ECOLOGICAL FARMING SYSTEM AND THE CULTIVATION OF PROTEIN-RICH CEREALS (*Triticum spelta* L.) IN THE CONDITIONS OF THE SLOVAK REPUBLIC

PESTOVANIE PŠENICE S VYSOKÝM OBSAHOM BIELKOVÍN (*Triticum spelta* L.) V EKOLOGICKOM POĽNOHOSPODÁRSTVE NA SLOVENSKU

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Abstract: *Spelt wheat is suitable for cultivation in ecological farming system. Rouquin variety was characterized by the highest yield and the best technological quality, other spelt varieties had gluten of lower quality. The nutritional value of spelt wheat was defined by high content of proteins, fibre and fat what predict spelt for use in the rational and special diet; also for preparation of biscuits and mixtures with common wheat.*

Abstrakt: *Pšenica špaldová je vhodná na pestovanie v ekologickom poľnohospodárstve. Odroda Rouquin sa vyznačovala najvyššou úrodou ako aj technologickou kvalitou. Kvalita ostatných hodnotených odrôd bola nižšia. Nutričná hodnota pšenice špaldovej bola charakterizovaná vysokým obsahom proteínov, vlákniny a tuk, čo ju predurčuje pre využitie v racionálnej a špeciálnej výžive, vo výrobe pečiva a zmesných múk s pšenicou potravinárskou.*

Key words**:** *spelt varieties, yield, gluten, quality, nutritional composition*
Kľúčové slová: *odrody pšenice špaldovej, úroda, kvalita lepku, nutričné zloženie*

INTODUCTION

High expansion of organic farming was detected during last years in Slovakia; total land area of organic farming in Slovakia overlapped 121 000ha (5.76%), of which the arable land area presents more than 36 000ha. The increasing demand by consumers for traditional products, the request for species suitable for growing in organic farming also in marginal areas and the need to preserve genetic diversity have renewed the attention towards the ancient species, *Triticum spelta* L.. The most obvious characteristic of spelt wheat is that, when threshed, the glume remains attached to the grain, thus, it has to be removed in an additional procedure. Nevertheless, the glumes bring some benefits; the grain is secured against diseases due to high portion of glumes. Furthermore, the yield of spelt is lower than that of modern bread wheat. The aim of this experiment was to evaluate the yield and quality of spelt wheat cultivated in conditions of the Slovak Republic and to recommend spelt wheat for further utilisation.

MATERIAL AND METHOD

The experimental base of the Faculty of Agrobioloy and Food Resources, Slovak Agricultural University in Nitra is situated at Dolná Malanta. Dolná Malanta belongs to warm agroclimatic region, arid subregion and to distinct of predominantly mild winter. Average air temperature is 16.4^0C and average annual precipitation is 532.5mm.

Five spelt varieties - Bauländer Spelz, Holstenkorn, Franckenkorn, Schwabenkorn and Rouquin- were used in our experiment. The field trial was realised during two vegetative periods (2004-2005) and was ordered into five independent blocks in three repetitions. The average plot size was $30m^2$ and the overall land area was $450m^2$. The soil cultivation was

realized at the experimental plots in order to create the suitable conditions for sowing and the following growth of the spelt wheat. Spelt wheat was cultivated in ecological system without fertilization. Production parameters (yield, weight of thousand grains, and the portion of glumes) were evaluated in three repetitions. The quality parameters were determined after dehulling of samples and evaluated according to valid standards. There were evaluated the content of wet gluten in %, Gluten index in %, extensibility in cm, swelling in ml, Zeleny test in ml, proteins, starch, fibre, sugars and fat in per cent. The achieved results were statistically analysed by using the ANOVA, LSD test and correlation.

RESULTS AND DISSCUSION

The differences between yields of spelt varieties were not significant. The highest yield (7.21t.ha^{-1}) was detected in Rouquin variety, which was characterized also by the lowest portion of glumes. The lowest yield was detected in Schwabenkorn variety, which was originated by selection of old spelt varieties. This variety was characterised by significant lowest WTG. Positive correlation (r = +0.67) indicated high influence of WTG on the yield of spelt wheat. There was also detected positive relation according to yield formation; the higher was the WTG the lower was the portion of glumes (r = -0.55). According to this results, we could say that higher amount of nitrogen was accumulated into the grain.

Some authors (Dotlačil, 2002; Bradova 2005) show higher weight of thousand grains as well as in our case (except of Schwabenkorn).

Table 1

The production parameters and the yield of spelt wheat varieties

Variety	WTG (g)	Yield (t.ha^{-1})	Portion of glumes (%)
Holstenkorn	52.67 b	6.04 a	29.94 ab
Franckenkorn	54.58 b	6.74 a	27.84 ab
Rouquin	53.90 b	7.21 a	27.04 a
Schwabenkorn	47.97 a	5.85 a	30.03 ab
Bauländer Spelz	52.83 b	6.30 a	30.72 b

The basic parameter of the technological quality of wheat is the wet gluten, where it's required minimal content is 27%. The content of wet gluten in spelt wheat ranged from 31.03% to 39.50% (fig. 1). Rouquin variety which is the crossbreed of *Triticum spelta* and *Triticum aestivum* was characterised by the highest quality as compared to other spelt varieties. It could be predicted that the *Triticum aestivum* L. genome influenced the quality of this variety. Franckenkorn variety contains 1/6 of *Triticum aestivum* genome, which indirect influenced the lower content of proteins; but the genome of spelt wheat is characterised by high content of wet gluten of very low quality. The content of proteins and wet gluten of typical spelt wheat variety (Schwabenkorn) were significant the highest but the gluten quality was lower. However, there is a relationship between Holstenkorn and Bauländer Spelz (one of the parents of Holstenkorn) the content and quality of wet gluten was different in both varieties.

