

QUALITY OF THE GRAIN OF MACEDONIAN WHEAT GENOTYPE IN DIFFERENT PRODUCTION SYSTEMS

Mite Ilievski^{1*}, Dragica Spasova¹, Milan Georgievski¹, Biljana Atanasova¹, Dalibor Jovanov¹

¹Faculty of agriculture, Goce Delcev University - Stip, Goce Delcev bb, 2400 Strumica, Republic of Macedonia

*e-mail: mite.ilievski@ugd.edu.mk

Abstract

Wheat is one of the most important crops for human consumption. The quality of grain of wheat depend the most on the variety, the external conditions and the applied agro-technical measures.

Based on four years of research (2004/05, 2005/06, 2006/07, 2007/08), highest percentage of protein in grain, in the conventional production, had variety *lizinka* (15.3%) and lowest (13.0%) variety *milenka*. In the organic wheat production, the greatest content of protein in the grain had variety *lizinka* (14.8%) and lowest (12.5%) variety *agrounija prima*. Biggest average sedimentation value of the tested genotypes had variety *podobrena orovcanka* (37,4 mL), but the smallest sedimentation volume had the variety *agrounija prima* (23,8 mL). Most gluten index in conventional wheat production had *altana* (76.21%) and lowest (49.01%) *agrounija prima*. In organic production, the largest percentage of gluten index had variety *orovcanka* (88.78) and lowest (53.87%) variety *mila*.

Of the existing range of wheat genotypes, selected in the Republic of Macedonia, for the mill and food industry, the most stable for getting grain of excellent quality, in conventional production, are varieties *lizinka*, *podobrena orovcanka* and *pelisterka*, while varieties *lizinka*, *orovcanka* and *podobrena orovcanka* are the most stable for grain of good quality in organic production.

Key words: *Quality, grain, genotypes, wheat, conventional, organic, production.*

1. Introduction

Wheat is the most important bread grain, as in distribution, production, consumption and nutritional value, as well as by the significance in international trade. (Ljubisavljević M. [1]). Wheat grain is rich in protein (16-17%), carbohydrates (77-78%), oils (1.2 to

1.5%), vitamins of B Complex (B1, B2, PP, etc.) as well as important compounds for the human organism as calcium, phosphorus, magnesium and iron (Vasilevski G. [2]).

The most important indicator of quality of wheat is the amount and quality of protein in grain. Proteins in wheat bread have a very high degree of digestion, while amino acids in their composition are considered essential and indispensable for the human organism that is not the case with proteins from other cereals.

These essential amino acids, toward individual participation percentages, can meet the daily needs of man in different percentage, from 40% (lysine) or completely (Glamočlija Đ. [3]).

The average yield of wheat in the Republic of Macedonia for the period from 2000 to 2007 is 2670 kg/ha (National Statistical Office of Republic of Macedonia [4]). Annual need of wheat grain in the world is 45 to 206 kg per person. The greatest need of wheat (70-80%) have countries with poorly developed husbandry (Vasilevski [2]).

Today there are several ways in the production of soft wheat, or different systems of cultivation. The quality of wheat in these farming systems is different. The main goal of our examinations was to establish the differences in quality characteristics of the tested wheat genotypes, grown in systems of conventional and organic production, as well as implementation and public presentation of the results to the producers and processors interested in the quality of varieties in these two systems of production.

2. Materials and Methods

The examinations were performed in the laboratories of the Faculty of Agriculture and Food – Skopje on ten (10) varieties of soft winter wheat produced in two

production systems (organic and conventional) in the Strumica region in the period from 2004 to 2008. The following varieties of soft wheat were examined: *milenka*, *bistra*, *lizinka*, *altana*, *mila*, *orovcanka*, *olga*, *agrounija prima*, *podobrena orovchanka* and *pelisterka*.

The following quality features of wheat grain were studied: protein content, sedimentation coefficient, gluten index, wet gluten and dry gluten. Proteins were determined of Infratec 1241 Grain Analyzer by Patent method ER0320477B1, 8704886-4. Sedimentation coefficient was determined by sedimentation test of L. Zeleny (ICC standards no. 116 and 118, ISO 5529). Gluten index, wet and dry gluten by Glutomatic System which is the official worldwide standard method for determination of glutens quantity and quality, including standards AACCC/No. 38-12, ICC/No. 137/1, 155 & 158, ISO 7495 and GAFTA Method 34:2. The results obtained are processed variation and statistical by the method of analysis of variance, and differences were tested by LSD-test.

