REZULTATE EXPERIMENTALE PRIVIND CALITATEA NUTRIȚIONALĂ ŞI TEHNOLOGICĂ A CEREALELOR DESTINATE PANIFICAȚIEI

EXPERIMENTAL RESULTS REGARDING NUTRITIONAL AND TECHNOLOGICAL QUALITY OF BACKING CEREALS

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Abstract: *The paper presents the results of research performed during 2004-2007 on Moara Domnească Experimental Field, near Bucharest City, regarding chemical composition and yield quality on three species of backing cereals: wheat, rye and triticale .Research distinguished following wheat grains chemical composition values: moisture between 1.59 and 11.89% and dry matter content comprised between 88.11 and 88.41%, from which: proteins between 12.01 and 12.20%; wet gluten between 25.37 and 28.78%; starch between 65.45 and 66.31%; lipids between 2.37 and 2.62%; cellulose between 1.85 and 2.09%; ash between 1.21 and 1.68% and between 247 and 272 seconds for Falling Number. By comparison, rye grains were distinguished themselves depending on: proteins between 13.03 and 13.32%, wet gluten between 3.68 and 4.07%, and Falling Number between 60 and 77 seconds. Triticale grains distinguished themselves through a proteins content between 14.29 and 14.64%, gluten between 4.16 and 4.50%, and Falling Number between 121 and 126 seconds.*

Rezumat: *Lucrarea prezintă rezultatele cercetărilor efectuate în perioada 2004-2007 la Câmpul Experimental Moara Domnească, situat în apropierea municipiului Bucureşti, cu privire la compoziţia chimică şi calitatea recoltei la speciile de cereale panificabile: grâu comun, secară şi triticale.*

Cercetările au evidenţiat următoarea compoziţie chimică a boabelor de grâu: umiditatea între 11,59 şi 11,89% şi conţinutul în substanţă uscată între 88,11 şi 88,41%, din care: proteine între 12,01 şi 12,20%; gluten umed între 25,37 şi 28,78%; amidon între 65,45 şi 66,31%; lipide între 2,37 şi 2,62%; celuloză între 1,85 şi 2,09%; cenuşă între 1,21 şi 1,68% şi 247 şi 272 secunde pentru Indicele de cădere. Prin comparaţie, boabele de secară s-au evidenţiat prin: proteine între 13,03 şi 13,32%, gluten umed între 3,68 şi 4,07%, iar Indice de cădere între 60 şi 77 secunde. Boabele de triticale au avut conţinuturi în proteine cuprinse între 14,29 şi 14,64%, gluten între 4,16 şi 4,50%, iar Indice de cădere între 121 şi 126 secunde.

Key words: *baking cereals, nutritional quality, food allergies.*
Cuvinte cheie*: cereale panificabile****,*** *calitate nutriţională, alergii alimentare.*

INTRODUCTION

Main crops that are representative for global agriculture and human nutrition are cereals. Flour (obtained through cereals milling) represents a complex of biochemical components which, together with some physical characteristics, induce the quality of final product for milling industry and raw materials for baking industry.

For milling industry, the following aspects are important: seeds aspect, seed vitreousity, gluten strengh, seeds coat, characteristics which influence to flour extraction rate. The baking process depends on the protein sand gluten, glucides, lipids content and on the flour capacity of making bubbles in the yeasting process.

At present, special issues of global policies regarding food safety and security is represented by food allergies like celiac disease. Celiac disease is a digestive disease that damages small intestine and interferes with absorption of nutrients from food. People who present celiac disease cannot tolerate gluten, found in wheat seeds. Gluten is found mainly in

food but may be found also in products used every day, such as stamp and envelope adhesive, medicines, and vitamins. This disease flattening of small intestine lining interferes with the absorption of nutrients. It is estimated that it affects about one million people in the European Union.

MATERIAL AND METHOD

Research regarding yield chemical composition of baking cereals was performed by samples procceded from Moara Domnească Experimental Field, other European coutries (Denmark, Poland, Germany, Greece), and from different agricultural areas of Romania.

The studied crops were: *Triticum aestivum* ssp. *vulgare*, *Secale cereale* L., *Triticosecale* Wittmack.

Chemical analysis has been done in the Yield Quality Laboratory of Field Crops Department from the Faculty of Agriculture, University of Agronomic Sciences and Veterinary Medicine Bucharest.

There were performed following chemical analysis: moisture, dry matter content, proteins, wet gluten, starch, lipids, ash, cellulose, and Falling Number.

