CHANGES OF GLUTEN PROPERTIES OF WHEAT DURING STORAGE

M. Móré[1], G. Diósi[1], Z. Győri[2], P. Sipos[1]

[1]University of Debrecen Centre for Agricultural and Applied Economic Sciences Institute of Food Science, Quality Assurance and Microbiology, 138 Böszörményi street, H-4032 Debrecen, Hungary, morem@agr.unideb.hu
[2]Szent István University Faculty of Economics and Social Sciences, Institute of Regional Economics and Rural Development Páter Károly street 1., H-2103 Gödöllő

Abstract

The major goal of our work was to determine how the gluten properties of wheat change under short-term storage. In our study we examined a winter wheat (Lupus) variety. Samples were collected from Látókép Research Institute of the University of Debrecen in 2012. Wet gluten content decreased for the third sampling time but for the 4th time the test resulted increase, but the final readings do not reach the initial value. Gluten spreading did not follow any tendency but the gluten index decreased by storage time continuously.

Key words: winter wheat, wheat gluten, gluten spreading, gluten index, storage

INTRODUCTION

Winter wheat (*Triticum aestivum*) is one of the most common crop which is widely grown in the world and it is the most important food grain source for humans, with 12-18% protein content. This quantity parameter is influenced by different factors, such as genotype and environmental factors (Gasztonyi, 2004). Wheat occupies a special place among cereals, and also very important in human diet so the quality of wheat is not a negligible point of view (Győri and Győriné, 1998).

Wheat has a unique biochemical property, which is not typical of other cereals. Wheat contains a complex mixture of proteins which is able to form a viscoelastic dough after mixing with water. When we wash out starch and water-soluble proteins from dough, the gluten remains (Khan and Nygard, 2006). Gluten includes proteins (gliadin, glutenin) which play key role to develop breadmaking quality of wheat thus influence the water absorption capacity, cohesivity, viscosity and elasticity on dough (Wieser, 2007).

In summary, cultivation of wheat has two very important aims, the quality and quantity of wheat (Bedő and Láng, 1997). Gluten content is maybe the most important component of grain quality. Wet gluten content is determined by washing out the flour with NaCl solution, to remove starch and other soluble compounds of the sample (Mis, 2000). After washing, a rubbery mass, the wet gluten remains.

The time of harvest, buying and takeover of wheat do not happen in the same time, thus, the quality maintaining storage of wheat is a very important

issue. Storage is a complex process, because the stored samples are biologically active. Storability is depend on the moisture content and temperature of the crop and also influenced by the temperature of storage area (Véha and Markovics, 2010). Mesterházy (1997) reported that wheat cannot be stored above 16% moisture content and the quality of winter wheat does not change if the moisture content is around 13%. Besides, the quantity of wet gluten content improves during the after-ripening period (Balla et al, 1993). However, Koch and Meyer (1957) found that the nutritional values do not change if the storage conditions are appropriate, references say that the quality of stored wheat lots are not stable (Mile and Győri, 2006; Mezei et al., 2007).

MATERIAL AND METHOD

Winter wheat samples were collected from Látókép Research Institute of the University of Debrecen in 2012 from a long-term mineral fertilization experiment set up in 1983 and it had a split-plot arrangement. The Table 1. shows the applied NPK doses in this experiment.

Table 1.

The applied NPK doses of the winter wheat field experiment (Látókép)

Treatments	**N (kg/ha)**	**P_2O_5 (kg/ha)**	**K_2O (kg/ha)**
Control	0	0	0
1.	30	22,5	26,5
2.	60	45	53
3.	90	67,5	79,5
4.	**120**	**90**	**106**
5.	150	112,5	132,5

We examined the results of the 4th treatment (120 kg/ha N-doses) of Lupus variety in three repetitions.

Storage facilities

After harvest and cleaning we stored the samples in polypropylene sacks. The samples moisture content was around 12-13% at the beginning of the storage time. We performed purifying by MSZ 6367/2:2001, corresponding to the quality requirements of stored wheat standard declared in MSZ 6383:1998.

