CHANGES IN WHEAT GRAIN DURING STORAGE AND EFFECTS OF STORAGE TEMPERATURE

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Abstract

There is one of the most important crop that provide food, fodders and industrial use, widely spread in cropping on all continents and also one of the older plant taken in culture - Wheat.

The plant has two types, winter and spring wheat. It is easily to be mechanized, in sowing, cropping and harvesting. The harvest is very stabile and can be stored in many ways without serious issues.

In the present study we chose eight cultivars of winter wheat common in Romania, Bihor county. There were Romanian cultivars taken in to study as the following: Dropia (D), Alex (A), Crişana (C), Ariesan (Ar), Apullum (Ap), Fundulea 4 (F4), Flamura 85 (F85), Dumbrava (Du).

The cropping of the studied wheat cultivars was done in 2008 in area of Oradea, Săcuieni and Bicaci. The harvesting was done in June due to climatic conditions.

The storage temperature was measured in order to see the correlation of storage parameters with temperature.

There were studied changes during eight months of storage for following parameters: Protein content, Gluten content, Starch content, Water content, Flour power, Mass of one thousand grains (MMB), Hectolitric mass (MH) and Mineral content.

At the end of the study the data were compared to emphasis the dynamic of changes and best storage program for each cultivar.

Key words: wheat, grain, storage, storage temperature, rheological properties..

INTRODUCTION

Wheat is one of the plant that have great importance as a food product, providing an important share of the carbohydrates and proteins needed by humans and animals.

It is responsible for more than half of the calories consumed by humans and animals. The forms of used of the wheat in human nutrition are highly diversified, but the most common is bread from the ancient times.

Wheat is the harvest that provide for consumers from nutritionally point of view the most economically option. Because of this yearly the wheat production in agricultural crops was increasing. The production increasing because of agrotechnik measure, extending the areas of cropping, increasing the yeld of cultivars and other factors.

The varieties of native Romanian autumn wheat have a share of about 70% of the area cultivated in Romania, representing about 1,5 million

hectares in farms and other important areas in small household that are not taken in to consideration.

In this way there is very important to assess the Romanian grains quality at the harvesting but more important in the storage time. Because of so important share in the cropping at the small and medium farms and also in households the storage assessment of the Romanian wheat cultivars become an important toll in optimization of the storage until use.

MATERIALS AND METHODS

Winter wheats grown by private farmers, harvested in 2008 were used in the present study as following: Dropia (D), Alex (A), Crișana (C), Ariesan (Ar), Apullum (Ap), Fundulea 4 (F4), Flamura 85 (F85), Dumbrava (Du).

Those eight cultivars were grown at five sites, in Bihor county around Oradea, Sacuieni and Bicaci.

The fertilisation was done y 60-90-60 phosphorus, nitrogen and potassium during March, April and May. Management also included the use of fungicides, insecticides and herbicides during the growing season according with national regulation.

Sowing was carried out in October and November and wheat harvested during July the following year.

Grains were harvested and stored in warehouses after a drying at 13% moisture. The warehouses were chosen because it is the most common storage infrastructure in use in Romanian smal farms and households based on older infrastructure built in communist time.

There were carried out following measurements of quality parameters:

- Protein content,
- Gluten content,
- Starch content,
- Water content,
- Flour power,
- Mineral content
- Mass of one thousand grains (MMB),
- Hectolitric mass (MH)

The methods use for the parameters analysis were the following:

- Protein content, NIR by Agricheck from Bruins Instruments,
- Gluten content, NIR by Agricheck from Bruins Instruments,
- Starch content, NIR by Agricheck from Bruins Instruments,
- Water content, NIR by Agricheck from Bruins Instruments,
- Flour power, by Auerman method,
- Mineral content, by calcinations in a furnace from Nabtherm,

- Mass of one thousand grains (MMB), gravimetric by Atilon scale from Acculab,
- Hectolitric mass (MH), electronic by Granomat from Pfeiffer.

During storage the temperature from the warehouses was recorded as monthly average.

