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BREAD-MAKING QUALITY OF SLOVAK AND SERBIAN WHEAT VARIETIES

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ABSTRACT

The basic prerequisite for the production of bakery products of a good quality is the knowledge of the quality parameters of raw materials introduced in the production process and the ability to use their potential. The bread making properties of 17 pure European wheat cultivars were analysed. Baking experiments were carried out according to the methodology of the research workplace; 1000 g of flour was processed with the addition of salt, sugar and yeast. Fermentation for 35 minutes at 30 ° C was followed by the baking with steaming (at 240 ° C and then 220 ° C). During an experimental baking test the selected parameters: loaf volume (cm^3), specific loaf volume ($cm^3.100g^{-1}$ loaf), volume efficiency ($cm^3.100g^{-1}$ flour), cambering (loaf height/width ratio), bread yield (%), bread yield baking loss (%) in bread were evaluated.

Loaf volume has been considered as the most important criterion for the bread-making quality. In the analysed samples (11 varieties of Slovak origin and 6 varieties of Serbian origin), the value of this parameter ranged from 3575 cm3 to 5575 cm3 with higher values occurred in Slovak varieties (average 4 640.91 cm3) compared to the Serbian varieties (average 4 363.33 cm3). Based on the complex evaluation of wheat varieties of the Slovak and Serbian origin assessing the selected quality parameters of the baking experiment it can be concluded that in terms of baking quality the three Slovak varieties IS Ezopus, Bonavita and Jarissa were the best. Therefore, they are recommended for cultivation and their subsequent use in the baking industry, in particular for the production of bread According to a baking quality the evaluated varieties can be sorted from best to worst in the following order: IS Ezopus (SK) > Bonavita (SK) > Jarissa (SK) > IS Questor > Etida (SRB) > Venistar (SK) > Renesansa (SRB) > IS Conditor (SK) > IS Corvinus (SK) > Zvezdana (SRB) > Simonida (SRB) > Viglanka (SK) > IS Agape (SK) > NS 40S (SRB) > Panonnija (SRB) > IS Escoria (SK) > IS Gordius (SK).

Keywords: wheat, quality, bread-making test

INTRODUCTION

Wheat is the most important grain crop in the world. It is responsible for the development of the great bread-wheat civilizations from Mesopotamia to India, and China to Egypt, Greece and Rome, and then to our region (**Bonjean *et al.*, 2011**). Wheat is in terms of energy and nutrition the most valuable raw materials of plant origin and apart from the content of nutritionally important substances its indispensable technological features make it ideal to use for making bread and pastries. Therefore, the evaluation of selected parameters of technological quality is an important part of the comprehensive evaluation. Wheat as the most important bread crop is an essential source for human nutrition and of all cereals has the widest range of species and varieties. It belongs among the most growing products not only in Slovakia but also in Serbia, and in each of these countries (Slovakia, SRB) are around 130 varieties of *T. aestivum* registered.

Bread-making is one of mankind's oldest technologies and bread has been of immense nutritional and economic importance over several millennia (**Cauvain and Young, 2007**). Wheat is a principal cereal suitable for bread-making thanks to its baking properties, its valuable nutritional characteristics and chemical properties which allow due to expansion during fermentation to produce high volume bread loaves. This suitability is a result of the properties of the wheat proteins (**Moriss and Bryce, 2002**). Nowadays, the quality of raw material is the most important issues for bakers (**Rozylo and Laskowski, 2011***)*. The basic prerequisite for the production of quality bakery products is the knowledge of the quality parameters of raw materials introduced in the production process and the ability to correctly use their potential. Product quality also depends on the individual technological operations, which the raw materials go through until a final product is produced.

The cultivation of wheat with good bread-making quality is characterised by different types of genetic backgrounds in Eastern Europe. In many countries, the genetic basis of good bread-making quality was represented by improved landraces created through mass selection, or by the first primitive varieties (**Bedö *et al.* 1998**). Originally, thanks to a number of different soil and climatic conditions in the Slovak Republic, cultivation of wheat was based mainly on local varieties (landraces), but the genetic base has gradually expanded with the introduction of foreign varieties (Mironovskaja 808, Jubilejnaja or Iljičovka, Bezostaja etc.). The quality of Slovak-bred varieties is mainly represented by range of high molecular weight (HMW) glutenins especially 0; 7+9; 5+10 although there is a certain degree of variability in the case of Glu 1A and Glu 1B loci (**Nováček and Fučíková, 2011**). **Payne *et al.* (1987)** confirmed that the variation in the independently established bread-making qualities of evaluated set of varieties could be accounted for by variation in HMW subunits of glutenin.