Analysis were achieved with modern equipments: Kjeldhal line with Digestor Bűchi (DK6) and total nitrogen distillation (Bűchi -UDK 130D); Soxhlet (SER 148) equipment; Falling Number for measuring α-amilase enzyme activity: Infrared spectrophotometer NIR Instalab 600; analyse used methodes were in conformity with Quality Standards Methods of International Association for Cereal Science and Technology (SR-ISO-7970/200).

RESULTS AND DISCUSSIONS

Moisture content of *Triticum aestivum ssp. vulgare* grains were in normal limits, respectively, between 10 and 12%.

Proteins average content were 12.34% for Alex cultivar, followed by Flamura 85 cultivar with 11.96% and Rapid cultivar with 11.93%. For Dropia cultivar, the average was 11.91%, for a three years experiment.

Regarding starch content, all samples had values over 65% (normal limits for wheat grains are 60–72%). It is being noticed, Alex cultivar with 67.94%, and the lower determined value was achieved with Flamura 85 cultivar, of 65.41%. Also, for Dropia cultivar, it was achieved a percent of 66.21%, and for the Rapid cultivar, the achieved average was of 66.18%.

Out of data analysis achieved for lipids, it is acknowledged that the limits were of 2.37 and 2.62%, Dropia cultivar was distuingshed itself with 2.52%.

Cellulose values have varied between 1.82% for Rapid cultivar and 2.86% for Alex variety, and for ash values content, the values had as limits 0.89 and 2.14%, with an average of 1.44%.

We can assert that for Falling Number, there were achieved good results, if there are taken into account the standards foresights, according to which, this must be comprised between 220 and 280 seconds, for an optimum activity of α-amylasis enzyme. Within our determinations, it is remarked, Falling Number values from 2004 year, reaching an average of 272.91 seconds, which proves a very good wheat baking quality. Also, research showed that all the samples submitted to the analysis, had a Falling Number higher than 250 seconds, which confirms the fact that all samples coming from different cultivars and areas met the conditions for being processed in the baking industry.

Chemical composition of *Secale cereale* grains was the following: moisture between 11.15 and 12.92%; proteins between 13.03 and 13.32%; gluten between 3.68 and 4.07%; starch between 67.62 and 69.66%, lipids between 0.75 and 1.06%, cellulose between 1.47 and 1.93%, ash between 1.60 and 1.93%; Falling Number between 60.66 and 77.66 seconds. In

Moara Domnească Experimental Field conditions, during the 3 years of experiments, the proteins content was a bit higher, in average with about 1%, in comparison with the seeds samples with different origin which were analysed.

Table 1

Chemical composition of *Triticum aestivum* ssp. *vulgare* grains (% d.m.) (2004-2007)

Cultivars	Proteins	Gluten	Starch	Lipids	Cellulose	Ash	Falling Number
	Year 2004						
Fundulea 4	11.34	26.81	64.83	2.35	2.04	1.79	267.3
Flamura 85	11.42	26.62	62.57	2.35	2.32	1.82	261.5
Dropia	11.30	27.46	63.95	2.43	1.73	1.76	257.3
Rapid	11.18	26.45	63.70	2.44	1.77	1.92	256.0
Alex	12.53	29.50	70.35	2.30	2.25	1.80	279.0
Mixed cultivars	13.57	31.70	68.90	2.33	2.10	1.48	289.0
Mixed cultivars	11.20	27.30	69.10	2.32	2.11	1.80	267.0
Mixed cultivars	13.77	31,80	67.10	2.56	2.21	1.48	288.0
Mixed cultivars	12.81	32.30	66.20	2.47	2.18	1.51	289.0
Mixed cultivars	12.94	27.90	67.90	2.41	1.98	1.48	275.0
2004 Average	**12.20**	**28.78**	**65.53**	**2.39**	**2.06**	**1.68**	**272.9**
	Year 2006						
Flamura 85	12.33	26.16	65.38	2.37	1.95	1.39	258.2
Dropia	12.33	27.07	66.80	2.26	2.01	1.46	259.2
Rapid	12.08	26.85	65.25	2.42	1.61	2.00	259.5
Alex	12.43	26.75	66.55	2.36	2.15	1.84	260.5
Mixed cultivars	11.78	22.60	66.80	2.43	1.89	1.61	270.0
Mixed cultivars	11.56	24.50	65.30	2.56	1.77	2.04	245.0
Mixed cultivars	12.67	23.70	68.10	2.22	1.56	1.78	271.0
2006 Average	**12.17**	**25.37**	**66.31**	**2.37**	**1.85**	**1.44**	**260.0**
	Year 2007						
Flamura 85	12.10	25.60	65.41	2.81	2.10	0.96	249.5
Dropia	12.12	25.80	66.21	2.89	1.93	0.90	252.8
Rapid	12.55	27.10	66.18	2.27	2.10	1.36	276.5
Alex	12.07	27.10	66.94	2.16	2.05	1.05	243.0
Mixed cultivars	10.98	22.80	65.23	2.89	2.14	2.14	223.0
Mixed cultivars	12.24	26.70	62.78	2.56	2.26	0.89	240.0
2007 Average	**12.01**	**25.85**	**65.45**	**2.62**	**2.09**	**1.21**	**247.4**
Average	**12.12**	**26.66**	**65.76**	**2.46**	**2.00**	**1.44**	**260.1**

