CHANGES IN WHEAT DURING STORAGE AT THREE DIFERENT TEMPERATURES

RUSKA L.*, TIMAR A. V.*

*University of Oradea – Faculty of Environmental Protection University of Oradea – Faculty of Environmental Protection atimar@uoradea.ro

Abstract

Changes in wheat grains stored are well known. The main issues are regarding homogeneity, harvesting conditions, conditioning conditions, grains physiology, storage conditions, pests, et.

In order to see the impact of the storage conditions - temperature - over the wheat grains stored we set up an experience with temperatures that usually are common during normal storage of wheat grains before use as raw material for flour production.

The temperature that we find most common in Romania were 10, 15 and 30 °C. We studied the changes in wheat grains for six months because this is the average storage duration in Romanian medium and small farms.

The parameters taken in to study were: pH as a freshness indicator, moisture contents of wheat grains that was chosen for emphasis the issues regarding storage and yield, enzymes- water soluble amylase and insoluble amylase contents -for assessing the drought production, total protein content, gluten content and synthetic Zeleny index.

Key words: Biochemical changes, Storage temperature, Wheat grains, Mid - term storage.

INTRODUCTION

Wheat is one of the most important cultivated plant from the world. It is provide an important share from diet and it is present in different forms in diet of Romanians from the ancient times.

In Romania, wheat is stored in brick warehouses, metallic and concrete silos, 1000 kg Big bags and 50 kg bags at temperature and moisture conditions very various.

During storage the concerns are more about foreign parts, physically parameters and pest control. Due to new equipments available on the market at affordable price the moisture content of the grains or humidity and the storage temperature is very easy to be shown and quantify.

Other parameters that are related with more difficult to analyze methods or expensive equipments or trained staff are a lot of time not taken in consideration.

Changes in pH, protein content, etc. reduced grains quality and especially baking quality. Reducing the content and quality of sugars are leading to slowing the dough fermentation due yeasts nutrition issues. The reduction of the wheat grains quality related to the parameters mentioned above and temperature that we propose are related with the own consumption of the embryo of wheat grains, pests, enzymes produced by normal or abnormal microflora of wheat grains stored under different

conditions of temperature and moisture with consequent reduction in protein and especially gluten content and quality. Physical and chemical changes in the composition of the grains as we mentioned are producing nutritional issues, technological issues and economically issues as well. For this reason quality control of the stored wheat grains become very important and due to easily implementation become also wide spread in medium and big farms and storage facility.

The aim of this study was to compare the effect of storage temperature on the quality of wheat grains regarding quality parameters mentioned in the beginning.

MATERIALS AND METHODS

Freshly harvested wheat was obtained from Agriculture Research Institute, SCAZ (ORADEA) and stored at 10, 15 and 30°C for a period of six months. All wheat samples were free from insect infestation and it was no chemical treatment used for preservation. About 800 g of each sample with 13% moisture after drying were placed in 1 liters screw cap plastic bins. The plastic bins (12 for each temperature level) were kept at the temperature of 10, 15 and 30°C for six months. Twice on month a bottle of each batch was taken in to study regarding parameters mentioned above.

The samples were analyzed for pH, titratable acidity, moisture, amylase, amylase, total protein content, gluten content, Zeleny index.

The pH was determined on a filtrate of a 10 g ground sample in 90 ml distilled water using a Innolab pH meter.

Moisture, Total protein content, Gluten content and Zeleny index were determined using the Agricheck NIR spectrometer from Bruins Instruments acording AOAC.

Amylase activity in wheat was measured by the method of Bernfeld after extraction of the enzyme with sodium acetate buffer.

Total amylase and water soluble amylase contents in stored wheat samples were determined using the Sowbhagya & Bhattacharya method

The water insoluble amylase contents were calculated by difference.

All determinations were carried out in triplicate and standard deviations (SD) were calculated according to the method of Teusdea A. Duncans multiple range tests were used to determine significant differences ($p < 0{:}05$).

RESULTS AND DISCUSSION

Changes in wheat grains related with the temperature level that we chose were obvious and relevant.