3. Results and Discussion

The results of the quality features of grain in conventional and organic production of soft wheat are shown in Table 1 and 2.

In a comparison of the average protein content in grain of two production systems, regardless of the years, varieties and climate conditions, and depending on the applied agro-technical measures, we can say that the content of proteins in conventional production (13.9%) is larger absolutely for 0.7% or relative for 5.30% than the content of protein in organic grain production (13.2%).

Table 1. Quality of wheat grain in conventional production

Variety	Average values of varieties in conventional production for the period 2004-2008				
	Protein (%)	Sedimentation value (%)	Dry gluten (%)	Wet gluten (%)	Gluten index (%)
<i>milenka</i>	13.0	30.5	32.4	10.2	63.99
<i>bistra</i>	13.5	28.7	29.6	10.1	54.90
<i>lizinka</i>	15.3	31.7	37.5	12.4	54.82
<i>altana</i>	13.4	28.4	27.6	9.7	76.21
<i>mila</i>	13.7	28.5	28.7	9.9	58.91
<i>orovcanka</i>	14.0	32.6	31.2	11.1	64.75
<i>olga</i>	13.6	27.1	27.6	9.2	74.59
<i>agrounija prima</i>	13.4	26.7	34.4	11.7	49.01
<i>podobrena orovcanka</i>	15.1	39.6	34.5	11.9	66.80
<i>pelisterka</i>	14.4	31.4	34.2	11.5	52.23
<i>average</i>	13.9	30.5	31.8	10.7	61.40
LSD 0.05	1.43	5.80	5.35	0.95	16.50
LSD 0.01	n.s.	8.50	n.s.	n.s.	23.13

In a comparison of the overall protein content by years of both production systems, regardless of varieties, and depending on the applied agro-technical measures may say that in the system of organic production is greater than in the conventional system of production in the first and third year of the examination, and less in the second and fourth year.

The amount of total proteins depends on the conditions of the environment, applied agro-technical measures and geographical origin of the variety (Glamočlija [3]). Highest protein content in grain, in the conventional production, had variety *lizinka* (15.3%) and lowest (13.0%) variety *milenka*. In the organic wheat production the greatest content of protein in the grain had variety *lizinka* (14.8%) and lowest (12.5%) variety *agrounija prima*. According to Strazdina *et al.* [6] yields for varieties grown in the organic system of production was higher, but protein content was lower.

Table 2. Quality of wheat grain in organic production

Variety	Average values of conventional varieties in production for the period 2004-2008				
	Protein (%)	Sedimentation value (%)	Dry gluten (%)	Wet gluten (%)	Gluten index (%)
<i>milenka</i>	13.2	29.6	27.5	9.0	65.13
<i>bistra</i>	13.1	28.4	28.4	9.9	60.41
<i>lizinka</i>	14.8	32.5	34.4	11.1	64.60
<i>altana</i>	13.4	29.7	28.7	9.4	76.95
<i>mila</i>	13.2	25.1	30.2	10.1	53.87
<i>orovcanka</i>	13.8	28.4	27.7	9.7	88.78
<i>olga</i>	13.8	26.9	25.9	9.0	80.43
<i>agrounija prima</i>	12.5	20.9	21.1	7.2	61.77
<i>podobrena orovcanka</i>	13.9	35.2	30.1	10.4	81.05
<i>pelisterka</i>	13.2	27.0	27.3	8.9	60.89
<i>average</i>	13.2	28.3	28.1	9.4	69.34
LSD 0.05	1.03	20.4	0.14	n.s.	17.98
LSD 0.01	1.43	28.5	n.s.	n.s.	25.13

Sedimentation coefficient of wheat grain, produced in the conventional system of production, is 30.5% and 28.3% produced in the organic system of production. In conventional production, sedimentation value was the highest in the variety *podobrena orovchanka* (39,6 mL), and the lowest (26,7 mL) in the variety *agrounija prima*. In organic production, sedimentation value was the highest in the variety *podobrena orovcanka* (35,2 mL), and lowest (20,9 mL) in the variety *agrounija prima*. It can be concluded that the agro-technical measures applied in the system of organic production did not affected in a better way of increasing the volume of sedimentation volume at soft wheat because not fertilizing with nitrogen fertilizers in spring, decreased

sedimentation value of grain. Ivanovski *et al.* [5] concluded that sedimentation value of the tested 22 varieties of wheat is different and ranges from 31 mL at *agrounija* 50 mL in *pobeda*.

