Agrár- és Vidékfejlesztési Szemle 2011. vol. 6. (1) supplement
„TRADITIONS, INNOVATION, SUSTAINABILITY"
Hódmezővásárhely, 5th May 2011 Conference CD issue ISSN 1788-5345

DOUGH REOLOGICAL AND KERNEL HARDNESS INVESTIGATION ON DIFFERENT HUNGARIAN WINTER WHEAT VARIETIES

SZABÓ, P. B.

University of Szeged, Faculty of Engineering, 6724 Mars square 7. Szeged, Hungary
e-mail: szpb@mk.u-szeged.hu

ABSTRACT - Dough reological and kernel hardness investigation on different Hungarian winter wheat varieties
The aim of this research was the investigation of winter wheat varieties, the kernel hardness and the dough features. We determined the kernel hardness with two dynamic methods. We measured the parameters of flour. The correlations among hardness index and the examined flour parameters were also significant (r=0.816-0.876). We found strong correlation between the grinding energy (e_g) and water absorption (r=0.878) of the flour. Hardness index – wet gluten (r=0.833), and hardness index – water absorption (r=0.876), hardness index – P value of alveograph (r=0.816) showed also positive correlations. We found correlation the water absorption and P value of alveograph (r=0.873).

Keywords: wheat kernel hardness, flour parameters, dough features

INTRODUCTION

The kernel hardness has great effect on the baking properties of the resulting flour. Flour, which is made from hard wheat generally have a medium to high protein content and stronger gluten than that, which is made from soft one. The kernel Hardness-locus on chromosome 5D is the main determinant of grain texture in bread wheat. Puroindoline-a (pin-a), puroindoline-b (pin-b) and Grain Softness Protein (GSP) genes are tightly linked at this locus and their products are the predominant components of friabilin, a 15 kDa endosperm protein complex. The friabilin protein comlex determines the kernel hardness. Generally, when the amount of the friabilin is high, the kernel hardness is soft reverse (ÁCSNÉ ET AL. 2001). We can sort the kernel hardness in these two groups. Hardness in wheat is largely controlled by genetic factors but it can be affected by the environment, for example the weather (GYIMES, 2004). The transgenic expression of wild type Pin-a sequence in the Pin-a null genotype gave soft grain with the characteristics of soft wheat including stronger starch bound friabilin. The results of MARTIN ET AL. (2006) support the hypothesis that both wild type Pin genes need to be present for friabilin formation and soft grain. Vitreousness is also impact to evaluate the Middle-European wheat. The flour of hard wheat with high gluten content generally contains about 12,0-13,0 % (or more) crude protein under Middle-European conditions. The relationship between wheat protein content and kernel texture is usually positive and kernel texture influences the eg during milling. Hard textured wheat grains require more e_g than those of soft ones. The aim of our research was to determine the relationships between kernel hardness and other technologically important traits in wheat varieties widely used in the Hungarian agriculture (VÉHA, 2005.).

MATERIALS AND METHODS

Registered and widely used seven of HRWW and four of SRWW Hungarian wheat varieties were tested in the study. We used the varieties of Szegedi Gabonatermesztési Kutató Kht. (Cereal Research NPC, Szeged) as samples, which were labeled with code number.

Cleaned grain samples were used to identify the hardness index (HI) by SKCS-4100 instrument (Perten Inc.). The SKCS-4100 can complete a test in about 3 minutes, and simultaneously reports mean and standard deviation data for kernel weight, diameter, and moisture content, as well as the HI. This machine examines 300 whole kernels (SZABO ET AL., 2005; BEAN ET AL. 2005).

Figure 1. SKCS 4100 instrument (Perten, Inc.)

Grain samples were grinded by Perten 3303 for establishing the e_g using a 1-phase output indicator interface. This involves grinding a sample, and sieving a weighed amount (usually 10 g) through a standard screen for a standard time. The percentage of throughs is recorded as the PSI (GYIMES ET AL. 2008).

Figure 2. Perten 3303 disc mill (Perten, Inc.)

Moisture content, wet gluten content, farinograph and alveograph tests were determined according to the EU-Standards. Farinograph gave information on the water absorption of the flour. Twin correlations were used to determine the relationship among the various traits, the significant level was 5 %.