The measurements were carried out in triplicate and were done at the beginning of the experience and at the end of every month of storage.

The recorded data were represented in a graphic form for a better correlation.

RESULTS AND DISCUSSION

The experience was started in 28th of June 2008 and was ended in 23 of January 2009 when the grains were used.

The following tables presented the variation of the storage parameters during storage.

Table 1. Temperature of storage environment

Month	Temperature average, ℃							
Cultivar	D	A	C	Ar	Ap	F4	F85	Du
0	21,64	20,72	22,14	19,46	21,52	20,65	21,84	22,44
1	22,24	22,55	23,26	20,65	22,72	21,46	22,16	22,96
2	22,54	23,72	23,46	21,12	22,84	23,52	22,12	22,96
3	21,36	22,18	22,62	20,16	21,42	22,15	21,16	22,04
4	19,65	20,02	20,14	18,44	19,52	20,15	20,14	20,00
5	18,01	18,42	18,25	17,86	19,32	18,68	19,32	19,42
6	16,00	15,72	15,86	16,04	15,50	15,85	16,44	17,14

Table 2. Protein content of the stored grains during six months

Month	Protein content, %							
Cultivar	D	A	C	Ar	Ap	F4	F85	Du
0	12,10	12,90	13,60	11,80	11,24	11,45	11,82	11,91
1	12,14	12,92	13,62	11,78	11,32	11,40	11,82	11,96
2	12,12	12,96	13,58	11,72	11,40	11,28	11,88	11,90
3	12,06	12,86	13,58	11,80	11,42	11,38	11,76	11,88
4	12,26	12,94	13,72	11,84	11,14	11,42	11,90	11,82
5	12,18	12,88	13,66	11,90	11,36	11,40	11,78	11,94
6	12,12	12,94	13,60	11,82	11,20	11,38	11,88	11,92

Table 3. Gluten content of the stored grains during six months

Month	Gluten content, %							
Cultivar	D	A	C	Ar	Ap	F4	F85	Du
0	30,2	30,4	32,1	29,6	28,2	28,6	29,5	28,3
1	30,1	30,3	32,2	29,8	28,0	28,8	29,4	28,5
2	30,2	30,5	32,1	29,8	28,2	28,8	29,6	28,5
3	30,3	30,6	32,4	29,8	28,4	28,8	29,7	28,4
4	30,6	30,9	32,4	29,9	28,5	29,1	29,8	28,5
5	30,9	31,4	33,4	30,1	29,4	29,3	30,0	28,9
6	31,2	31,2	33,2	30,2	29,2	29,6	30,2	29,0

Table 4. Starch content of the stored grains during six months

Month	Starch content, %							
Cultivar	D	A	C	Ar	Ap	F4	F85	Du
0	61,80	60,12	58,19	59,12	58,00	58,22	59,11	60,36
1	61,78	60,14	58,16	59,14	58,10	58,18	59,14	60,32
2	61,82	60,08	58,21	59,18	58,04	58,16	59,10	60,35
3	61,78	60,14	58,18	59,15	58,08	58,20	59,16	60,45
4	61,76	60,02	58,08	59,10	58,00	58,15	59,14	60,34
5	61,72	60,00	58,06	59,10	58,02	58,18	59,15	60,38
6	61,74	60,10	58,04	59,08	58,00	58,16	59,00	60,30

Table 5. Moisture of the stored grains during six months

Month	Moisture, %							
Cultivar	D	A	C	Ar	Ap	F4	F85	Du
0	14,6	14,8	14,4	14,5	14,7	14,6	14,3	14,0
1	14,4	14,6	14,2	14,2	14,4	14,1	13,9	13,7
2	14,0	14,1	13,9	13,8	14,1	13,9	13,7	13,6
3	13,8	13,7	13,6	13,5	13,7	13,6	13,3	13,4
4	13,8	13,6	13,5	13,4	13,7	13,5	13,3	13,3
5	13,8	13,7	13,6	13,5	13,9	13,6	13,4	13,3
6	13,9	13,8	13,7	13,6	13,9	13,8	13,6	13,3

