertilizer application, and harvest maturity all influence micronutrient concentrations in plants. Understanding the micronutrient makeup of food items is vital due to their important nutritional function in the human Little information is given in the scientific literature about the difference in the concentration of trace elements in different types of wheat (Ranhotra et al., 1995). Piergiovanni et al. found that emmer and spelled differed from other varieties of wheat mainly by higher concentrations of Li, Mg, P, Se and Zn (Piergiovanni et al., 1997). Ruibal-Mendieta et al reported that Fe, Zn, Cu, Mg and P concentrations were 30% to 60% higher than common wheat (Ruibal-Mendieta et al., 2005). Lachman et al. found that higher levels of selenium in grain were associated with crossbreeding and emmer (58.9–68.4 µg/kg DM) and einkorn (50.0–54.8 µg/kg) cultivars; Selenium content was lower in spring cultivars and ranged from 29.8 to 39.9 µg/kg (Lachman et al., 2011). Selenium content is important because some soils have been observed to be deficient in the mineral selenium, which has beneficial effects on human health, and selenium has antioxidant activity (Lachman et al., 2012). Studies have found large differences among rare micronutrients Zn (from 34% to 54%), Fe (from 31% to 33%) and Cu (from 3% to 28%) when some wheat types are compared (Suchowilska et al., 2012).

On the contrary, some heavy metals are very toxic (Cd, Pb) and attempts are made to reduce the content of wheat by treatment with brassinosteroids (Yläranta, 1996; Kroutil et al., 2010).

Correct use of the soil fertilization system in the process of growing plants for the food industry, especially by enriching them with selective microelements, allows obtaining products rich in microelements. Eating products naturally enriched with microelements ensures the sufficiency of microelements necessary for human life. (Ekholm et al. 2007).

The following are the main functions and daily amounts (for adult men) of some micronutrients as accepted recommendations of the Linus Pauling Institute at the University of Oregon, USA (Kroutil et al., 2010).

diet (Ekholm et al. 2007).

While the micronutrients listed above perform important tasks in human life, replacing them with natural and safe products over time has become a major problem. That is why the utilization of these important elements at the expense of natural products is directly related to the improvement of the soil fertilization system, taking into account the composition of the soil in the process of growing agricultural plants. In this study, a wheat plant was selected, which is planted on large areas (250 million hectares) and consumed in large quantities (360 million tons). Alekseevich, Babur and Antanina varieties of wheat, Triticum aestivum L., which are cultivated on a large scale in the territory of Uzbekistan and have high productivity, were selected as the object of research. The obtained samples were subjected to macro and microelement analysis and their analysis by spectrometry on Avio 200 ICP-OES device (Perkin Elmer, USA).

MATERIALS AND METHODS

Grains of high-yielding soft wheat of Alekseevich, Babur and Antanina varieties planted in the field experiment area of the Agrobiotechnologies and Biochemistry Research Institute were selected for analysis.

Mineralization: The wheat samples were first ground to a clear solution through the mineralization process. 200 mg (accuracy ± 0.1 mg) of each sample was weighed on an analytical balance (FA220 4N). The wheat sample was mineralized using a technology called MILESTONE Ethos Easy (Italy). A sample (200 mg) was measured according to the mineralization scheme, 6 ml of nitric acid (HNO3) filtered by distillation, that is, acid filtered in an infrared acid cleaner (Distillacid BSB-939-IR), and 2 ml of hydrogen peroxide (H2O2) was added to speed up the mineralization process. Mineralization was performed on all samples for 50 minutes at 1800 degrees Celsius. Following the mineralization process, the mixture in each test tube was transferred to separate conical volumetric flasks (50 mL) and diluted with distilled water (BIOSAN, Latvia). The solution in the flask is transferred to specific test tubes in the Autosampler (SC2 DX Perkin Elmer) section and analyzed.

Preparation of standard solutions: 2% (blank) solution of nitric acid purified in an acid purifier was prepared for analysis on the Avio 200 device. A prepared blank solution was used to dilute standard samples. High precision ICP multi-element standard for device calibration-33 10mg/l ISO 17034 Lot. No. 958205 and ICP multi-element standard solution IV 1000mg/l Lot. No. HC 15457555 standard samples were used. For calibration, using standard solutions, 3 different concentrations of 10 mg/l, 1 mg/l and 0.1 mg/l standard solutions were prepared.

