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Determination of some physical-chemical properties of bio-fortification soft wheat and flour of the varieties "Treska"

Marija Menkinoska[1]| Vinko Stanoev[2] | Valentina Pavlova[1] | Tatijana Blazevska[1] | Victorija Stamatovska[1] | Natasa Gjorgovska[2]

[1]University St. Climent Ohridski-Bitola Republic of Macedonia, Technology-technical Faculty, 1400 Veles, Macedonia.

[2]University "St. Cyril and Methodius"-Skopje Republic of Macedonia , Agricultural Institute, 1000 Skopje, Macedonia.

Correspondence
Marija Menkinoska, University St. Climent Ohridski-Bitola Republic of Macedonia, Technology-technical Faculty-Veles

Email:
marija_menkinoska@yahoo.co.uk

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Abstract
Cereal crops as a basic food for humans, little is used as a grain, but with milling they are processed in the milling products: flour, meal, flakes and bran. Determining the content of some ingredients, such as protein, ash, wet gluten, fat, etc. in food products is important because they are present in the raw materials and final products. The importance of knowing the physical and chemical properties of wheat and flour is due to the determination of quality and kind of flour which is produced after milling process. The aim of this research is to examine the influence of Fe-EDTA fertilizers through soil, foliar and soil +foliar application on some physical and chemical properties of bio-fortification soft wheat and flour of the varieties ,,Treska ,, During the investigation we determined the highest ash content in the seed obtained with soil + foliar application of iron, while in the flour was measured the highest ash content by soil application of iron. We concluded that the supplement iron in soil increase the percentage of protein in the grain and flour. We found that soil + foliar application of iron leads to a significant increase of % fat and wet gluten in grain and flour compared to soil or foliar application of chelating fertilizers. It might be concluded that the agronomic bio-fortification with Fe-EDTA soil + foliar application and Fe-EDTA soil leads to improved examined physical - chemical properties of wheat and flour.

1. INTRODUCTION

The process of grinding in itself, is important from a nutritional point of view. Generally, as more grain is processed, as more it is lower the content of vitamins in the flour. For example, the content of minerals and vitamins in white flour can bereduced by one third of the content in cereal crops (1). The influence of grinding is insignificant for scrap and proteins because these nutrients are concentrated in the endosperm of grain. With aim supplementation and improvement of the micronutrient flour composition one of the more commonly used methods in the high developed countries, is the enrichment of foods with micronutrients. In the case of mineral micronutrients, this method is easily realized. However, although this approach is quite effective for developing countries, it seems to be expensive, and therefore and therefore hardly accessible. As an alternative an economically justified solution has recently been imposed agronomic bio-fortification that represents a long-term and effective strategy because allows cultivation of crops that contain higher amounts of nutrients (2). Given the great economic importance of soft wheat as strategic culture in our country, the possible ones should be studied the benefits of using bio-fortification as an alternative strategy that will contribute to improving the the quality of wheat production. Considering that in R. Macedonia has little data on the effect of soil, foliar and soil + foliar use of chelating Fe fertilizers on some physical-chemical properties of bio-bortification wheat and flour imposed the need to carry out investigations in this direction, to obtain appropriate knowledge.

2. MATERIAL AND METHODS

Plant material

The variety of the type "Treska" soft wheat (Triticum aestivum), was used as a plant material in this research.

Location and setting experiment

On the lands belonging to the Agricultural Institute in Skopje (Macedonia), in the testing economy "Dolno Lisiche", during the production year 2012/2013, a test was placed according to the method of accidental bloc system, with 4 variants, three time repeated, while the testing parcel being of 30 m² size (3).

Application of fertilizer

The following variants are included in the test of this research:

Fe application in soil (variant 1)
Fe application in soil and foliar (variant 2)
Fe foliar application (variant 3)
Control – without fertilizing (variant 4)
During this research were applied two types of fertilizers Yara Vera ™ Amidas and Nutrichem Folifer-Fe EDTA (3).

Determination of the amount of ash in grain and mill products

The amount of ash is determined by gravimetric method. The method is applied in determining the ash and grain mill products intended for human consumption (4).

Determination of total nitrogen

The content of the total nitrogen in the plant material is determined by the micro-method of Kjeldahl (5).

Determination of proteins

The total protein content is calculated mathematically from the results obtained for the content of the total nitrogen. The amount of total protein is determined if the nitrogen content is multiplied by a factor of 5.7. The protein content is expressed in (%).

Determination of fat The total fat content of the plant material is determined according to Soxlet method by diethyl ether extraction.