Grain at the organic produced wheat had a higher gluten index (69.34), than the grain in conventionally produced wheat (61.40). In a comparison of gluten index of the two systems of production, regardless of the years of production, varieties and climate conditions, and depending on the applied agro-technical measures, we can say that the gluten index in organic production (69.34) is greater absolute for 7.94 or relative for 12.93% of the gluten index in conventional production (61.40). In a comparison of gluten index by years of both production systems, regardless of varieties, and depending on the applied agro-technical measures may say that the gluten index in the system of organic production is higher in all years, than in the system of conventional production.

In a comparison of the content of wet gluten in the two systems of production, regardless of the years, varieties and climate conditions, and depending on the applied agro-technical measures, we can say that in conventional production (31.8%) is larger in absolute for 3,7% or in relative 13.17% to the content of wet gluten in organic production (28.1%).

In a comparison of the dry gluten content of the two systems of production, regardless of the years, varieties and climate conditions, and depending on the applied agro-technical measures, we can say that in conventional production (10.7%) is absolutely greater for 1,3% or relative to 13.83% of the dry gluten content in organic production (9.4%). It is due to different agro-technical measures which were applied, particularly with fertilizing with KAN 27% in the tillering growth stage of the wheat in the conventional system of production, a measure that was left in the system of organic production.

In a comparison of the dry gluten content by years of both production systems, we can say that the system of organic production is higher in the first and third year, and less in the second and fourth year of the conventional system of production. Such differences in the content of wet gluten between the two systems of production that occur during the same soil and climatic characteristics of the region, the year with the same genotypes are the result of the application of different agro-technical measures.

4. Conclusions

Based on four years of research (2004/05, 2005/06, 2006/07, 2007/08) of the chemical quality features of wheat varieties produced in conventional and organic production, the following conclusions can be made:

- Protein content in grain of wheat produced in the conventional system of production (13.9%) is higher for 0.7% absolute or relative to 5.30% of the protein content in grain in organic production (13.2%).
- Sedimentation coefficient, regardless of years of examination and genotypes, the wheat grain produced in the conventional system of production is 30.5% and 28.3% in organic.
- Gluten index in organic production (69.34) of wheat is increasing absolutely for 7.94 or relatively for 12.93% of the gluten index in conventional production (61.40).
- The percentage of wet gluten in wheat grain derived from conventional production (31.8%) is higher absolute for 3.7% or relative for 13.17% of the percentage of wet gluten in organic production (28.1%).
- In a comparison of the contents of dry wheat gluten in the two systems of cultivation, we concluded that in conventional production (10.7%) it is higher absolute for 1.3% or relative for 13.83% of the dry gluten content at organic wheat (9.4%). Certainly, it is due to different agro-technical measures which were applied, particularly with fertilizing with KAN 27% in the tillering growth stage of the wheat in the conventional system of production, a measure that was left in the system of organic production.
- Quality of wheat, especially the chemical composition of the grain is better for conventionally produced wheat. Also, we should take into account the specificity of the variety of the tested genotypes.

5. References

- [1] Ljubisavljević M. (1999). *Zrnasti proizvodi, opis, obim proizvodnje, hemiski sastav, kvalitet, zdravstvena ispravnost, promet, zakonska regulative*. Biblioteka "Nutrientia", Knjiga 5, Beograd.
- [2] Василевски Г. (2004). *Зрнести и клубенести култури*. Универзитетски учебник, Издавач Expresive graphics-Скопје.
- [3] Glemočlija Đ. (2004). *Posebno ratarstvo, žita i zrneve mahunarke*. Izdavačka kuća „Draganić“, Beograd.
- [4] Државен завод за статистика на Република Македонија (2000/07). *Полјоделство, овоштарство и лозарство, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007*. Статистички прегледи: Земјоделство. Скопје.
- [5] Ивановски М., Видевска Д., Јанкуловски Љ., Каменарска И. (2003). *Технолошки својства на сортите мека пченица од производната 2000/2001 година во Скопскиот реон*. Зборник на трудови. XXVIII средба „Факултет-стопанство“, стр. 75-89, Скопје.
- [6] Strazdina V., Bleidere M. (2004). *Cereal varieties for the organic farming in Latvia. Proceedings of the first World Conference on Organic Seed*. Challenges and Opportunities for Organic Agriculture and the Seed Industry, FAO Headquarters, Rome, Italy. pp.186-187.