Preparation of 10 mg/l solution. A 100 ml measuring flask was taken and filled with 30 ml of 2% blank solution, 5 ml of ICP multi-element standard solution IV standard solution was poured and then diluted with blank solution up to the mark of the container;

Preparation of 1 mg/l solution. A 100 ml measuring flask was taken and 30 ml of 2% blank solution was poured into it. 10 ml of the standard solution with a concentration of 10 mg/l was poured and then diluted with a blank solution up to the mark of the container;

Preparation of 0.1 mg/l solution. A 100 ml measuring flask was taken and 30 ml of 2% blank solution was poured into it. 1 ml of the standard solution with a concentration of 10 mg/l was poured and then diluted with a blank solution up to the mark of the container.

Taking into account the high concentration of elements such as K, Fe, P in the composition of the samples, a standard sample of 40 mg/l was also prepared. During the calibration process, some elements were recalibrated based on the ICP multi-element standard-33 standard.

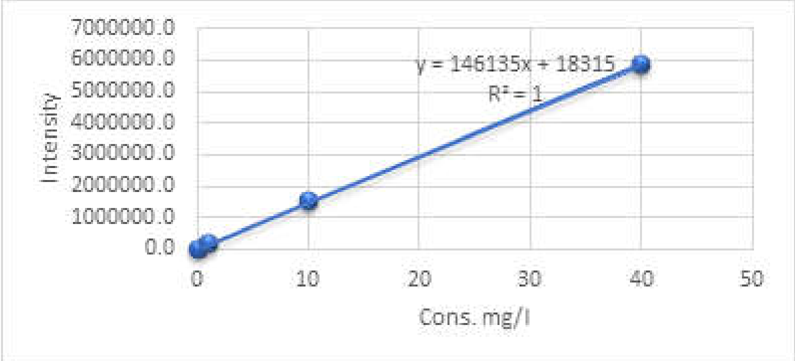
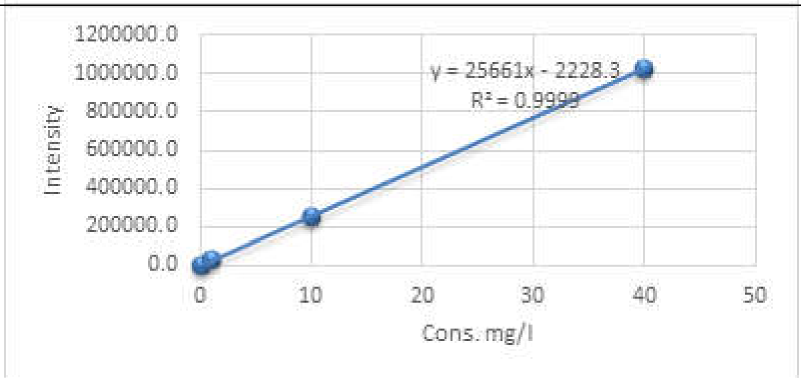
The device was started and the appropriate parameters (Table 2) were set depending on the sample to be analyzed:

Table 2: Parameters set for analysis on the Avio 200 device

System parameters	
RF Power:	1.5 kW
Plasma gas (argon) flow:	11.0 l/min
Sample spray speed:	0.7 l/min
Auxiliary gas flow:	0.2 l/min
Lamp type:	With 1.4 mm ID injector tube standard one-piece quartz torch
Nebulizer Type:	The glass is concentric
Nebulizer pressure:	160 kPa
Pump pipe:	GRY-GRY (input) BLK-BLK (output)
Pump speed:	15 rpm
Sampling rate:	3.0/1.0 ml/min
Integration time:	3 sec
Automatic PMT voltage:	650 V

The Avio 200 ICP-OES Inductively Coupled Plasma Optical Emission Spectrometer (Perkin Elmer, USA) was set up using the following parameters: Sample flow rates of 3.0 and 1.0 mL/min, argon flow of 11 L/min, and voltage of 1.5 kW (1500W).