The bread-making quality of wheat is affected by genotype selecting, growing treatments, their interactions and conditions of technological process (**Sabo and Pepo, 2007; Pepo *et al.* 2005**). The baking test is therefore the most useful test available for determining the practical value of a particular wheat flour sample (**Hampl *et al.*, 1981; Beleslin, 1988; Đaković, 1997).** It provides the most comprehensive assessment of the quality and impact of the used raw materials in terms of technological processes. Thanks to this test it is possible to evaluate all the raw materials, parameters and processes in the baking industry needed to have final products of good quality. From this perspective, the evaluation of wheat varieties with different origins using the baking experiment is considered to be an important aspect.

MATERIAL AND METHODS

In the framework of the research the following biological material was analysed - varieties of summer wheat (Triticum aestivum L.) - **Renesansa, Etida, NS 40S, Panonnija, Simonida, Zvezdana** originating from Serbia (samples were provided by the Institute of Field and Vegetable Crops from Novi Sad - Serbia, wheat was grown in Serbia), and summer wheat varieties originating from Slovakia - **IS Escoria, IS Corvinus, IS Agape, IS Ezopus, IS Questor, Bonavita, IS Gordius, IS Conditor, Venistar** (provided by the Central

Controlling and Testing Institute of Agriculture in the Slovak Republic, Solary) and Viglanka (provided by the Plant Production Research Centre Piešťany Piestany, Research and Breeding Station Vígľaš - Pstruša). For analysis the samples of flour obtained from a laboratory mill Quadrumat Senior by Brabender Oh G, Duisburg, Germany were used in determining milling quality (fraction I). From this fraction the baking experiment has been carried out according to the methodology of the research workplace. Experimental baking was realised under laboratory conditions from 1000 g of flour processed with the addition of salt, sugar and yeast in the laboratory kneading machine Diosna SP12 (programme – 10 seconds at 20 Hz, 120 seconds at 25 Hz and 300 seconds at 50 Hz). Fermentation in the electronically regulated deck oven with fermentation area (MIWE Condo) for 35 minutes at 30°C was followed by the baking with steaming (10 min at 240°C and then 25 min at 220°C). The dough for baking experiment was prepared according to the following recipe:
- water according to the water absorption capacity, so that the resulting farinograph dough consistency without the addition of yeast was 500 FU,
- addition of 2% of salt on weight of flour,
- addition of 4% of yeast on weight of flour,
- addition of 1% of sugar on weight of flour.

After cooling the following quality parameters were evaluated in the baked loaves: loaf volume (cm^3) by bread volume measurer OBK 2, MEZOS-SQ, Slovakia, specific loaf volume ($cm^3.100g^{-1}$ loaf), volume efficiency ($cm^3.100g^{-1}$ flour), cambering (loaf height/width ratio), water absorption capacity (%), bread yield (%), bread yield loss (%).

RESULTS AND DISCUSSION

Traditionally loaf volume has been considered as the most important criterion for the bread-making quality. Loaf volume is generally taken as the best single factor on which judgement is based (**Dencic *et al.*, 2013**). In the analysed samples the value of this parameter ranged from 3575 cm3 to 5575 cm3 (Figure 1), with higher values occurred in Slovak varieties (average 4 640.91 cm3) compared to the Serbian varieties (average 4 363.33 cm3). Product volume values were higher in Slovak varieties up by 6.36% (blue) in comparison to the Serbian varieties (red).