From the assortment of analysed values, highest value of proteins content was remarked with Moara Domnească source, of 13.24%, followed by Mureş source with 13.15% and Poland with 13.10%.

An aspect worth to be signalled refers to the content in gluten from rye grains which was very low, respectively below 5%. This illustrates that this species must be used for baking in mixture with wheat flour. From the point of view of nutritive qualities, however rye distinguishes itself, by the fact that due to low content in gluten and to its composition, the grains may be used by people who present intolerance to gluten, respectively they present celiac disease.

Also, as a consequence of our research, we were able to acknowledge the low values of Falling Number, about 65 seconds, in average for the 3 years of experiments and which confirms a very low activity of α-amylasis enzymes for the baking process.

Concerning content in starch, this varied between 68.37% for Mureş source and 68.27% for Moara Domnească source. For lipids, content reached a value of about 2%, similar with the other years of experiments, same as for cellulose, where the content was almost same during all the experiments years, respectively of about 2.46%; for ash, the contents registered values of 1.68%, during all experiments years.

Table 2

Chemical composition of *Secale cereale* grains (% d.m.) (2004-2007)

Grains origin (provenance)	Proteins	Gluten	Starch	Lipids	Cellulose	Ash	Falling Number
	Year 2004						
Moara Domnească	13.62	3.35	67.50	1.20	1.80	1.58	78.0
Prahova	13.33	4.05	68.77	1.02	1.92	1.92	77.0
Mureş	13.31	4.09	68.75	1.00	1.94	1.94	76.0
Germania	13.28	4.78	70.30	1.10	2.10	1.63	82.0
Polonia	13.07	4.09	68.50	0.80	1.90	1.60	73.0
2004 Average	**13.32**	**4.07**	**68.76**	**1.03**	**1.93**	**1.71**	**77.2**
	Year 2006						
Moara Domnească	12.92	2.75	68.96	0.98	1.22	1.66	65.0
Prahova	13.02	3.67	69.67	0.76	1.67	1.76	64.0
Mureş	13.04	3.69	69.65	0.74	1.69	1.74	61.0
Slovenia	13.06	3.91	70.80	0.68	1.89	1.89	72.0
Grecia	13.12	4.38	69.30	0.59	1.94	1.71	57.0
2006 Average	**13.03**	**3.68**	**69.66**	**0.75**	**1.68**	**1.75**	**63.8**
	Year 2007						
Moara Domnească	13.20	2.27	68.35	1.03	1.60	1.58	57.0
Mureş	13.11	4.78	66.73	1.30	0.98	1.63	60.0
Prahova	13.08	4.01	67.60	1.04	1.48	1.60	61.0
Polonia	13.10	4.03	67.64	1.08	1.46	1.60	58.0
Grecia	12.98	5.02	67.78	0.86	1.83	1.60	65.0
2007 Average	**13.09**	**4.02**	**67.62**	**1.06**	**1.47**	**1.60**	**60.2**
Average	**13.14**	**3.92**	**68.68**	**0.94**	**1.69**	**1.68**	**67.0**

The chemical composition of *Triticosecale* grains was the following: moisture had as limits 10.31 and 12.51%; proteins between 14.29 and 14.64%; starch between 56.34 and 57.46%; lipids between 1.73 and 1.84%; celullose between 2.54 and 2.96%, ash betwen 2.00 and 2.07%; Falling Number between 121 and 126 seconds. An important aspect is constituted by the fact that *Triticosecale* grains presented a very low quantity of gluten, which varied

between 4.16 and 4.50% and which makes to be used in the baking process in good conditions, only in mixture with wheat flour. Also, due to fact that they are free of gluten, the products resulted from triticale grains processing may be used by people who present intolerance to this component.