They occurred during storage at different temperatures shown different values and dynamic according with metabolism increase we

presume. The range of storage temperature included in this study (10–30°C) covered the atmospheric temperatures (and the equilibrium temperatures in bulk stored wheat grains during autumn and winter) that the wheat grains encounter in Romania, Oradea normally.

Table 1. Moisture of the stored grains during six months

Storage time	Moisture, %					
	Values			Diferences		
	10 °C	15 °C	30 °C	10 °C	15 °C	30 °C
0	13	13	13	100	100	100
1	12,51	12,3	12,18	96,23077	94,61538	93,69231
2	12,37	12,18	12,03	95,15385	93,69231	92,53846
3	11,97	11,95	11,86	92,07692	91,92308	91,23077
4	11,96	11,87	11,72	92,00000	91,30769	90,15385
5	11,89	11,22	11,26	91,46154	86,30769	86,61538
6	11,87	11,12	11,15	91,30769	85,53846	85,76923

Table 2. Ph of the stored grains during six months

Storage time	pH					
	Values			Diferences, %		
	10 °C	15 °C	30 °C	10 °C	15 °C	30 °C
0	6,42	6,42	6,42	100	100	100
1	6,55	6,35	6,23	102,0249	98,90966	97,0405
2	6,57	6,3	5,89	102,3364	98,13084	91,74455
3	6,37	6,2	5,4	99,22118	96,57321	84,11215
4	6,32	6	5,1	98,44237	93,45794	79,43925
5	6,4	6,02	5,08	99,68847	93,76947	79,12773
6	6,31	6,11	4,88	98,28660	95,17134	76,01246

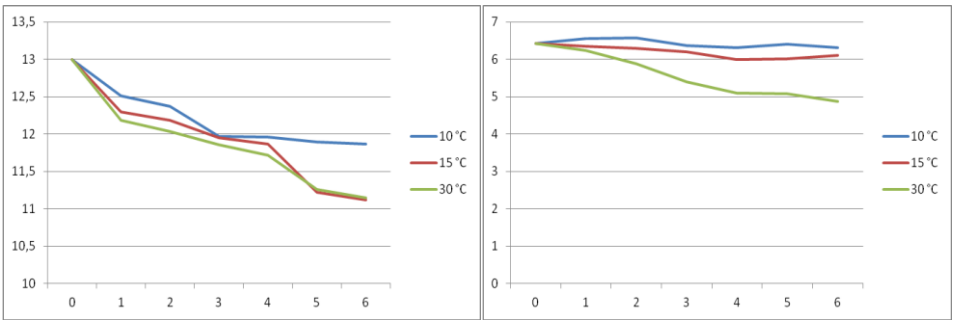

Figure 1. Moisture and Ph dynamic of the stored grains during six months

It was shown that the level of moisture recorded a reduction at all temperature levels. There were smaller changes in moisture content during storage of wheat grains at 10°C for six months (Figure 1). The decrease in moisture were much higher at 15°C and 30°C after three months of storage. The differences were quite significant, up to 14,23 % at 30°C.

The pH values were also declining. The biggest difference was also in 30°C experimental variant up to 23,09 %.

Table 3. Amylase activity of the stored grains during six months

Storage time (months)	Amylase activity, I.U.					
	Values			Diferences		
	10 °C	15 °C	30 °C	10 °C	15 °C	30 °C
0	12,43	12,43	12,43	100	100	100
1	12,50	12,31	12,22	100,56315	99,034594	98,310539
2	12,30	12,19	12,09	98,954143	98,069187	97,264682
3	11,77	11,98	11,88	94,690265	96,379726	95,575221
4	11,86	11,95	11,79	95,41432	96,138375	94,851167
5	11,89	11,87	11,74	95,655672	95,494771	94,448914
6	11,92	11,72	11,68	95,897023	94,288013	93,966211