Laboratory tests

Laboratory tests were carried out in the Institute of Food Science, Quality Assurance and Microbiology of the University of Debrecen. We examined Lupus from the crop year 2012.

Our aim was to determine the changes of gluten properties (wet gluten content, gluten spreading, gluten index) during storage. After conditioning process we examined wheat samples for four times (2012.07.24., 2012.07.31., 2012.08.21., 2012.09.18.).

We mixed 1 kg from each samples and after homogenization, wheat conditioning was performed. Moisture content of wheat varies around 12-13% depending on sample, and they were normally conditioned to 16,5% prior to milling (25^0C, 24h). Winter wheat samples were milled by a LABOR MIM FQC 109 (METEFÉM, Budapest, Hungary) laboratory mill using 250 µm sieve.

Flour samples were tested for wet gluten content (MSZ-ISO-5531:1993), gluten spreading (MSZ-ISO-5531:1993) and gluten index (ICC method No. 155). We used Perten Instruments Glutomatic 2200 gluten washer and Centrifuge 2015 (PERTEN INSTRUMENTS AB, Huddinge, Sweden) to determine these quality parameters. The experimental results were analyzed by One-Way ANOVA (Post Hoc test - Duncan test) by the SPSS for Windows 13 statistical program package (SPSS Inc., USA).

RESULTS AND DISSCUSIONS

Wet gluten content

The wet gluten content was the highest at the first evaluation time (37,03%). After the first time, the wet gluten content decreased to 33,15% for the third sampling time, but for the 4th time the test resulted increase, but the final readings do not reach the initial value (Fig. 1.).

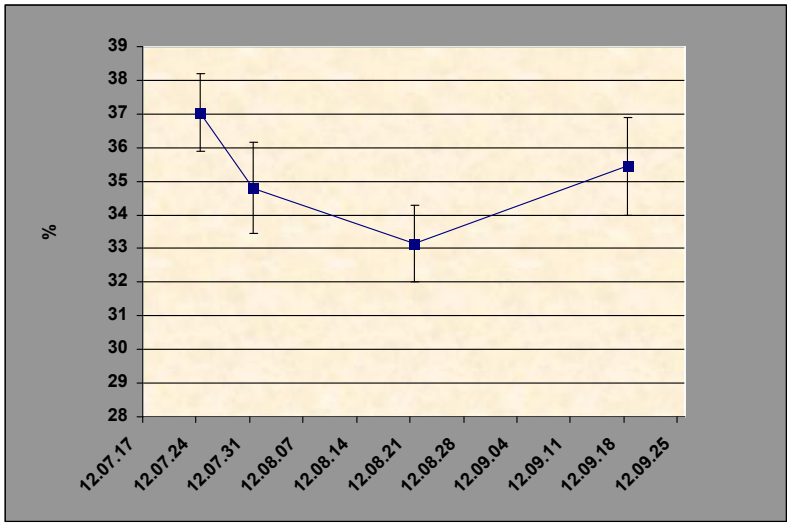

Fig. 1 Changes of wet gluten contents of Lupus during storage

We can say that there were significant differences ($p<0,05$) between the samples (Lupus) which were tested in different time. Balla et al. (1993) reported that after ripening (1 month) the quantity of wet gluten content increase, so our study also proved this statement.

Gluten spreading

In the storage experiment we measured gluten spreading too in each time. We measured the highest values in the second time (3,8 mm/h) and the lowest in the third time (1,7 mm/h) . The Fig. 2. presents that the readings change continuously in the examined period but generally met the requirements of qualifying standard.