Table 3

Chemical composition of *Triticosecale* grains (% d.m.) (2004-2007)

Grains origin (provenance)	Proteins	Gluten	Starch	Lipids	Cellulose	Ash	Falling Number
	Year 2004						
Moara Domnească	13.57	3.36	55.36	1.65	3.11	1.95	118.0
Călăraşi	14.28	4.37	56.35	1.85	2.84	2.05	121.0
Ilfov	14.30	3.89	56.33	1.84	2.86	2.03	119.0
Germania	15.25	4.07	57.45	1.78	2.89	2.12	126.0
Polonia	14.07	5.14	56.23	2.10	2.56	2.07	120.0
2004 Average	**14.29**	**4.16**	**56.34**	**1.84**	**2.85**	**2.04**	**121.0**
	Year 2006						
Moara Domnească	14.17	3.83	56.41	1.45	3.01	1.93	121.0
Călăraşi	14.50	4.78	57.06	1.70	2.97	1.99	122.0
Ilfov	14.52	4.11	57.10	1.80	2.95	2.01	121.0
Slovenia	15.02	5.02	57.62	1.84	3.00	2.06	129.0
Grecia	14.34	4.98	57.22	1.98	2.87	1.98	125.0
2006 Average	**14.51**	**4.50**	**57.08**	**1.75**	**2.96**	**2.00**	**123.6**
	Year 2007						
Moara Domnească	14.65	4.90	56.34	1.85	2.89	2.28	124.0
Ialomiţa	14.54	4.03	57.47	1.62	1.95	1.46	122.0
Ilfov	14.66	4.56	57.45	1.64	2.93	2.48	128.0
Germania	14.67	4.14	57.14	1.67	2.93	1.24	129.0
Polonia	14.68	3.89	58.90	1.87	2.01	2.89	127.0
2007 Average	**14.64**	**4.30**	**57.46**	**1.73**	**2.54**	**2.07**	**126.0**
Average	**14.48**	**4.32**	**56.96**	**1.77**	**2.78**	**2.03**	**123.5**

CONCLUSIONS

As a consequence of research performed during 2004-2007 for baking cereals, following conclusions concerning chemical composition and crop quality may be emphasized as important:

1. Moisture and dry matter content of grains were framed in regular limits for moisture of cereal species which reached maturity, respectively 10.79 and 12.66% for humidity and between 89.21 and 87.34%, for dry matter.

2. The chemical composition of wheat seeds was the following: water content between 11.59 and 11.89% and dry matter content between 88.11 and 88.41%, out of which: proteins between 12.01 and 12.20%; wed gluten between 25.37 and 28.78%; starch between 65.45 and 66.31%; lipids between 2.37 and 2.62%; cellulose between 1.85 and 2.09%; ash between 1.21and 1.68% and 247 and 272 seconds for Falling Number.

3. For rye, research distinguished following chemical composition: moisture between 11.15 and 12.92%; proteins between 13.03 and 13.32%; gluten between 3.68 and 4.07%; starch between 67.62 and 69.66%; lipids between 0.75 and 1.06%; cellulose between 1.47 and 1.93%; ash between 1.60 and 1.93%; Falling Number between 60 and 77 seconds.

4. By comparison, at triticale, following chemical composition was achieved: moisture between 10.31 and 12.51%; proteins between 14.29 and 14.64%; starch between 56.34 and 57.46%; lipids between 1.73 and 1.84%; cellulose between 2.54 and 2.96%; ash between 2.00 and 2.07%; Falling Number between 121 and 126 seconds.

5. For Falling Number, there was distinguished the common wheat, which presented an optimum activity of the α-amylasis enzyme, in comparison with rye and triticale, which had

a Falling Number comprised between 67 and 123 seconds. The intensity of α-amylasis enzyme activity puts conditions to the rheological traits of core, the husk colour, the taste and flavour of bread.

6. Another aspect worth to be signalled is the fact that gluten of rye and triticale grains was in a very low quantity, a lot inferior to wheat, respectively under 5%. On the other side, rye and triticale, due to the content reduced in gluten and to its composition may be used by people who present celiac disease. Also, the Falling Number presented very low values of only 78 and 120 seconds, this is expressed a lot lower baking quality in comparison with wheat. This makes that rye and triticale grains should be used in the baking process in good conditions, only in mixture with wheat flour.

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