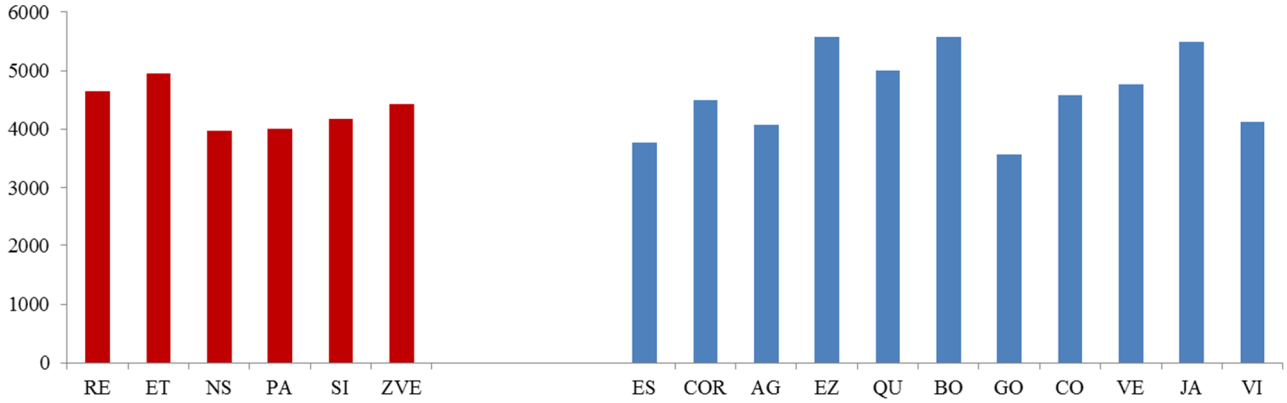

Figure 1 Loaf volume (cm^3)
Legend:
RE - Renesansa, ET - Etida, NS – NS 40S, PA - Panonnija, SI - Simonida, ZVE - Zvezdana (SRB),
ES - IS Escoria, COR - IS Corvinus, AG - IS Agape, EZ - IS Ezopus, QU - IS Questor, BO - Bonavita, GO – IS Gordius, CO - IS Conditor, VE - Venistar, JA - IS Jarissa, VI – Viglanka (SK).

Nevertheless, also among Serbian varieties were the ones whose loaf volume can be considered as good (Etida, Renesanca) with values a bit lower than the best Slovak varieties (IS Ezopus, Bonavita, Jarissa). The worst results were found in the Slovak varieties IS Escoria and IS Gordius.
In overall evaluation the largest loaf volume was found in samples **IS Ezopus** (SK) and **Bonavita** (SK) (5 575 cm^3), followed by (in descending order): **IS Jarissa** (SK) > **IS Questor** (SK) > **Etida** (SRB) > **Venistar** (SK) > **Renesansa** (SRB) > **IS Conditor** (SK) > **IS Corvinus** (SK) > **Zvezdana** (SRB) > **Simonida** (SRB) > **Viglanka** (SK) > **Is Agape** (SK) > **Panonnija** (SRB) > **NS 40S** (SRB) > **IS Escoria** (SK) > **IS Gordius** (SK).
The loaf volume shows a quantitative measurement of the baking performance and it is therefore the most important bread characteristic. Further parameters are the specific loaf volume, expressing loaf volume/loaf weight ratio and density, expressing loaf weight/loaf volume ratio (**Artan *et al.*, 2010**). The effect of different variety of flour on the specific loaf volume and density of the bread were investigated too. The value should be as high as possible, the value above 350 $cm^3.100g^{-1}$ is considered as "very good" (**Muchová, 2001**), and bread from flour made from **IS Bonavita** (SK), **Ezopus** (SK), IS **Jarissa** (SK) and **Etida** (SRB) belonged to this category. Flour giving products with the specific loaf volume 300 – 349 $cm^3.100g^{-1}$ is considered as „good". Samples from IS Queastor (SK), Venistar (SK), IS Conditor (SK), Renesansa (SRB), IS Corvinus (SK), Zvezdana (SRB) and Simonida (SRB) belonged to this category. Further samples were evaluated as „average" with values of the specific loaf volume between 210 – 299 $cm^3.100g^{-1}$ of the product. Higher values were obtained in Slovak varieties (average value 326.86 $cm^3.100g^{-1}$) in comparison to Serbian varieties (average value 311.29 $cm^3.100g^{-1}$). The average value of the specific loaf volume in Slovak varieties was higher by 5.0% than in Serbian ones (Figure 2).