Table 6. Flour power of the stored grains during six months

Month	Flour power							
Cultivar	D	A	C	Ar	Ap	F4	F85	Du
0	55	50	58	51	49	48	50	48
1	54	52	57	53	50	47	50	49
2	55	51	59	52	50	46	51	50
3	56	50	58	53	48	48	52	49
4	57	49	59	52	50	49	52	49
5	55	51	58	50	50	48	52	50
6	58	51	60	53	51	49	53	50

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

Month	Mineral content, %							
Cultivar	D	A	C	Ar	Ap	F4	F85	Du
0	1,61	1,66	1,58	1,35	1,54	1,60	1,64	1,66
1	1,60	1,64	1,59	1,36	1,54	1,58	1,64	1,64
2	1,62	1,64	1,56	1,35	1,52	1,61	1,65	1,63
3	1,61	1,65	1,57	1,37	1,53	1,62	1,65	1,65
4	1,63	1,65	1,58	1,34	1,54	1,60	1,64	1,66
5	1,62	1,66	1,58	1,34	1,56	1,59	1,62	1,67
6	1,61	1,64	1,59	1,35	1,55	1,60	1,65	1,65

Table 8. MMB of the stored grains during six months

Month	MMB, g							
Cultivar	D	A	C	Ar	Ap	F4	F85	Du
0	48,21	49,07	50,11	47,21	44,68	43,58	42,87	42,29
1	48,20	49,10	50,10	47,24	44,66	43,62	42,88	42,30
2	48,22	49,09	50,12	47,20	44,68	43,59	42,88	42,32
3	48,18	49,08	50,10	47,22	44,71	43,58	42,86	42,29
4	48,20	49,12	50,11	47,24	44,69	43,57	42,84	42,28
5	48,23	49,09	50,12	47,25	44,68	43,59	42,87	42,27
6	48,24	49,09	50,10	47,24	44,68	43,60	42,86	42,24

Table 9. MH of the stored grains during six months

Month	MH, kg							
Cultivar	D	A	C	Ar	Ap	F4	F85	Du
0	75,90	76,36	80,10	76,11	74,77	74,45	73,17	72,89
1	75,85	76,32	80,05	76,08	74,76	74,40	73,12	72,86
2	75,80	76,30	80,02	76,02	74,72	74,36	73,07	72,86
3	75,76	76,28	80,00	76,00	74,67	74,30	73,05	72,88
4	75,78	76,30	80,04	76,04	74,65	74,34	73,08	72,88
5	75,82	76,32	80,06	76,06	74,68	74,40	73,12	72,89
6	75,90	76,36	80,10	76,11	74,77	74,45	73,17	72,89