Table 4. Water soluble Amylase activity of the stored grains during six months

Storage time (months)	Water soluble Amylase					
	Values			Diferences		
	10 °C	15 °C	30 °C	10 °C	15 °C	30 °C
0	8,82	8,82	8,82	100	100	100
1	8,75	8,72	8,70	99,206349	98,866213	98,639456
2	8,67	8,61	8,60	98,29932	97,619048	97,505669
3	8,52	8,54	8,50	96,598639	96,825397	96,371882
4	8,47	8,42	8,42	96,031746	95,464853	95,464853
5	8,45	8,41	8,38	95,804989	95,351474	95,011338
6	8,42	8,36	8,35	95,464853	94,78458	94,671202

Table 5. Insoluble Amylase activity of the stored grains during six months

Storage time (months)	Insoluble Amylase activity					
	Values			Diferences		
	10 °C	15 °C	30 °C	10 °C	15 °C	30 °C
0	23,38	23,38	23,38	100	100	100

1	23,40	23,41	23,44	100,08554	100,12831	100,25663
2	23,41	23,43	23,44	100,12831	100,21386	100,25663
3	23,42	23,45	23,45	100,17109	100,2994	100,2994
4	23,44	23,47	23,46	100,25663	100,38494	100,34217
5	23,45	23,49	23,51	100,2994	100,47049	100,55603
6	23,49	23,55	23,62	100,47049	100,72712	101,02652

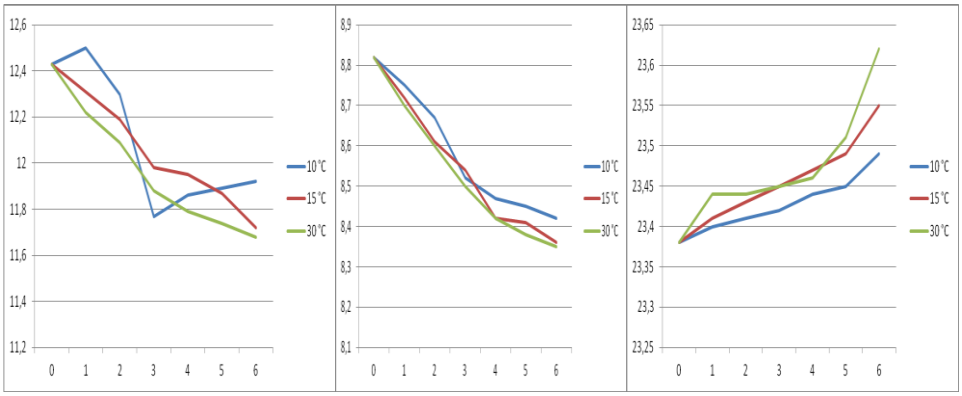

Figure 2. Amylase activity of the stored grains during six months

Table 6. Total protein content of the stored grains during six months

Storage time (months)	Total protein content, %					
	Values			Diferences		
	10 °C	15 °C	30 °C	10 °C	15 °C	30 °C
0	14,62	14,62	14,62	100	100	100
1	14,59	14,57	14,55	100,56315	99,034594	98,310539
2	14,58	14,55	14,50	98,954143	98,069187	97,264682
3	14,54	14,48	14,48	94,690265	96,379726	95,575221
4	14,50	14,42	14,40	95,41432	96,138375	94,851167
5	14,42	14,36	14,30	95,655672	95,494771	94,448914
6	14,62	14,30	14,28	95,897023	94,288013	93,966211

Table 7. Gluten content of the stored grains during six months

Storage time (months)	Total protein content, %					
	Values			Diferences		
	10 °C	15 °C	30 °C	10 °C	15 °C	30 °C
0	32	32	32	100,0000	100,0000	100,0000
1	31,2	31,4	31,1	97,5000	98,1250	97,1875
2	31,4	31,3	31,6	98,1250	97,8125	98,7500
3	31,6	31,5	31,7	98,7500	98,4375	99,0625

4	31,7	31,6	31,7	99,0625	98,7500	99,0625
5	31,8	31,8	31,9	99,3750	99,3750	99,6875
6	32	32,2	32,4	100,0000	100,6250	101,2500

