MINERAL COMPOSITION IN GRAIN OF WHEAT VARIETIES

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INTRODUCTION

The cereal grain is the core of human nutrition. The grain of wheat, is the most important crop, next to rice, corn, and soybean (Ben-Ari and Makowski, 2016) for human consumption and for animal feed. The determination of mineral composition and nutritional value of wheat is extremely important as it takes an important place among the crop species being extensively grown as staple food sources. The importance of wheat is mainly due to the fact that its seed can be ground into flour, semolina, etc., which form the basic ingredients of bread and other bakery products, and thus it presents the main source of nutrients to the most of the world population (De Gobba et al., 2016; Liu et., 2016). The wheat grain quality depends on the content of organic compounds (protein and its fractions, carbohydrates, and fat), mineral nutrients (phosphorus, calcium, potassium, magnesium, and microelements), vitamins, antioxidants, and antinutritional compounds (Mallick et al., 2013; Poudel and Bhatta, 2017). Concentrations of iron (Fe) and zinc (Zn) in wheat grain have received particular attention due to the widespread deficiency of these trace elements in humans (Welch and Graham, 2004). According to this, the main objective of this research is to determine the content of some macro and micro elements in grain of wheat varieties.

Figure 1. Wheat (A- growing stage; B- seed)

MATERIAL AND METHODS

PLANT MATERIAL

Three soft wheat (fig. 1) varieties were used as an experimental material for this research (*radika*, *amazon 150* and *pobeda*). All wheat varieties are used in commercial wheat production in the Republic of North Macedonia. The seed was produced for commercial purpose from first generation certification seed (C1) in 2018.

METHOD OF WORK

Microwave digestion method (model Mars, CEM) was applied to destroy the organic matrix to determine the content of Fe, B, Cu, Mn, Zn, Ca, Mg, Na, K, P and S. The content of macro and micro elements in digest samples was performed using inductively coupled plasma mass spectrometry (fig. 2, MS-ICP).

Figure 2. Inductively coupled plasma mass spectrometry

DATA PROCESSING

The content of macro and micro elements was estimated by SPSS software. The phenotypic linear correlation between chemical elements was calculated

RESULTS AND DISCUSSION

Based on a range of reports and survey studies, the average concentration of Zn in whole grain of wheat in various countries is between 20 to 35 mg/kg (Cakmak et al., 2004). According to Šramková et al. (2009) Fe concentrations in wheat grain from plants grown in Mexico were from 28,8 to 56,5 mg/kg 1 with average value 37,2 mg/kg. The content of macro amd micro elements in wheat varieties are given in Table 1. *Radika* variety has the highest content of manganese, calcium, magnesium and potassium, compare to the other tested varieties. The content of iron (31,05 mg/kg) and boron (4,56 mg/kg) was the highest in grain of *amazon 150* variety. In *pobeda* variety was determinate the highest content of copper (9,15 mg/kg), zinc (31,62 mg/kg) and sodium (108,23 mg/kg).

Table 1. Descriptive statistics for macro and micro content in grain of wheat varieties

Variety		Fe mg/kg	B mg/kg	Cu mg/kg	Mn mg/kg	Zn mg/kg	Ca g/kg	Mg g/kg	Na mg/kg	K g/kg	P g/kg	S g/kg
Radika	average	**22,12**	**2,59**	**6,94**	**12,72**	**28,94**	**1,59**	**1,29**	**80,14**	**3,35**	**2,75**	**0,75**
	min	21,00	1,10	4,12	5,78	19,9	0,32	0,86	65,78	2,34	2,59	0,64
	max	22,80	1,23	9,15	14,70	44,80	2,66	1,56	88,53	3,98	2,79	0,87
	CV (%)	1,63	1,45	1,01	2,24	2,66	1,89	1,16	0,83	1,38	1,79	2,05
Amazon 150	average	**31,05**	**4,56**	**7,63**	**8,85**	**26,11**	**0,72**	**1,18**	**80,92**	**3,04**	**3,41**	**0,77**
	min	27,13	2,22	11,65	5,78	23,70	0,40	0,87	71,89	2,53	2,83	0,72
	max	34,80	9,23	2,90	11,45	27,89	0,98	1,56	97,54	3,60	4,11	0,81
	CV (%)	0,71	1,16	2,22	0,79	1,49	1,18	1,81	1,15	1,88	1,67	1,95
Pobeda	average	**27,44**	**3,38**	**9,15**	**8,18**	**31,62**	**0,74**	**0,81**	**108,23**	**2,53**	**3,25**	**0,88**
	min	17,01	1,97	3,12	7,56	31,20	0,34	0,56	90,78	2,11	2,56	0,72
	max	38,19	4,89	14,22	9,09	31,89	1,23	1,08	121,50	2,87	3,71	0,97
	CV (%)	1,22	1,19	2,14	1,54	1,18	1,63	0,89	1,56	2,89	2,59	1,41

The result from performed phenotypic correlation is depicted in Table 2. The content of sulfur was in negative correlation with content of magnesium (r = -0,997), at level of significance p<0.05. Also, significant negative linear correlation was obtained between content of cooper and potassium (r = -0,997). Significant correlations between chemical elements also were reported by Svečnjak et al., 2013.

Table 2. Phenotypic linear correlation between macro and micro elements in wheat varieties

Element	Fe	B	Cu	Mn	Zn	Ca	Mg	Na	K	P	S
Fe	1										
B	0,975	1									
Cu	0,408	0,195	1								
Mn	-0,852	-0,715	-0,825	1							
Zn	-0,416	-0,608	0,660	-0,121	1						
Ca	-0,924	-0,815	-0,727	0,988	0,036	1					
Mg	-0,325	-0,106	-0,996	0,772	-0,725	0,662	1				
Na	0,134	-0,089	0,959	-0,633	0,845	-0,504	-0,981	1			
K	-0,474	-0,267	**-0,997***	0,865	-0,603	0,775	0,987	-0,936	1		
P	0,984	0,920	0,564	-0,932	-0,248	-0,977	-0,488	0,308	-0,623	1	
S	0,251	0,030	0,986	-0,720	0,776	-0,603	**-0,997***	0,993	-0,971	0,419	1

** Correlation is significant at the P<0.01 * Correlation is significant at the P<0.05

CONCLUSION

All tested wheat varieties differed in their rankings for content of macro and micro elements, due largely to the genetic potential of the variety, but at the same time all wheat varieties content the optimum concentration of these elements.

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