GRAIN QUALITY OF SPRING WHEAT VARIETIES

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ABSTRACT

Spring wheat is main crop of Mongolia and sown more 90% of agricultural planting area. Total wheat production of Mongolia are increasing gradually, but out of strong and valuable wheat for bread and flour production. Main case of providing sustainable wheat production are develop and widely cultivate strong and valuable wheat varieties resistant to abiotic stresses, with high yield and good quality. Spring wheat varieties by HMW-GS loci were similar, but variety Darkhan-166 /Arvin/ was more than others varieties. Wheat varieties Darkhan-144, KP-547-12, Darkhan-131, Darkhan-144 and KP-561-12 have a high 1000 grain weight (41.5-44.8 g). Spring wheat varieties KP-547-12, Darkhan-131 and KP-561-12 have a high dry gluten content (13.1-14.2%). Water absorption of spring wheat varieties were 61-62% and by this parameters Darkhan-131, Darkhan-166 and KP-547-12 varieties were a high. Dough development time of wheat varieties were 8-13 мин and Darkhan-131, Darkhan-166, Darkhan-172 and KP-547-12 varieties have a high flour power. Wheat varieties Darkhan-131 and KP-547-12 have a high dough energy (828.8-857.2 g.mm).

KEY WORDS: quality, wheat, dough, electrophoresis, absorption, extensibility, cluster

INTRODUCTION

Strategy foods of Mongolia are meat, milk, cereals seed, wheat, flour and drinking water. Spring wheat is main crop of Mongolia and sown more 90% of agricultural planting area. Total wheat production of Mongolia are increasing gradually, but out of strong and valuable wheat for bread and flour production.

For improvement this situation importance need to develop new variety with a high yield and a good quality. Only putting a quality control in all stage of plant breeding, variety test and registry possible develop variety with good quality.

Main case of providing sustainable wheat production are develop and widely cultivate strong and valuable wheat varieties resistant to abiotic stresses, with high yield and good quality.

Thus, study technological quality of new wheat varieties ever really important. Accordingly proper to analyze quality of new wheat varieties by seed storage proteins, evaluate quality of dough and identify correlation between quality parameters.

MATERIALS AND METHODS

Plant materials
This study was conducted in a laboratory at the Department of Crop Sciences, BOKU University, Vienna, Austria during 2014. For the electrophoretic analyses of HMW-GS samples of kernels of ten registered spring wheat varieties and genotypes (Darkhan-106, Darkhan-131, Darkhan-141, Darkhan-144, Darkhan-166 (Arvin), Darkhan-172, Darkhan-175, Darkhan-196, Darkhan-210, KP-547-12 and KP-561-12) were used.
Electrophoresis
Glutenins were extracted from single crushed wheat kernels, using the procedures of Singh et al. (1991). Proteins were fractionated by one-dimensional sodium dodecyl sulphate polyacrylamide gel electrophoresis (SDS-PAGE) using the Laemmli buffer system (Laemmli 1970). The acrylamide / bisacrylamide concentration (T), and the cross linker (C) were used as follows: T = 8% and C = 1.28%. Electrophoresis was performed at a constant current of 30 mA/gel, at 10°C, for the time required for the tracking marker dye to migrate off the gel. Protein in the gels were fixed for 1 hour with 10% (w/v) trichloroacetic acid solution; and subsequently stained with 0.5% (w/v) Coomassie Brilliant Blue R-250 solution, 25% (v/v) methanol, and 10% (v/v) acetic acid. De-staining was carried out with running water.
Nomenclature
The bands of HMW-GS were read, using the nomenclature described by Payne and Lawrence (1983).
Dough characteristics
Dough mixing characteristics were determined on 10 g flour samples using a Promylograph T3 apparatus (Max Egger, St. Blasen, Austria). Dough extension tests on a micro-scale were performed using a TA.XT2i texture analyzer (Stable Micro Systems Ltd., Godalming, Surrey, UK) equipped with the Kieffer dough and gluten extensibility rig (Smewing, 1995). Analysis of the extension curves was carried out as described by Grausgruber et al. (2002) with the modification that dough was mixed to optimal consistency by the Promylograph apparatus.
Statistical analyses
Statistical analyses were performed with the STAR (Statistical Tool for Agricultural Research), Vers. 2.0.1

RESULTS

HMW subunits of wheat glutenin are major components of the elastomeric polymers that underpin bread making and other food uses (Shewry *et al*., 1995).