Table 8. Zeleny index of the stored grains during six months

Storage time (months)	Total protein content, %					
	Values			Diferences		
	10 °C	15 °C	30 °C	10 °C	15 °C	30 °C
0	54	54	54	100,0000	100,0000	100,0000
1	52	53	54	96,2963	98,1481	100,0000
2	52	53	53	96,2963	98,1481	98,1481
3	53	54	54	98,1481	100,0000	100,0000
4	54	55	55	100,0000	101,8519	101,8519
5	54	53	54	100,0000	98,1481	100,0000
6	53	54	54	98,1481	100,0000	100,0000

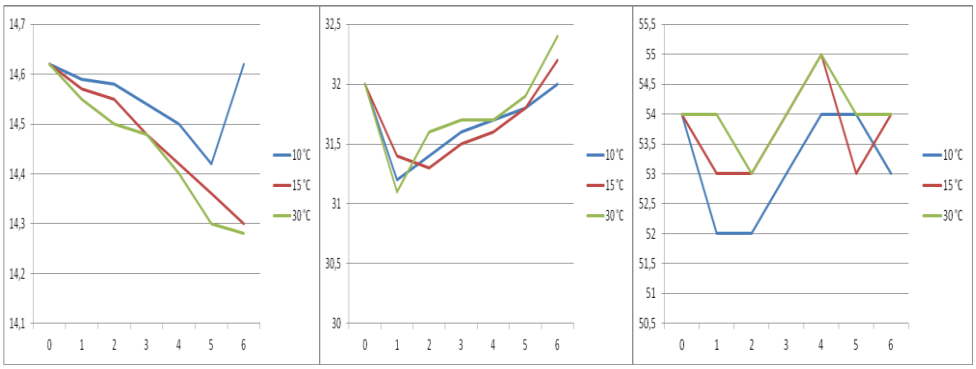

Figure 3. Protein content, Gluten content and Zeleny index dynamic of the stored grains during six months

CONCLUSIONS

Global quality of wheat grains described by selected parameters was influenced as a result of storage at temperatures that are common in Romanian climatic conditions. The protein content of bulk stored wheat grains decreased during six months of storage at 15 and 30 °C.

The Gluten content was most stabile at 15°C and this correlated with Zeleny index that reach at the same temperature maximum value lead to a clear conclusion that the optimal storage temperature from our experience is 15 °C. This is very hard to be kept but, by insulation can be done with decent costs.

ACKNOWLEDGMENTS

The researches were carried out in the project: PN-II-ID-PCE-2008; 1103/2009 ”Study of the relationships in the soil-water-plant-atmosphere

system on the land affected successively by excess and deficit of moisture from North Western Romania regarding the improve of the yield quantity and quality".

REFERENCES

1. Abramson, D., W. E. Muir, D. S. Jayas, 1999. Multi-year monitoring for quality changes of grain stored in 550 tone capacity grain bins in western Canada. Proceedings of the 7th international working conference on stored-product protection: Vol. 2 (pp. 1301–1313). Chengdu, PR China: Sichuan Publishing House of Science and Technology,
2. Bailey J. E., 1974. Whole grain storage. In Storage of Cereal Grain and Their Products (C. M. Christiansen, ed), 53-78. St. Paul, Minnesota: American Association of Cereal Chemists,
3. Colin Wrigley, Harold Corke, Charles Walker, 2005. Encyclopedia of grain science, Elsevier;
4. Honseney RC , 1986, Principles of Cereal Science and Technology. American Association of Cereal Chemists Inc, St. Paul. Minnesota.
5. Kenneth J., P.E. Hellevang, 1998. Temporary Grain Storage, The Encyclopedia of Grain Science
6. Matz S., 1970. Cereal Technology, Westport. C.T.. The avi Publishing Company Inc
7. Rehman ZU, M Yasin, WH Shah, AFM Ehtheshamuddin, 1995, Biochemical changes in rice during storage at three different temperatures. Pak J Sci Ind Res 38: 98–100.
8. ***, A.A.C.C. (American Association of Cereal Chemists), 2000. Approved methods. 10th ed. St. Paul, MN