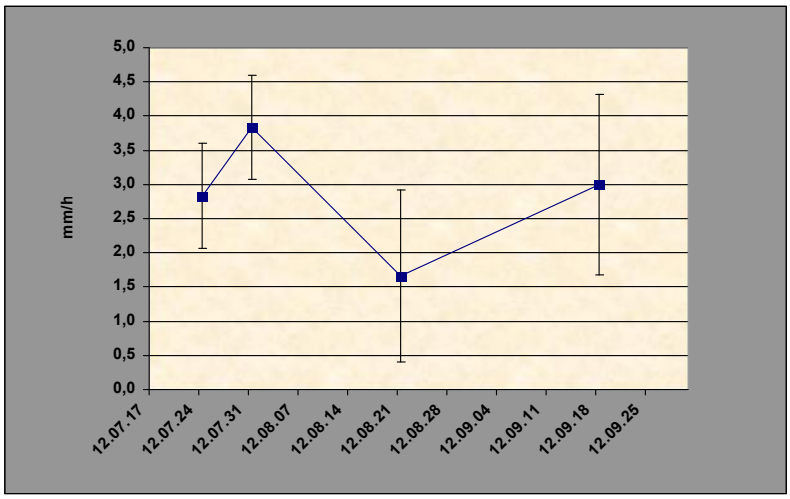

Fig. 2 Changes of wet gluten spreading of Lupus during storage

Statistically significant ($p <0.05$) difference was identified in the influence of storage time on gluten spreading.

Gluten index

In contrast to the previous two properties of Lupus, gluten index decreased by storage time, so the highest result (98,49%) was one what we measured in the first time, while the lowest was experienced in the last time (80, 25%) (Fig. 3). A high gluten index above 95% indicates strong gluten**,** while index values lower than 60% indicate flours too weak for bread production (Violeta and Georgeta, 2010).

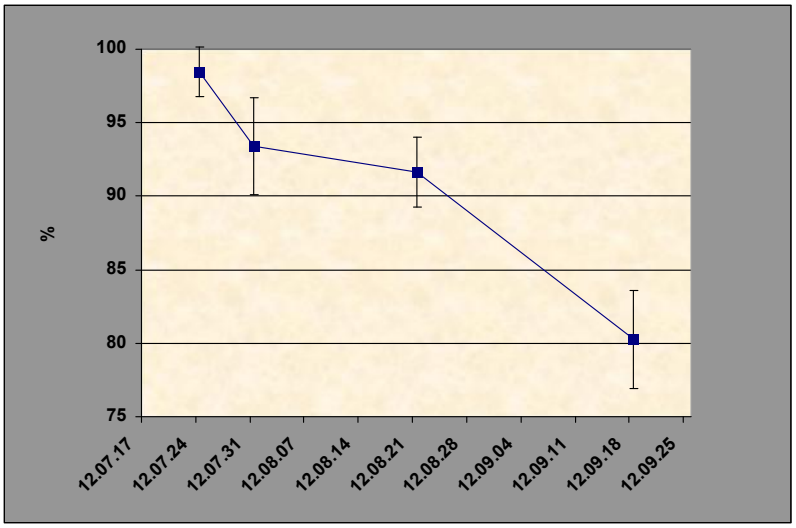

Fig. 3 Changes of gluten index of Lupus during storage

A significant differences ($p < 0.05$) were between the gluten index of wheat samples at different times.

CONCLUSIONS

As a result of the short term winter wheat grains storage experiment we can say that the storage time influences the gluten properties of Lupus. We analyzed three gluten properties: wet gluten content, gluten spreading and gluten index. The results of the statistical evaluation show that there are statistically significant differences among the four measuring time during storage, but the tendencies of different parameters are different; after an initial decrease the gluten content increased. Altough both two gluten quality characteristic parameters refer to the strength of gluten network, the trend of change of gluten spreading values did not follow any tendency, but the gluten index decreased continuously. Revealing the chemical background of these changes further experiemnts are necessary.

Acknowledgments

The researches were carried out in the project: HURO/1001/323/2.2.2, GRAINS SAFETY Researches regarding the influence of some technological elements over the wheat and corn grains quality stored in Bihor and Hajdu Bihar counties Project founded by Hungary-Romania Cross-Border CooperationProgramme 2007-2013(www.huro-cbc.eu)

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