Spring wheat varieties by HMW-GS loci were similar, but variety Darkhan-166 /Arvin/ was more than others varieties (Table 1).
Wheat varieties Darkhan-144, KP-547-12, Darkhan-131, Darkhan-144 and KP-561-12 have a high 1000 grain weight (41.5-44.8 g).

Table 1
Seed storage proteins, gluten content and agronomic traits of spring wheat varieties

No	Spring wheat varieties	HMW-GS electrophoresis (Paine score)	Agronomic traits		Gluten content	
			1000 grain weight (g)	Seed plumpness >2.8 mm (%)	Wet gluten (%)	Dry gluten (%)
1	Darkhan-131	7	41.7	56.7	39.7	13.4
2	Darkhan-141	7	35.8	48.6	38.4	12.7
3	Darkhan-144	7	41.5	24.9	38.9	12.8
4	Darkhan-166	8	36.9	8.4	35.3	11.6
5	Darkhan-172	7	37.8	50.8	35.8	12.1
6	Darkhan-175	7	34.9	43.5	38.4	12.7
7	Darkhan-196	7	33.3	50.6	36.2	11.8
8	Darkhan-210	7	35.3	20.7	32.1	11.7
9	KP-547-12	7	41.5	20.2	38.1	13.1
10	KP-561-12	7	44.8	33.3	45.2	14.2

Seed plumpness of spring wheat varieties Darkhan-196, Darkhan-172 and Darkhan-131 were 50.6-56.7%. Spring wheat varieties KP-547-12, Darkhan-131 and KP-561-12 have a high dry gluten content (13.1-14.2%).

Water absorption of spring wheat varieties were 61-62% and by this parameters Darkhan-131, Darkhan-166 and KP-547-12 varieties were a high (Table 2).

Table 2

Dough characteristics of spring wheat varieties

No.	Spring wheat varieties	Promylograph T3 Viscosimeter (Farinograph)						SMS Kieffer Dough Extensibility (Extensograph)		
		Water absorption (%)	Maximum resistance (PU)	Dough development time (min)	Dough stability (min)	Quality number (min)	Curve lenght (min)	Maximum resistance of dough (g)	Dough extensibility (mm)	Dough energy (g.mm)
1	Darkhan-131	62.0	575	9	11	20	34	12.7	87.8	857.2
2	Darkhan-141	61.0	535	9	9	18	27	10.1	71.6	619.5
3	Darkhan-144	61.0	615	10	9	15	26	10.7	69.0	582.9
4	Darkhan-166	61.8	585	11	11	17	67	13.4	72.8	746.8
5	Darkhan-172	61.0	600	10	13	22	45	13.0	81.1	798.3
6	Darkhan-175	61.5	575	10	9	14	26	9.4	57.3	496.3
7	Darkhan-196	61.0	580	9	8	15	24	9.8	33.4	289.4
8	Darkhan-210	61.0	500	7	10	20	25	12.7	74.1	755.1
9	KP-547-12	62.0	580	8	13	20	44	14.3	77.7	828.8
10	KP-561-12	61.0	510	7	10	20	33	11.3	50.6	432.5

Dough development time of wheat varieties were 8-13 мин and Darkhan-131, Darkhan-166, Darkhan-172 and KP-547-12 varieties have a high flour power.

Wheat varieties Darkhan-131 and KP-547-12 have a high dough energy (828.8-857.2 g.mm)

The strongest relations were detected to seed storage proteins and curve length (r=0.83). The medium relations were detected to seed storage proteins and water absorption (r=0.38), water absorption between dough stability (r=0.44), curve length (r=0.53) and dough energy (r=0.53), dough stability between curve lenght (r=0.63) and dough energy (r=0.43), curve lenght to dough energy (r=0.41).