RESULTS AND DISCUSSION

Hardness Indexes and grinding energies of selected wheat entries in the study (*Table 1*.).

Table 1. Hardness index and e_g

Entry code	Hardness Index	Grinding Energy (mWh/cm^2)
VI.	19,6	0,21
II.	27,3	0,23
IX.	28,6	0,25
III.	36,0	0,24
VII.	57,3	0,43
IV.	61,0	0,44
VIII.	67,3	0,46
XIII.	68,3	0,47
XII.	80,6	0,53
X.	80,6	0,55
XI.	81,3	0,54

The Perten-HI and grinding energy values were showed in *Table 1*. The SKCS 4100 compartmentalize the results in two groups. Under 50, the samples belong to Soft Wheat-, while samples above values 50 considered as Hard Wheat category. The average HI was 55.2 with minimum of 20 and maximum of 81 values. The II., III., VI. and the IX. samples are Soft Wheat, and the other samples are Hard Wheat.

Table 2 and *Table 3* show the selected parameters of the sample.

Table 2. Selected parameters of the samples

Class	Entry code	Moisture (%)	Flour yield (%)	Water absorption capacity (ml)	Wet gluten (%)
SOFT	II.	13.27	71.88	54.8	21.58
	III.	13.86	71.79	57.3	27.48
	VI.	14.01	74.01	54.0	16.85
	IX.	14.00	68.33	56.6	25.30
HARD	IV.	13.90	72.89	60.9	28.13
	VII.	13.85	71.28	61.4	22.88
	VIII.	13.58	70.16	63.2	33.68
	X.	13.37	70.96	67.9	31.70
	XI.	13.15	67.94	66.8	35.60
	XII.	12.82	70.46	63.0	29.68
	XIII.	12.92	69.66	56.9	31.08

Table 3. Results of the Alveograph

Class	Entry code	Alveograph			
		P (mm)	L (mm)	P/L	W (J)
SOFT	II.	42.40	65.50	0.65	102.06
	III.	63.49	93.75	0.68	204.54
	VI.	45.72	51.50	0.89	103.99
	IX.	49.99	67.30	0.75	123.80
HARD	IV.	88.25	70.00	1.26	251.35
	VII.	105.50	43.00	2.45	195.84
	VIII.	87.95	75.50	1.14	226.64
	X.	93.18	59.90	1.56	178.48
	XI.	100.30	47.00	2.16	189.91
	XII.	103.90	61.45	1.69	252.19
	XIII.	54.85	66.00	0.83	148.09

Table 4. Correlation matrix for the technological traits and grinding energy of wheat samples

		Hardness Index HI (%)	Grinding energy (mWh/cm^2)	Moisture (%)	Flour yield (%)	Water absorption capacity (ml)	Wet gluten (%)	Alveograph			
								P (mm)	L (mm)	P/L	W (J)
Hardness Index HI (%)		1									
Grinding energy (mWh/cm^2)		0.991	1								
Moisture (%)		-0.637	-0.600	1							
Flour yield (%)		-0.437	-0.417	0.417	1						
Water absorption capacity (ml)		0.876	0.878	-0.346	-0.402	1					
Wet gluten (%)		0.833	0.781	-0.531	-0.660	0.756	1				
ALVEO.	P (mm)	0.816	0.826	-0.244	-0.224	0.873	0.560	1			
	L (mm)	-0.217	-0.320	0.141	0.096	-0.260	0.171	-0.325	1		
	P/L	0.640	0.687	-0.187	-0.240	0.724	0.300	0.875	-0.691	1	
	W (J)	0.675	0.634	-0.151	-0.055	0.623	0.582	0.808	0.209	0.468	1

According to the results, there was a very strong correlation between the grinding energy and the kernel hardness (r=0.991). As *Table 4*. shows, the correlations among hardness index and the examined flour parameters were also significant (r=0.816-0.876). We found strong correlation between the eg and water absorption (r=0.878) of the flour. Hardness index – wet gluten (r=0.833), and hardness index – water absorption (r=0.876), hardness index – P value of alveograph (r=0.816) showed also positive correlations. We found correlation the water absorption and P value of alveograph (r=0.873).

CONCLUSIONS

The aim of the research was to determine the connection among the hardness index, grinding energy and the flour end-use quality parameters. There was a very strong correlation between the grinding energy and the kernel hardness (r=0.991) (*Figure 3*.). We found strong correlation between the wet gluten and hardness index (r=0.833) of the flour (*Figure 4*.).