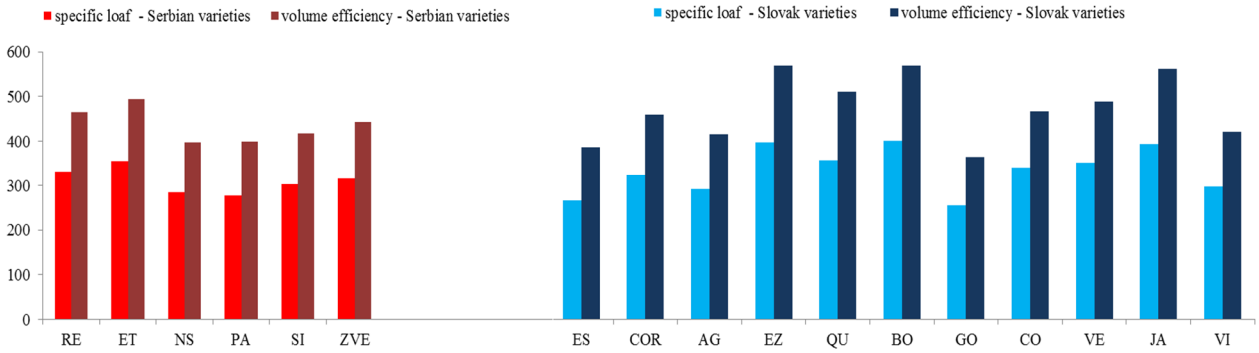

Figure 2 Specific loaf volume ($cm^3.100g^{-1}$ loaf) and volume efficiency ($cm^3.100g^{-1}$ flour),
Legend:
RE - Renesansa, ET - Etida, NS – NS 40S, PA - Panonnija, SI - Simonida, ZVE - Zvezdana (SRB),
ES - IS Escoria, COR - IS Corvinus, AG - IS Agape, EZ - IS Ezopus, QU - IS Questor, BO - Bonavita, GO – IS Gordius, CO - IS Conditor, VE - Venistar, JA - IS Jarissa, VI – Viglanka (SK).

Volume efficiency is a very important direct indicator of the baking quality. It represents the product volume produced from 100 g of flour. It is considered as a basic parameter to determine the quality of baked products (**Hampl *et al.*, 1981**). Concerning this parameter the best results were obtained for the following

varieties **IS Ezopus** (SK), **Bonavita** (SK), **IS Jarissa** (SK) and **IS Questor** (SK). The values reached over 500 $cm^3.100g^{-1}$ of flour (very good quality). Flours from varieties Etida (SRB), Venistar (SK), Renesansa (SRB), IS Corvinus (SK), IS Conditor (SK), Zvezdana (SRB), Simonida (SRB), Viglanka (SK), IS Agape (SK) and Panonnija (SRB) are flours of good quality. Remaining varieties (NS 40S, IS Ezopus, IS Gordius) produced loaves with low values of volume efficiency.

Cambering (loaf height/width ratio) shows the loaf height to width ratio of loaves baked in standard forms. Its higher value is desirable and predicts the product with better shape (**Bonafaccia *et al.*, 2003**). Ideally the loaf should have an arched shape, rounded at transition from the bottom to the upper crust, and have a high ratio of width to height. Flat shape indicates poor quality of flour and is the result of too much loose dough. Round shape indicates too rigid and short dough, poorly fermented. All evaluated samples had very good cambering (above 0.7) with average value of Slovak samples 2.86% higher than Serbian samples (Figure 3).

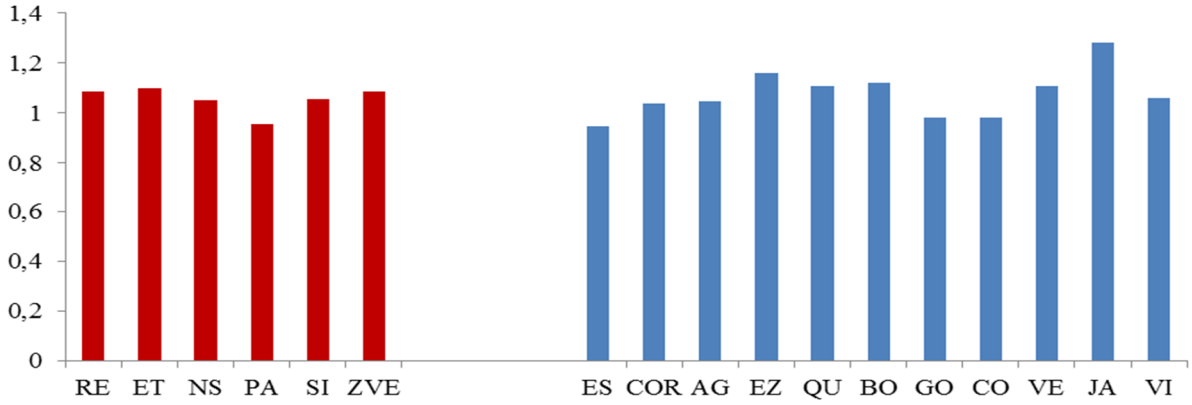

Figure 3 Cambering (loaf height/width ratio)
Legend:
RE - Renesansa, ET - Etida, NS – NS 40S, PA - Panonnija, SI - Simonida, ZVE - Zvezdana (SRB),
ES - IS Escoria, COR - IS Corvinus, AG - IS Agape, EZ - IS Ezopus, QU - IS Questor, BO - Bonavita, GO – IS Gordius, CO - IS Conditor, VE - Venistar, JA - IS Jarissa, VI – Viglanka (SK).