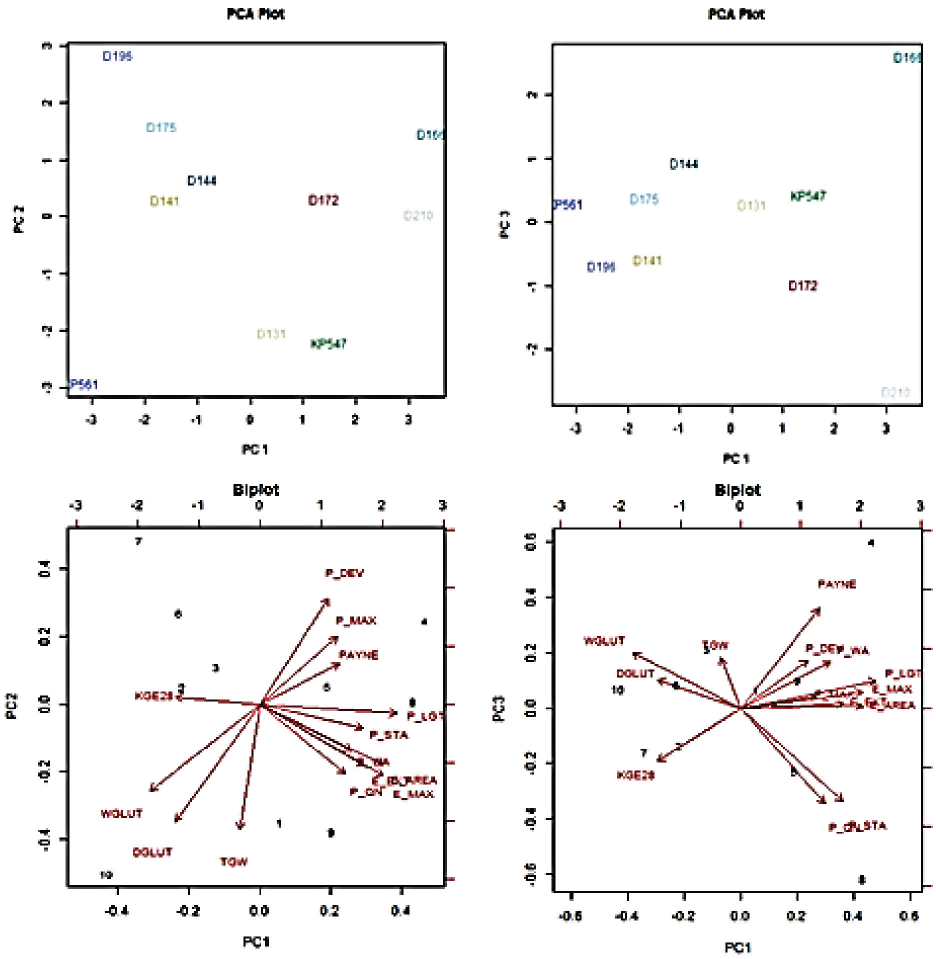
PCA revealed four principal components with an eigenvalue >1; PC1 and PC2 explained together 63.6% of total variation; first three PCs explain 77.1% and first four PCs 87.5% /Table 3, Picture 1/.