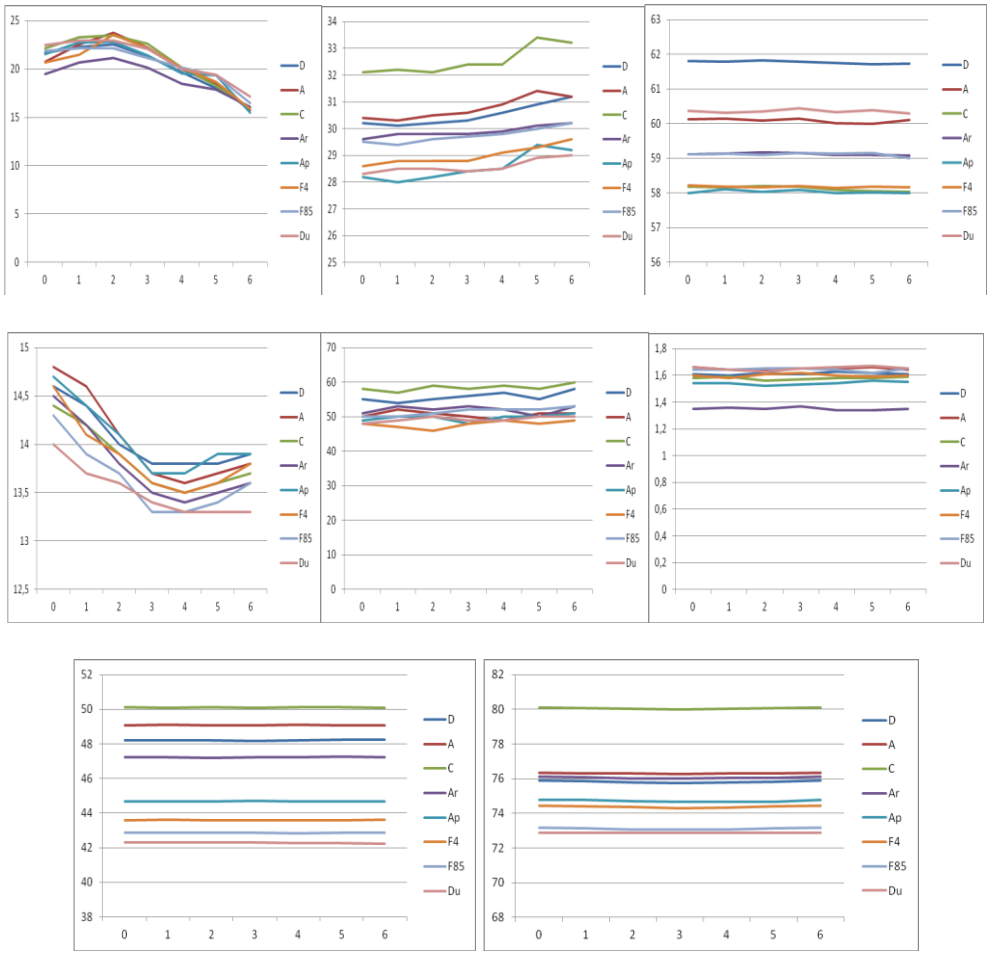

Fig. 1.1. Protein content, Gluten content, Starch content, Water content, Flour power, Mineral content, Mass of one thousand grains (MMB) evolution during storage

The values recorded shown normal decrease of the parameters during storage. There is a notice regarding a pic of values in the beginning and end of the storing according table 1.1. from this table we can emphases a direct correlation between chemical and physical parameters for the studied cultivars during storage.

Temperature maximum values recorded were 23,72 ℃ and minimum were 15,72 ℃, Protein content maximum values recorded were 13,66 % and minimum were 11,28 %, Gluten content maximum values recorded were 33,40 % and minimum were 28,00 %, Starch content maximum values recorded were 61,82 % and minimum were 58,00 %, Water content maximum values recorded were 14,80 % and minimum were 13,30 %, Flour power maximum values recorded were 60,00 and minimum were 56,00, Mineral content maximum values recorded were 1,66 % and minimum were 1,34 %, Mass of one thousand grains (MMB) maximum values recorded were 80,10 g and minimum were 72,86 g.

The most relevant values were related with chemical parameters - gluten and mineral content that shown an interesting recovering during storage,

CONCLUSIONS

The storage of studied cultivars for six months confirm the previous researches about correlation between storage and quality properties of the wheat. The studied cultivars had the same attitude related with storage like others.

The only issue was related with duration, temperature of environment and critical parameters. In this way there were parameters that had an almost linear attitude like Starch content, Flour power, Mineral content, Mass of one thousand grains (MMB).

This was explained due to small values of differences and share of this differences related with share of the parameter in the whole grain.

Despite the values the most important was the trend. There were differences between cultivars and also there were differences related with the time of parameters assessment.

In this way it was shown that parameters related with cultivars storage after reaching the physically equilibrium from temperature, water content and mass of the grains recorded recovering of the decreased parameters and reach maturity level, that recommend them to the consumption after six months of storage.

The technological parameters increase the value of the final product and also there is a strong trend to improve the values after three or four months of storage.

The study is relevant for autumn and winter time when was conducted. Anyway there is certain moment when the consumption depleted the reserves, around January - February and the rest of the stored production due to low level in quantity is not relevant regarding to possible losses.

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”.

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