Method for determination of wet gluten content in cereals and milling products

The amount of gluten is determined by Kaluđerski (6).

3. RESULTS AND DISCUSSION

Mineral substances in grain and flour (ash content)

The content of mineral substances indirectly shows the ratio of anatomical parts in grain flour. The results obtained in Table1. show some variations in the ash content as a result of the different application of Fe EDTA.

Table 1. Ash content in grain and flour

Variant	Ash content % grain	Index of control	Ash content % flour	Index of control
1	1,91	121,65	0,50	113,63
2	2,05	130,57	0,49	111,36
3	1,64	104,45	0,47	106,82
4	1,57	100,00	0,44	100,00

A higher content of ash in the grain in variant 1 was found for 21.65%, variant 2 for 30.57% and variant 3 by 4.45%, compared to variant 4. In doing so the highest is the ash content of variant 2, which is expected because in this variant the fertilizer was applied soil-foliar. The ash content of flour shows a similar tendency to increase as the grain, thus in this case variant 1 increased by 13.63%, variant 2 by 11.36%, variant 3 by 6.82% relation to variant 4. The highest is the ash content in variant 1 in relation to variant 4. Wheat flour of mineral matter, mostly containing phosphorus and calcium, then magnesium, chlorine and potassium. The other elements are represented in micro quantities. The relation of these elements to the individual parts of the grain is different, and therefore in the flour (6).
According to the regulations for quality wheat flour characterized into 3 types: type 400, type 500 and type 850. According to regulations in the Republic of Macedonia flour type 500 should have ash content from 0,46 to 0,55% (13).
In our study, the results we received for ash content in flour (table1) compared to the mentioned regulations can be characterized as type 500. It contains peripheral parts, giving it a slightly darker color, increased content of mineral substances, proteins, fats and vitamins at the expense of reducing the starch, which makes it nutritiously more favorable than the flour type 400.

Content of wet gluten
The quality of the wheat is made up of several parameters, some of which are genetically conditioned, from the inherited characteristics of the variety, and in a large percentage are also affected by the agro-ecological factors of the breeding. The content of wet gluten is an important indicator of the quality of the grain because it affects the quality of the bread. Analyzing the results for the quality properties presented in Table 2. it is concluded that the content of wet gluten in the grain is increased in variant 1 by 6.45%, variant 2 by 12.9%, variant 3 by 9.68% compared to variant 4. The highest increase in wet gluten in the grain is obtained in variant 2.
In the flour there is a similar tendency: the increase in variant 2 is significantly by 24.14%, variant 3 by 20.69% and variant 1 by 17.24%, compared to variant 4. The highest increase in wet gluten in flour as in grain is obtained in variant 2.

Table 2. Content of wet gluten in grain and flour

Variant	Grain	Index of control	Flour	Index of control
1	33	106,45	34	117,24
2	35	112,90	36	124,14
3	34	109,68	35	120,69
4	31	100,00	29	100,00

Our results suggest that the greatest impact on the moist gluten content has the used fertilizer, because in the grain and the flour was measured the highest value of the wet gluten in variant 2 obtained by adding Fe soil + foliar compared with control.
Our results are close to the results of Ivanoski (7) who conclude that the five different varieties of wheat that is applied foliar fertilizer Kristalon ™, varieties Radica and Treska has higher absolute values of wet gluten in flour in all varieties compared to wet gluten in the grain. According to them it shows that between varieties exist genetic difference, so these two varieties are carriers of genes that synthesize larger percentage of proteins (gluten) in the endosperm (flour) compared to the varieties Milena, Babuna and Bistra.

Protein content in grain and flour

Also an important component of the quality of grain and flour is percentage of protein. The analysis of the protein content has scientific and practical significance. Spare proteins are located in the endosperm in cereal crops.
The results shown in Table 3, show some differences that result not only from hereditary traits but also on climatic factors and applied fertilizers.

Table 3. Protein content in grain and flour

Variant	Protein% grain	Index of control	Protein% flour	Index of control
1	13,00	107,52	12,5	110,89
2	11,85	98,02	11,29	100
3	11,85	98,02	10,77	95,4
4	12,09	100	11,29	100

The obtained results presented in Table 3 show the slightly decreased of percentage of raw protein in the grain in variants 2 and 3 by 1.98% compared to the control.Only in variant 1 was observed increase and largest % in terms of control. As for the flour, it can be noted that, only in variant 3 there is a decrease in protein by 4.6% in terms of control. Although variant 2 had a reduction in wheat protein in the flour, the values of these variants are the same as control.