Table 3

Principal component analysis

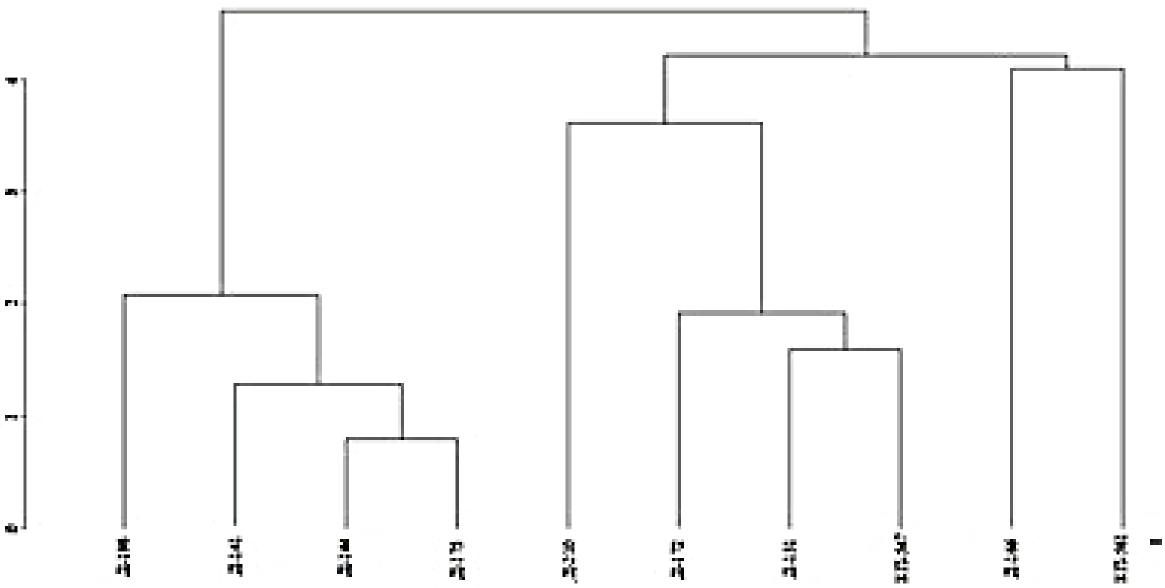
Statistics	PC1	PC2	PC3	PC4	PC5	PC6
Standard deviation	2.3363	1.8547	1.3749	1.2102	0.8364	0.7585
Proportion of Variance	0.3899	0.2457	0.1350	0.1046	0.0500	0.0411
Cumulative Proportion	**0.3899**	**0.6356**	**0.7706**	**0.8752**	0.9252	0.9663
Eigen Values	5.4583	3.4398	1.8904	1.4645	0.6996	0.5753

Biplot of PC1 vs PC2 and PC1 vs PC3 showing the position of the individual wheat samples (top) and the influence of the different quality traits (bottom).



Picture 1. Principal component analysis (PCA)

Cluster analysis of the first four PC scores reveals three clusters: (I) Darkhan-141, Darkhan-144, Darkhan-175 and Darkhan-196; (II) Darkhan-131, Darkhan-172, Darkhan-210 and KP-547; (III) Darkhan-166 and KP-561 /Picture 2/.



Picture 2. Dendrogramme of cluster analysis.

DISCUSSION

Researchers reported to evaluate grain quality importance wheat seed storage proteins, especially HMW-GS loci. Results of this study shown the strongest relations between seed storage proteins and curve length (r=0.83).

Payne *et al.* (1987) discovered a correlation between the presence of certain HMW-GS and gluten strength, measured by the SDS-sedimentation volume test. Grain gluten storage proteins associated with dough elasticity (Shewry *et. al,* 1997).

Therefore, we are possible detect lines with a good quality by seed storage proteins in early stage of wheat breeding.

CONCLUSION

1. Spring wheat varieties by HMW-GS loci were similar, but variety Darkhan-166 /Arvin/ was more than others varieties
2. Spring wheat varieties Darkhan-131, Darkhan-166 /Arvin/, Darkhan-172, Darkhan-175 and KP-561-12 have a high water absorption, flour power and dough energy.
3. Correlation analysis confirmed the important role of the seed storage protein for food wheat processing and final end-use. The strongest relations were identified to curve length (r=0.83). medium relations were detected to seed storage proteins and water absorption (r=0.38), water absorption between dough stability (r=0.44), curve length (r=0.53) and dough energy (r=0.53), dough stability between curve lenght (r=0.63) and dough energy (r=0.43), curve lenght to dough energy (r=0.41).
4. Spring wheat varieties Darkhan-166 /Arvin/ and KP-561-12 have a good grain quality by the PCA and cluster analysis

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