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BIOCHEMICAL CHARACTERISTICS OF FIVE SPELT WHEAT CULTIVARS (TRITICUM SPELTA L.)

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Summary

Five winter spelt cultivars Bauländer Spelz, Franckenkorn, Holstenkorn, Rouquin, Schwabenkorn and one common winter wheat variety Samanta were analysed. The wheats were grown in 1998/99 growing season, without fertilization and any chemical treatments. Composition of amino acids, hydrolytic enzymes and storage proteins in wheat flour and HMW glutenin subunits in wheat grains was traced. Values for amino acids ranged comparable in both spelt and common wheats. Values for alfa-amylase, endoproteases and exoproteases ranged in the normal physiological limits for full mature grains. Lower spelt wheat value for alfa-amylase and endoproteases activities refer to the higher sprouting resistance of analysed cultivars. The highest technological quality presented cultivar Schwabenkorn. No of analysed spelt wheat cultivars were homogeneous in the HMW glutenin subunits composition.

Key words**:** amino acids, enzymes, storage proteins, SDS-PAGE, *Triticum spelta L.*

Introduction

Wheat is the most widely grown crop in the word because of its unique protein characteristics. While most of the world wheat crop arises from production of common and durum cultivars, there is increasing interest in ancient wheat species, especially spelt (*Triticum spelta L.*) ones, particularly with regard to use in special bakery products, heatlth and organic foods.
Spelt wheat shows a higher resistance to enviromental influences than common wheat. This currently has limited use, except as animal feed, because of the retention of hulls on the grain after threshing (Vlasák, 1995). After dehulling, the grains are promoted as being more nutritious than current commercial species and potentially nonallergenic. It is reported to have a unique flavour and high vitamin content. Spelt wheat is a coeliac-toxic cereal and has to be avoided by coeliac patients (Forssell et.al., 1995).
The objective of the present study was to evaluate the amino acids, enzymes and storage proteins composition of five winter spelt wheat and one comparative common winter wheat.

Material and methods

The accessions evaluated in this study were five winter spelt cultivars Bauländer Spelz, Franckenkorn, Holstenkorn, Rouquin, Schwabenkorn and one common winter wheat variety Samanta. The wheats were grown in 1998/99 growing season, without fertilization and any chemical treatments. Flour samples were analysed by standard AACC procedures for moisture and crude protein was extracted using condidtions of Osborne extraction methods (Chen et.al, 1970). Alfa – amylase (Kruger, 1972, Spofa test, Slovakofarma a.s. Hlohovec, Slovak Republic, Bradford, 1978), exoproteases (Preston, 1978, Whitaker et.al, 1980) and endoproteases (Preston, 1978, Bradford, 1976) were quantified. Amino acids content was determined by hydrolyzing flour samples in 6 mol/l HCl and analysed on T339 M automatic amino acid analyzer.
For identification and characterization of wheat varieties the standard vertical discontinuous electrophoretic reference method by ISTA organization was applied (Wrigley, 1992). Glutenin wheat proteins were extracted from individually ground kernels and separated on 10% polyacrylamide gels in the presence of SDS. The gels were stained with Coomassie Brilliant Blue solution and destained with de-ionized destilled water. The stained bands were qualified by scanning densitometry (LD-01 Instrument).

Table 1 Storage proteins composition of flours of five winter spelt cultivars and one winter wheat variety

Cultivar	Proteins[a] (%)	Proteins fractions[b] (%)				Gli+Glu [c] (%)	Gli/Glu
		Alb+Glo[d]	Gliadins	Glutenins	Residue		
Bauländer Spelz	10.40	24.62	35.69	32.29	7.40	67.98	1.11
Franckenkorn	10.40	27.78	35.48	29.32	7.42	64.80	1.21
Holstenkorn	9.91	26.03	37.39	27.65	8.93	65.04	1.35
Rouquin	9.75	27.41	36.29	28.06	8.24	64.35	1.29
Schwabenkorn	10.48	23.23	39.15	31.52	6.10	70.67	1.24
Samanta	9.12	25.85	33.98	30.08	10.09	64.06	1.13

[a] % of dry basis, [b] % of flour proteins, [c] Gliadins and glutenins, [d] albumins and globulins

Results and discussion

The results from the analyses of the storage protein composition of flours of analysed spelt wheat cultivars with the comparison to common wheat cultivars are given in Table 1. There exist differences in the content of total proteins between varieties. The highest content of proteins was determined by cultivar Schwabenkorn (10.48%) and the lowest one showed Samanta (9.12%). The content of protoplasmatic proteins – albumins and globulins, varied from 23.23% (Schwabenkonr) to 27.78% (Franckenkorn). Some differencies were established in the content of gliadins and glutenins too. Generally we can say, that the highest technological quality presented cultivar Schwabenkorn, which showed 70.67% content of storage proteins.

Table 2 Amino acids composition of flour proteins of five analysed winter spelt cultivars and one winter wheat variety.