Graph 1: Calibration graphs obtained on the basis of standards (in the case of Fe and K)

<table>
<tr><th>Elements</th><th>Calibration graph</th><th>Correlation coefficient</th></tr>
<tr><td>Fe</td><td>
</td><td>R^2=1</td></tr>
<tr><td>K</td><td>
</td><td>R^2=0,9999</td></tr>
</table>

The sample mineralized under acidic conditions was analyzed in an Avio 200 spectrometer. The device has a high precision level and can measure the components in the solution with an accuracy of 10-9g. As a result of recalculation, the results obtained at the end of the analysis (table 3) had the following values:

Table 3: Amount of elements in 100 g of wheat samples (mg/100g)

Elements	Alekseevich	RSD deviation	Babur	RSD deviation	Antanina	RSD deviation
Li (mg/100g)	0,045	8.2%	0,043	6.9%	0,062	6.2%
Al (mg/100g)	0,504	4.7%	0,429	3.8%	0,521	4.8%
Mo (mg/100g)	0,92	5.9%	0,822	5.8%	0,767	5.1 %
Te (mg/100g)	0	0 %	0	0 %	0	0 %
Se (mg/100g)	0	0 %	0	0 %	0	0 %
Sr (mg/100g)	12,9	1.9%	8,46	2.3 %	14,12	1.3 %
K (mg/100g)	268,58	0.6%	360,08	0.4%	290,8	0.3%
Na (mg/100g)	9,68	1.2%	8,84	2.2%	10,22	1.2%
Ba (mg/100g)	0,062	8.3%	0,043	9.4%	0,127	7.4%
Ag (mg/100g)	0	0 %	0	0 %	0	0 %
Pb (mg/100g)	0,032	9.2%	0,041	13.2%	0	0 %
Cd (mg/100g)	0,004	35.4%	0,0016	27.2 %	0,004	29.3 %
As (mg/100g)	0	0 %	0	0 %	0	0 %
Cr (mg/100g)	0,121	3.5%	0,087	2.9%	0,163	3.1 %

Mn (mg/100g)	5,61	1.3%	4,98	1.6%	3,96	1.8 %
B (mg/100g)	7,54	5.8%	3,18	2.3%	3,12	2.6 %
Ca (mg/100g)	53,36	0.6%	46,36	0.9%	50,08	0.6 %
Fe (mg/100g)	7,62	2.3%	5,28	1.4%	5,34	1.5 %
P(mg/100g)	663,76	0.6%	701,08	0.3%	615,96	0.2 %
S (mg/100g)	37,06	0.9%	24,48	1.7%	34,68	1.3 %
Mg (mg/100g)	196,62	0.7%	219,3	1.1%	172,4	1.0 %
Zn (mg/100g)	9,24	1.0 %	6,16	0.8 %	4,92	1.8 %
Cu (mg/100g)	0,935	7.1%	0,861	6.1%	0,643	4.4 %
Co (mg/100g)	0	0 %	0	0 %	0	0 %
Ni (mg/100g)	0,443	6.1 %	0,426	3.6 %	0,441	3.8 %

RESULTS AND DISCUSSION

It was found out from the optical spectrometry analysis (Figure 1) that potassium, phosphorus and magnesium elements important for physiological processes are significantly present in Babur wheat variety (respectively 360.08mg/100g, 701, 08mg/100g and 219.3mg/100g) were found to be high. Although the calcium element recorded almost similar indicators in all varieties, it was determined based on the comparative analysis that the phosphorus and magnesium elements in the Antanina variety, and the potassium element in the Alekseevich variety are less compared to the other varieties.

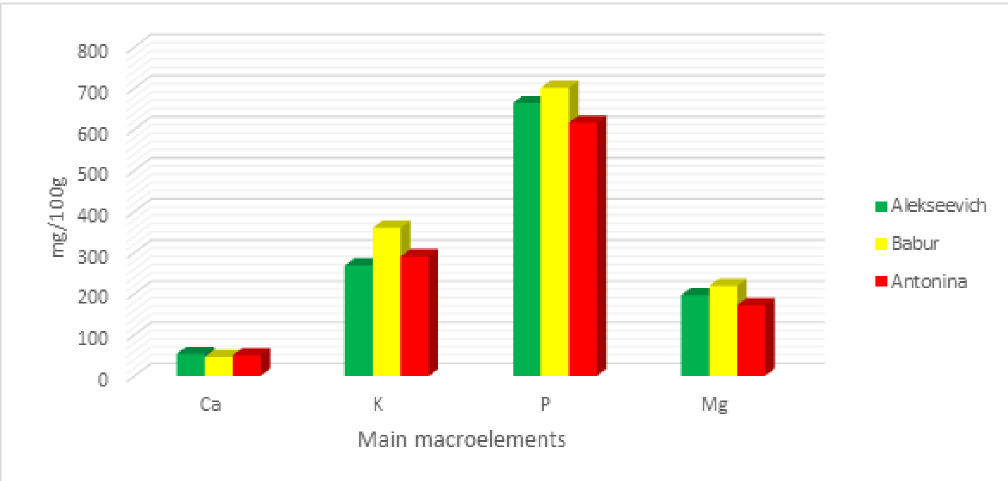


Figure 1: The main macroelements identified as a result of the analysis.