The highest protein content in flour exists in variant 1 by 10.89% in terms of control. In this case, the effect of Fe EDTA as a chelating compound stabilizing metal ions (in this case iron) is confirmed, and protecting them from oxidation and deposition, leading to an increase in the percentage of proteins in variant 1.
Also, Abbas [8] concluded in their research that the soil application of Fe at doses of 0, 4, 8, 12 and 12 $kg.ha^{-1}$ in the form of $FeSO_4$ leads to an increase in the percentage of proteins and an increase in Fe concentration in wheat.
According to Habib (9) application of 150 $g.ha^{-1}$ iron in the form of Fe_2O_3, increases iron content in the grain leads to an increase in the percentage
of proteins.

Fat content

Wheat flour contains a certain amount of fat, which has a beneficial effect on the technological quality of the flour, improving the interaction of the flour starch and gluten (9).
Results obtained from the analysis of fat content in grain presented in Table 4 shows that the percentage of fat the grain was reduced in variant 3 by 11.66% compared to control. All other variants show an increase in the percentage of
fat variant 1 by 15%, variant 2 by 30.83%.
In flour, the percentage of fat shows significantly reduction, in variant 1 by 59.52%, variant 2 by 11.51%, variant 3 by 59.52%.

Table 4. Fat content in grain and flour

Variant	Fat % grain	Index of control	Fat % flour	Index of control
1	1,38	115	1,02	40,48
2	1,57	130,83	2,23	88,49
3	1,06	88,33	1,02	40,48
4	1,20	100,00	2,52	100,00

Analyzes of % of fats have generally shown that soil + foliar iron application lead to a significant increase in% of fat in flour compared to soil or foliar application.

4. CONCLUSION

With agronomic bio-fortification through soil, foliar and soil + foliar application of Fe chelate fertilizers it was determined:
- The highest ash content in the grain e measured in the variant with adding Fe soil + foliar, while in flour the highest the ash content is measured in the variant to which Fe is applied soil.
-The highest value of the wet gluten in the grain and flour in variant 2 obtained by adding Fe + foliar soil which confirms the impact of the fertilizer used
-The grain higher percentage of protein was measured with variant 1 while the remaining variants 2 and 3 are insignificantly reduced.
-In flour it can be noted that, the greatest content of protein in flour exists in variant 1
- Soil + foliar application of iron lead to significant an increase in % of fat in the grains and flour compared to soil or foliar application of chelatingfertilizers.

It can be concluded that the application of Fe EDTA soil + foliar and Fe EDTA soil leads to improvement of the examined parameters compared to foliar application and control
variant.

REFERENCES

1. Ottaway P ed. (1999) The Technology of Vitamins in Food. Kluwer Academic/Plenum Publishers, Dordrecht.
2. Bouis HE, Graham RD, Welch RM (2000) The Consultative Group on International Agricultural Research (CGIAR) Micronutrients Project: Justifications and objectives. Food Nutr Bull 21:374–381.
3. Menkinoska M., I. Gjorgoski, S. Manasievska-Simic, V. Pavlova, Z. Popeska, V. Stanoev, T. Blazevska, H. Poposka, N. Gjorgovska , V. Levkov (2014) The Influence of Fe-chelates Fertilizers on the Soft Wheat`s Quality International Journal of Emerging Technology and Advanced Engineering Website: www.ijetae.com (ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 4, Issue 9).
4. Kaluđerski G., Filipović N. (1998). Metode ispitivanja kvaliteta žita, brašna i gotovih proizvoda. Tehnoloski fakultet, Novi Sad;
5. Jacobs M.V.(1950) Micro-Kjeldahl metod for biologikals, J. of Amer. Pfarm.Assoc.11.
6. Žeželj M. (2005). Tehnologija žita i brašna: prerada brašna, NIP Glas javnosti doo, Beograd.
7. Ivanovski M. i Stanoev V. (2006) Резултати од примената на фолијарното ѓубре Кристалонтм - специјал кај меката пченица Годишен зборник на Земјоделски институт Скопје UDK: 633.11.631.8.
8. Abbas G., M. Q. Khan, M. J. Khan, F. Hussain and I. Hussain (2009) Effect of iron on the growth and yield contributing parameters of wheat (triticum aestivum l.) The Journal of Animal & Plant Sciences 19(3): Pages: 135-139 ISSN: 1018-7081 139.
9. Habib, M., (2009) Effect of foliar application of Zn and Fe on wheat yield and quality. Afr. J. Biotechnol., 8, 6795-6798.