Water absorption is the amount of water required to make dough of proper consistency for bread baking when mixed to optimum conditions based on the feel and appearance of the dough (**Cauvin *et al.*, 2003, Puhr and D´Appolonia, 1992**). Water absorption is an important quality factor to the baker as it is related to the amount of bread that can be produced from a given weight of flour (**Koppel and Ingver, 2010**). Because water is one of the least expensive ingredients, bakers can increase bread yield by choosing a flour with a higher water absorption and, thus, increase profits. This is an important factor from an economic standpoint (**Puhr and D´Appolonia, 1992).** Since bread is sold by its weight, the results referring to the loss in the dough weight after mixing are very interesting (Table 1).

The highest water absorption capacity was obtained for the variety IS Ezopus (64%), the lowest for Venistar (53%). Higher average value of water absorption capacity was found for Serbian varieties by insignificant 2.78% in comparison to Slovak varieties.

Bread yield is one of the main performance indicators of production efficiency as it shows the consumption of the main raw material - flour. It shows how many weight portions are produced from 100 weight portions of flour with additives (**Bojňanská, 2004**). The bread yield values varied between 137.16% and 145.16%.

Bread yield losses during baking are caused by the loss of humidity evaporating during the process. Determining the actual baking losses is very important as the finished product after baking must have a defined weight. The loss by baking is influenced mainly by the weight of the product, by shape and moisture content. Average baking loss is at bread 9 – 12%, pastry 10 – 15% (**Puhr and D´Appolonia, 1992).** Baking losses were in all evaluated samples appropriate and there were found no significant differences (Table 1).

Based on the comprehensive evaluation of wheat varieties of the Slovak and Serbian origin during which the selected quality parameters of a baking experiment were assessed, it can be concluded that in terms of baking quality following three Slovak varieties were the best: **IS Ezopus, Bonavita** and **Jarissa**. Therefore, they are recommended for cultivation and their subsequent use in the baking industry, in particular for the production of bread. Figure 4 shows the obtained results.

Table 1 Selected parameters of bread making quality of *Triticum aestivum* L. evaluated samples

Variety	Water absorption capacity (%)	Bread yield (%)	Bread yield loss (%)
RENESANSA	61	140,14	13,46
ETIDA	61	138,89	13,40
NS40S	60	139,50	12,77
PANONNIJA	62	144,63	11,26
SIMONIDA	59	138,27	12,03
ZVEZDANA	62	140,11	12,38
IS ESCORIA	60	145,16	11,41
IS CORVINUS	58	142,10	12,23
IS AGAPE	60	142,44	12,15
IS EZOPUS	64	143,42	13,83
IS QUESTOR	62	142,99	13,99
BONAVITA	62	142,26	13,80
IS GORDIUS	59	143,57	11,01
IS CONDITOR	54	137,16	13,53
VENISTAR	53	138,39	13,08
IS JARISSA	61	143,00	12,86
VIGLANKA	58	142,26	11,75

Based on the baking quality evaluated varieties can be sorted from best to worst in the following order: **IS Ezopus (SK) > Bonavita (SK) > Jarissa (SK) > IS Questor > Etida (SRB) > Venistar (SK) > Renesansa (SRB) > IS Conditor (SK) > IS Corvinus (SK) > Zvezdana (SRB) > Simonida (SRB) > Viglanka (SK) > IS Agape (SK) > NS 40S (SRB) > Panonnija (SRB) > IS Escoria (SK) > IS Gordius (SK).**