Wheat grain also contains microelements in sufficient quantity, and it was found that the main important microelements, such as iron, zinc, copper, manganese, and boron, are the highest in the Alekseevich variety. Especially boron (7.54mg/100g), iron (7.62mg/100g) and zinc (9.24mg/100g) elements were significantly higher compared to Babur and Antanina varieties.

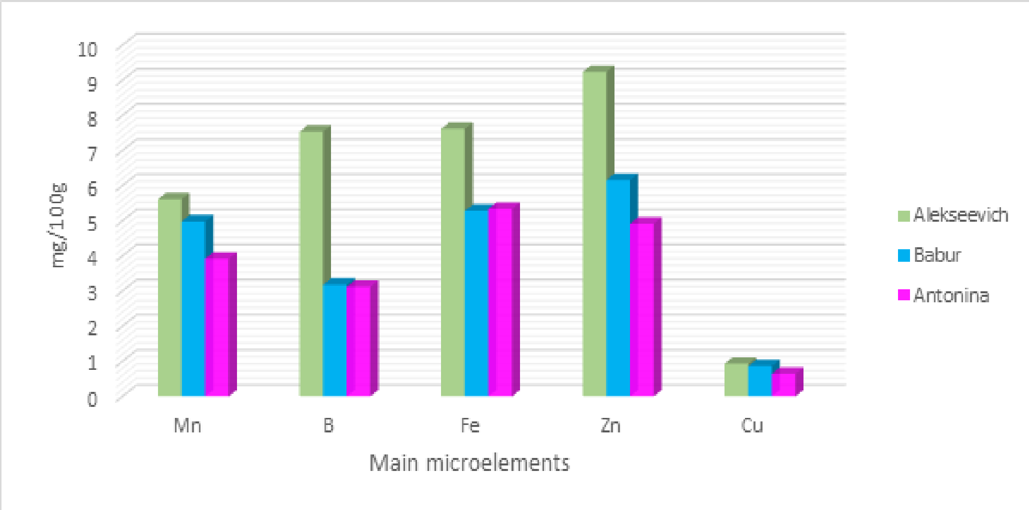


Figure 2: Amount of important micronutrients.

The results of the research show that manganese, zinc and copper elements (3.96mg/100g, 4.92mg/100g and 0.643mg/100g, respectively) were found to show relatively less indicators in the Antanina variety taken for analysis.

There are more microelements that perform basic and extremely important functions in the activity of enzymes considered important for the physiology of living organisms, and potassium, which controls the permeability of cell membranes, is an important component of ATF, which provides energy in the mitochondria. It turned out that elements such as phosphorus and magnesium, which control many vitamins and active substances, are abundant in the Babur variety. Studies have shown that the absorption of elements from the soil by a wheat plant planted in the same soil conditions mainly depends on the varieties adapted to the environment. Cultivation of plants like Alekseevich, which can contain important microelements in high quantities, and their use in agriculture and life is an important task for farms and clusters.

CONCLUSION

During the research, wheat grains obtained from Alekseevich, Bobur and Antanina varieties of soft wheat - Triticum aestivum L., which are grown in many regions of the world, and their element composition - analysis of micro, macro and harmful heavy elements were taken. The composition of the obtained samples was checked spectrometrically on an Avio200 (ICP - OES) device. Elemental analysis of Alekseevich, Babur and Antanina varieties of wheat plant, considered important for food and industry and animal husbandry, comparing potassium (360.08mg/100g), phosphorus (701.08mg/100g) and magnesium (219, 3mg/100g) elements were found to be high in Babur variety, iron (7.62mg/100g), zinc (9.24mg/100g), copper (0.935mg/100g), manganese (5.61mg/100g) and important trace elements such as boron (7.54 mg/100g) were found to be the highest in Alekseevich variety. In particular, iron and zinc elements were found to be significantly higher in comparison to Babur and Antanina varieties. Manganese (3.96mg/100g), zinc (94.92mg/100g) and copper (0.643mg/100g) elements were found to be less in the Antanina variety taken for analysis. Cultivation of wheat varieties enriched with many elements, such as iron, boron, copper, and zinc, which have many functions in living organisms and are the main components of more than ten enzymes, is the main demand of the present time. Planting all types of food crops on large areas, growing food products based on analyzes in laboratories equipped with modern advanced equipment will be a solution to problems such as "hidden hunger".

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