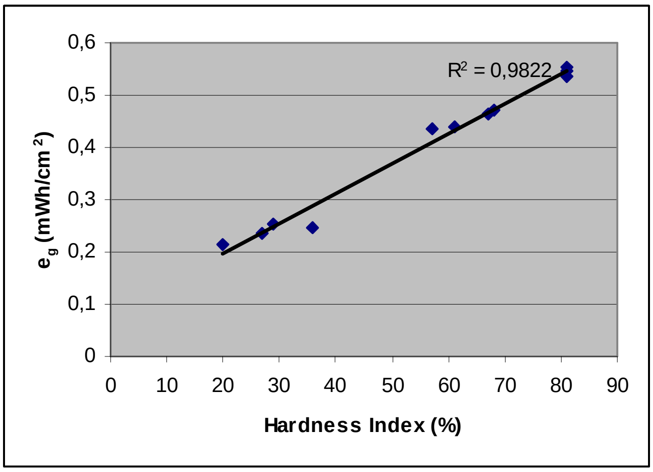

Figure 3. Connection between the HI and e_g

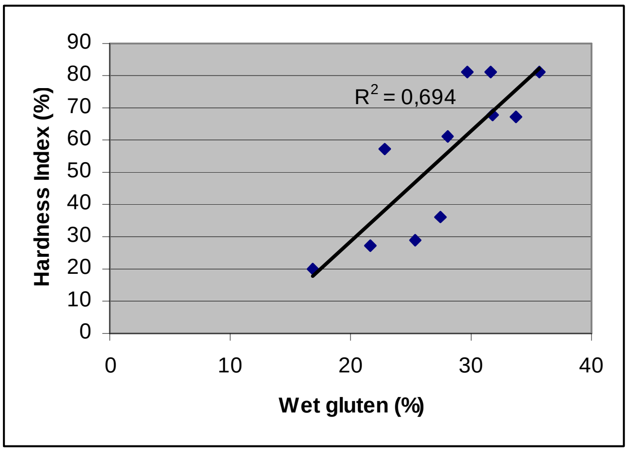

Figure 4. Connection between the HI and wet gluten

The associations were found in this study would help to better understand the technological aspects of wheat and flour quality as well as provide useful information to breeders to develop new, high quality hard or soft wheat varieties.

REFERENCES

ÁCS PÉTERNÉ, MATÚZ JÁNOS (2001): A szemkeménység mérési módszerének NIR készülékre történő adaptálása és felhasználása szegedi búza genotípusok szelekciójában (abstract in Hungarian), MTA, MÉTE, KÉKI 303. Tudományos Kollokvium 276. füzet, p. 6-7

BEAN, S.R., CHUNG, O.K., TUINSTRA, M.R., PEDERSEN, J.F., ERPELDING, J. (2005): Evaluation of the Single Kernel Characterization System (SKCS) for Measurement of Sorghum Grain Attributes. USDA-ARS, Cereal Chem. 83(1), p. 108-113.

GYIMES, E. (2004): Investigation of Relationship Among the Agro:physical Features of Wheat (Triticum aestivum) Kernel Varieties. PhD Thesys Mosonmagyaróvár (in Hungarian)

GYIMES, E., SZABO P.B. (2008): Különféle típusú búzák aprózódási tulajdonságai, MTA AMB K+F Tanácskozás, ISBN 978-963-611-449-7, p. 51. o. (in Hungarian)

MARTIN J.M., MEYER F.D., SMIDANSKY E.D., WANJUGI H., BLECHL A.E., GIROUX M.J. (2006): Complementation of the pina (null) allele with the wild type Pina sequence restores a soft phenotype in transgenic wheat. THEOR. AND APPLIED GENETICS 113 : 1563-1570.

SZABÓ P.B., VEHA, A., GYIMES, E. (2005): Different Methods for Determining Kernel Hardness, SZTE SZÉF Tudományos Közlemények, p. 42-45, ISSN 1785-3419 (in Hungarian)

VÉHA, A. (2005): Correlation between the kernel-hardness of different endospermium structure bread-wheats and flour quality parameters. Habilitation lectures (in Hungarian).