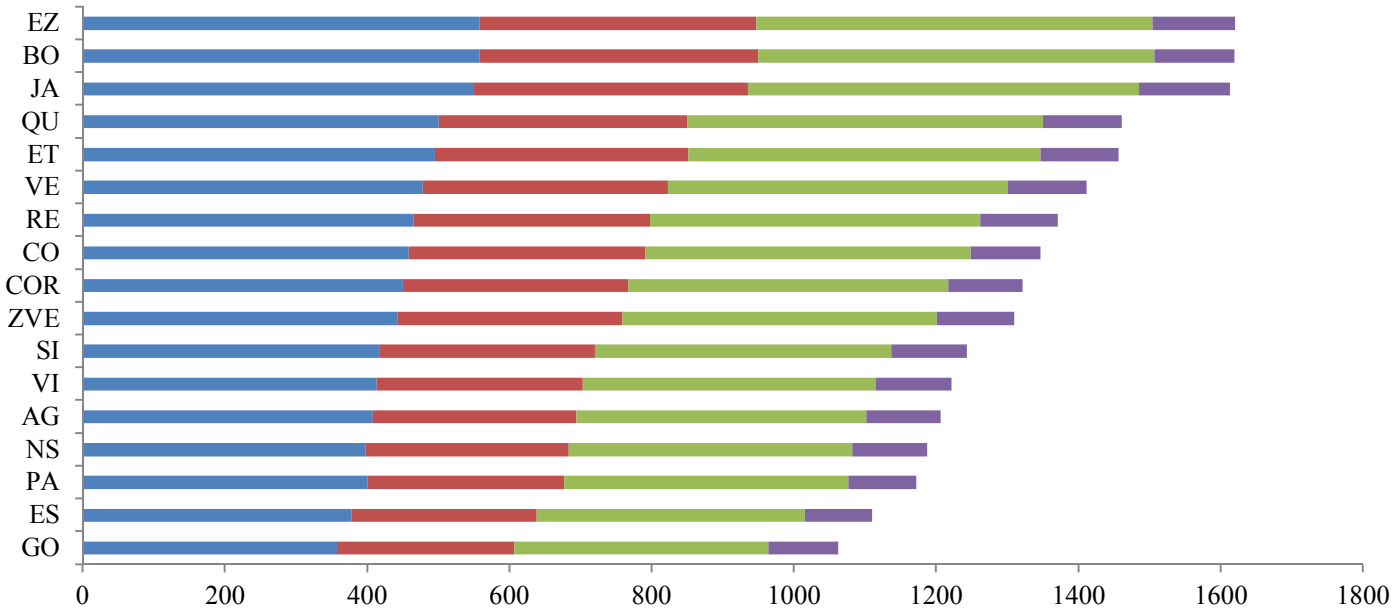

Figure 4 Baking quality of evaluated varieties (loaf volume + specific loaf volume + volume efficiency + cambering x 100)
Legend:
RE - Renesansa, ET - Etida, NS – NS 40S, PA - Panonnija, SI - Simonida, ZVE - Zvezdana (SRB),
ES - IS Escoria, COR - IS Corvinus, AG - IS Agape, EZ - IS Ezopus, QU - IS Questor, BO - Bonavita, GO – IS Gordius, CO - IS Conditor, VE - Venistar, JA - IS Jarissa, VI – Viglanka (SK).

Taking into consideration that the baking test is the direct indicator of the baking quality these parameters can be considered as the most important of all. Based on indirect indicators of milling quality IS Escoria (SK) and Panonnija (SRB) were rated as very good varieties (**Mocko *et al*., 2012),** however based on the results of our baking experiment they were evaluated as the worst. Based on indirect indicators of baking quality (N-substances, gluten and its properties, Zeleny sedimentation value) IS Questor was evaluated as the best variety **(Mocko *et al.* 2012).** This variety was rated as the fourth best within the framework of our baking experiment. The varieties evaluated as the best during the baking experiment did not show the best baking quality based on indirect indicators. It shows that indirect indicators should be only considered as indicative and the real suitability of wheat for baking use can be established only via baking experiment. As regards the comparison of Slovak and Serbian varieties, some Slovak varieties showed exceptional baking quality, but on the other hand, the worst results were also found in the Slovak varieties. Serbian varieties can be considered as of average quality but more balanced. The best Serbian variety was Etida and the worst Panonnija which was rather surprising taking into consideration the rheological parameters of the latter.

CONCLUSION

The baking experiment as the most important direct indicator of the wheat baking quality was carried out with samples of flour derived from new varieties of Slovak and Serbian origins. Based on the evaluation of the results it was found that there were large qualitative differences between the analysed samples. In general, varieties of Slovak origin can be considered to be slightly better with some varieties of excellent baking quality as well as some with poor baking quality. Serbian varieties can be considered as of average quality but more balanced.
In terms of baking quality the following Slovak varieties were the best: **IS Ezopus, Bonavita** a **Jarissa**. Therefore, they are recommended for cultivation and their subsequent use in the baking industry, in particular for the production of bread. The worst was the variety IS Gordius, also of Slovak origin.

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