Cultivar	Bauländer Spelz		Francken-Korn		Holsten-korn		Rouquin		Schwaben-korn		Samanta	
Amino acids	mg/g[a]	(%)[b]	mg/g[a]	(%)[b]	mg/g[a]	(%)[b]	mg/g[a]	(%)[b]	Mg/g[a]	(%)[b]	mg/g[a]	(%)[b]
Asp	6.31	4.47	6.02	4.44	6.45	4.61	5.11	3.94	6.39	4.87	6.25	5.73
Thr	3.80	2.69	3.69	2.72	4.01	2.87	3.58	2.76	3.68	2.81	2.64	2.42
Ser	6.54	4.63	6.48	4.78	6.37	4.55	6.14	4.73	6.02	4.58	5.05	4.63
Glu	50.42	35.72	47.14	34.77	50.17	35.84	45.68	35.20	46.60	35.50	38.25	35.07
Pro	18.34	12.99	18.39	13.56	16.84	12.03	17.82	13.73	16.24	12.37	14.14	12.96
Gly	5.42	3.84	5.32	3.92	5.30	3.79	4.97	3.83	4.88	3.72	3.84	3.52
Ala	4.99	3.54	4.73	3.49	5.12	3.66	4.59	3.54	5.01	3.82	3.51	3.22
Val	5.72	4.05	5.62	4.14	5.97	4.27	5.38	4.14	5.76	4.39	4.60	4.21
Ilu	4.45	3.15	4.40	3.25	4.70	3.36	4.27	3.29	4.69	3.57	3.79	3.47
Leu	9.71	6.88	9.29	6.85	9.96	7.12	8.77	6.76	9.28	7.07	7.14	6.55
Tyr	5.01	3.55	4.79	3.53	4.86	3.47	4.80	3.70	4.46	3.40	3.23	2.96
Phe	6.37	4.51	6.47	4.77	5.94	4.25	6.03	4.64	5.83	4.44	5.11	4.69
His	3.45	2.44	3.67	2.70	3.73	2.67	3.12	2.40	3.20	2.44	2.44	2.24
Lys	3.77	2.67	3.64	2.68	3.77	2.69	3.42	2.63	3.49	2.66	3.58	3.28
Arg	6.89	4.88	5.96	4.40	6,78	4.84	6.10	4.70	5.77	4.39	5.51	5.05
total	141.2	100.0	135.6	100.0	140.0	100.0	129.8	100.0	131.3	100.0	109.1	100.0

[a] mg/g of dry basis, [b] % of flour proteins,

Values for amino acids ranged comparable in analysed spelt and common wheat (Table 2). Cultivar did not affect their content significantly. Some small differences were determined in the arginine, asparagic acid, valine, leucine, tyrozine, arginine. Values for lysine, the most limiting amino acid in the Triticum spesies ranged widely from 2,63 % to 3,28 %. This content corresponds to literature infomation (Michalík, 1992).

Hydrolytic enzymes, alfa-amylases, endoproteases and exoproteases are the first enzymes which are activated in the germinating wheat grains. This enzymes is becoming important from the technological aspects. The high activity of them has negative influence on the baking properties. Value for hydrolytic enzymes ranged in the normal physiological limits for full mature grains. Lower spelt wheat values for alfa-amylase and endoproteases activities refers to the higher sprouting resistance of analysed cultivars (Table 3).

Every cultivar breadmaking quality qualitative biochemical analysisi presents the specification of the basic biochemical cultivar characteristics – the determination of the individual HMW glutenin subunits composition and the Glu-score calculation (Table 4). The evaluation of the 100 individual grains analysis obtained electrophoreograms showed that the common comparative cultivar Samanta is homologeneous, with 0, 7+8, 5+10 HMW glutenin subunits and the value Glu-score 8. No one of analysed spelt wheat cultivars are homogeneous. Three or four, respectively, electrophoretical profiles groups with a different HMW glutenin subunits composition were determined by all of them.

Table 3 Activity of enzymes in the winter spelt and winter wheat grain cultivars.

Cultivar / Enzymes	Baulän-der Spelz[a]	Franc-kenkorn[a]	Holsten-korn[a]	Rou-quin[a]	Schwa-benkorn[a]	Saman-ta[b]
α-amylase (μkat/g)	1.31	0.70	0.57	0.69	0.80	1.80
Exoproteases (U/mg.100)	0.00	0.00	0.00	0.00	0.00	0.00
Endoproteases (U/mg.100)	13.79	14.34	12.76	11.05	13.37	19.32

[a] *Triticum spelta* L., [b] *Triticum aestivum* L.

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EFFECT OF N-NUTRITION ON GAS EXCHANGE CHARACTERISTICS OF WHEAT (*TRITICUM AESTIVUM* L.)

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Summary

Wheat plants grown under two N-nutritional regimes were used to determine the effect of N-nutrition on the regulation of $C0_2$ assimilation rate (A) and stomatal limitation to A under drought stress. Drought stress reduced leaf water potential (-0.5 to -1.92 MPa) and A (23 to 0
μmol.m^{-2}.s^{-1}). Gas-exchange measurements indicated greater sensitivity high-N plants compared to low-N plants as water stress developed. Daily range of stomatal related changes was greater in high-N plants, as well. WUE was changing with increasing water limitation. Osmotic effect of N-nutrition was mediated by increasing concentration of prolin during the water stress.

***Key words*: winter wheat, N-nutrition, gas exchange, water stress

Introduction

Both stomatal and metabolic factors have been shown to limit gas exchange rates in lives (Lawlor, 1995, Cornic, Massacci, 1996). Water limitation and N-nutrition has numerous effects on photosynthesis. While physiological responses of plants to either water stress or N nutrition have been extensively investigated, the interaction of these two factors has received little attention (Morgan, 1984). N-nutrition has both the nutritional and osmotic effect in plants (McIntyre, 1997). Osmotic effect of N via amino acids, mainly prolin is known (Kameli, Lösel, 1993). In two experiments the effect of N-nutrition on photosynthesis and water regimes were investigated.

Material and methods

Two experiments were done. Plants of wheat (*Triticum aestivum* L. cv. Samanta) were grown in 15 1 containers containing a soil substrate. No N-fertiliser was supplied to low-N plants. High-N plants have two nitrate treatments (1gN/SkgSoil): first before sowing, second at the end of tillering. Plants grown outdoors were placed in the glasshouse to be drought stressed just before anthesis.