On the basis of correlation analysis, we can predict that the higher was the content of proteins and wet gluten the lower was the gluten quality. The lower Zeleny value of spelt showed probable low gluten strength of the flour (Oliviera *et al*., 2000). This result is in agreement with other author (Winzeler, 1990) who found that spelt has lower Zeleny values compared to wheat. The sedimentation was significantly influenced by the amount of gluten (r = +0.59), the lower quality of wet gluten was detected due to higher sedimentation (Zeleny test), but it was not significant. Also the gluten was more flowable when the sedimentation was higher (r = -0.63), we can say that, the values of this indicator are mostly influenced by the amount of wet gluten.

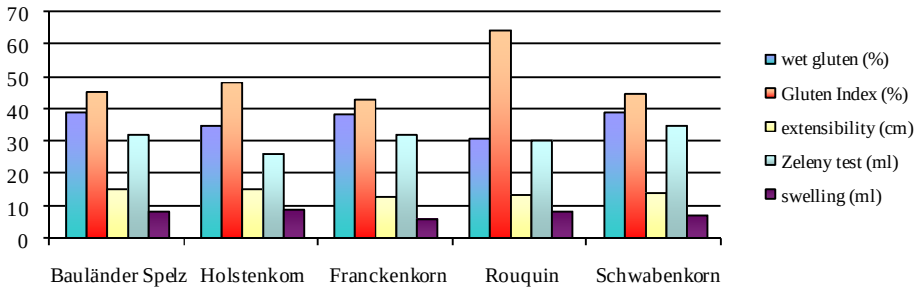

Figure1. The content and quality of wet gluten

Belitz (1989) indicated good baking properties of Rouquin and Gálova *et al.* (2001) presented the highest technological quality in Schwabenkorn.

The average content of proteins was 16.3% (tab.2), the highest was in Schwabenkorn (18.55%), however Marquez (2007) detected in spelt wheat only 11.8% of proteins it was still higher amount than in common wheat. Bonafaccia *et al.* (2000) shows high content of proteins and fibre (do 2%). Moudrý and Dvořáček (1997) compared chemical composition of spelt wheat grain with grain of *Triticum aestivum* and they found out that higher content of proteins, fibre a minerals is influenced by genotype. Fibre prebiotic influence on the gastrointestinal tract increases the absorption of minerals. The highest content of fibre was detected in Bauländer Spelz. The content of starch was more than 60% in all varieties (tab. 2). Protein-saccharine complex forms the dough structure and is the main source of sugars which are important for baking applications.

Lacko-Bartošová *et al.* (2001) shows more than 2% of fat, what was confirmed with our analyses too. Čertík (2006) detected 1.7% of fat. Ruibal-Mendieta (2002) also hypothesised, that lipid content of the aleuronic layer (also a lipid-rich fraction of the grain) could be higher than that of wheat. The highest content of fat was in Holstenkorn, which was defined by almost the lowest content of fibre, sugars and proteins. Bauländer Spelz variety contained most fibre, sugars but least starch. Correlation confirmed that the higher was the content of fibre; the lower was content of starch. Genetically pure varieties of spelt wheat, (without *Triticum aestivum* L. genome) were characterised by lower yields, high content of wet gluten of lower quality. Those varieties were typical with the highest portion of proteins, fibre and sugars.

Table 2

Nutritional quality of spelt wheat

Variety	Proteins (%)	Fat (%)	Fibre (%)	Starch (%)
Bauländer Spelz	17.55 c	2.07 a	1.40 b	61.31 a
Schwabenkorn	18.55 d	2.19 a	1.12 ab	63.12 ab
Holstenkorn	15.62 b	2.58 b	0.95 a	64.60 b
Franckenkorn	14.88 a	2.36 ab	1.28 ab	63.06 ab
Rouquin	14.80 a	2.03 a	0.94 a	65.25 b
Average	16.28	2.25	1.14	63.47

On the basis of scientific literature and realised analysis it could be said that all evaluated varieties are suitable for cultivation in ecological farming and for the production of special cereal products.

CONCLUSIONS

The conditions of cultivation in organic farming of the Slovak republic are suitable for all evaluated spelt varieties. The best yield and production parameters were detected in Rouquin variety, which is a crossbreed of spelt and common wheat. Typical spelt varieties were characterised by high content of wet gluten of lower quality, what is in accordance with findings of many authors. On the basis of analysis of technological quality, the best results for bread-making were detected in Rouquin. However in old spelt varieties was the nutritional quality higher. In conclusion, we recommend mixing genetically pure spelt varieties of higher nutritional quality with crossbreeds of common wheat of higher technological quality or with common wheat; it could have better bread-making and nutritional quality.

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