PHYSICAL-CHEMICAL CARACTERISTICS OF *TRITICUM AESTIVUM* WHEAT FROM THREE ROMANIAN REGIONS

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ABSTRACT
The purpose of this paper was to determine the total protein content, gluten content, moisture, Zeleny sedimentation index, hectolitre mass and deformation index of *T. aestivum* wheat. The total protein content, gluten content, Zeleny sedimentation index and hectolitre mass was analyzed by the NIR, Infralum FT 10 cereal analyzer instruments. Humidity was determined by oven drying method and deformation index by thermostating. The samples were collected from three Romanian areas: West, South and Central. The highest total protein content was registered in wheat from South (13.5%), followed by wheat from West (13.2%), respectively from Centre (10.6%). The gluten content, in direct correlation with total protein content, was in the range 24% (wheat from Centre) - 30% (wheat from South). The deformation index of West and South samples was 5 mm, respectively 2mm of sample from Central. Wheat South Zeleny sedimentation index was 44 mL followed by West area wheat (49 mL) and wheat from Central (51 mL). The wheat samples hectolitre mass was very close, between 80.5-81.0 kg/hL. The humidity of the samples varied from 11.9% to 12.7%. The results recommend the wheat from South Romania area as being of high quality, followed by wheat from West Romania area. The wheat from Centre Romania area is of medium quality.

Keywords: wheat, humidity, gluten, protein, sedimentation index.

INTRODUCTION

For a production of over 7 million tonnes of wheat and a consumption of almost 3 millions tones, Romania has a theoretical possibility to exceed the importer position with the exporter once taking into consideration also a competitive price, because the neighbours (Ukraine, Hungary, Bulgaria and Serbia) also have an overproduction.
The common wheat is used for bread processing and it represents 90% of total wheat cultivated in the world, being known as autumn, spring respectively. The wheat is consumed mainly as bread and/or pasta. The wheat flour that results from milling is an important constituent of some dry mixtures, sauces or other processed foods. The wheat is processed in a large variety of bakery products due to the visco-elastic properties of the dough. (BELDEROK ET AL., 2000). The ratio between elasticity and extensibility establishes the final utilization of wheat. The wheat proteins determine the visco-elastic properties of the dough, depending on the forming of a dough net called gluten. (FERRANTI, 2004). The gluten quantity and quality (sedimentation index, deformation index) has been studied for 250 years to establish the optimal use in bakery processing. The gluten is isolated by dough washing, when the major soluble particles are eliminated, resulting a protein mass which presents elongation resistance. (BRZEZINSCHI, 2006). The gluten runs to 75% of protein dry matter, the difference representing starch and lipids.
The wheat physical-chemical characteristics and its quality depend on geographical area provenience being influenced by soil and climatic conditions.
The aim of this study was to assess the physical-chemical indicators (protein and gluten content, sedimentation index, deformation index, moisture and, hectolitre mass) which determine the bakery quality for wheat coming from three different Romanian areas: West,

South and Centre.
The climatologically conditions have a major influence regarding the wheat quality parameters, especially protein and gluten content, hectolitre mass and deformation index. The values of these parameters are improved by high temperature and low precipitation. (BIROU, 2011). In South and West Romania areas, the thermal and hydrological regime is characterized by higher temperature and lower precipitation compared to Centre Romanian area where the temperature is lower and the precipitation are abundantly (CONTRACT ADER 8.1.1., 2012; IANOSDAN DUMA, 2000)
Wheat samples were collected from a particular producer - West area, Timiș county, South area, Călărași county and Central area, Brașov county. All wheat samples originate from the same species: *Triticum aestivum* and belong to 2012 crop.

Determination of hectolitre mass, total protein content, gluten content and Zeleny sedimentation index
The analysis has been performed by using the NIR, Infralum FT 10 cereal analyzer. The determinations were made in the spectral range between 8000-14000 cm^{-1}. The powder samples have been put into the analyzer until they reached the top. The wall width was 6 mm. The physical-chemical parameter values have been directly displayed in the analysis report of the analyzer. (CARLOS, 2008; RABA ET AL., 2009; KADDOUR ET AL., 2008).

Determination of moisture content
In order to determine the water content, the oven drying method was used. (RABA, 2005). A sample of 5 g was weighed on analytical balance in a weighing vial, than the sample was introduced in oven at 105 $^{\circ}$C for two hours until a constant mass was obtained. After drying the vial was cooled in desiccators and then weighed again. Quantification of water content was done according to the relation:

$$U = (Mi - Mf)/ Mi \times 100 \qquad \text{(RABA, 2005)}$$

Where: U = moisture (%)
Mi= vial weight with sample before drying (g)
Mf= vial weight with sample after drying (g)

All determinations were performed in triplicate, calculating their arithmetic mean.

Determination of deformation index
Deformation index was determined by thermostating method. The principle of this method consists in maintaining a gluten sphere for 1 hour, at 30 $^{\circ}$C and diameter measurements before and after thermostating.
An amount of 5 g wet gluten was modelled as spherical, then measuring its diameter. The ball was introduced in thermostat at 30°C for one hour. After that the ball's diameter was measured again.
The deformation index was calculated with the relation:

$$I_D = D_f - D_i \qquad \text{(RABA, 2007)}$$

Where: I_D = deformation index (mm)
D_f = diameter before thermostating (mm)
D_i = diameter after thermostating (mm)
All determinations were performed in triplicate, calculating their arithmetic mean.

RESULTS

Hectolitre mass

(*Figure 1.*) presents the results on hectolitre mass for the three analysed wheat samples determined by NIR analyzer.

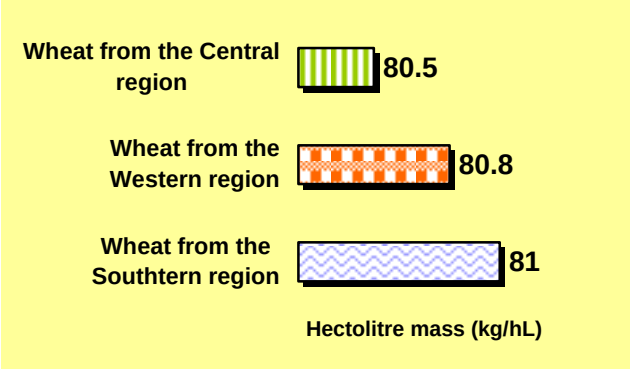

Figure 1. Hectolitre mass of analysed wheat samples

The results show closed values for these three wheat samples between 80.5-81kg/hL.

Humidity content

(*Figure.2*) presents the humidity values determined for the wheat samples subject to oven dry method.

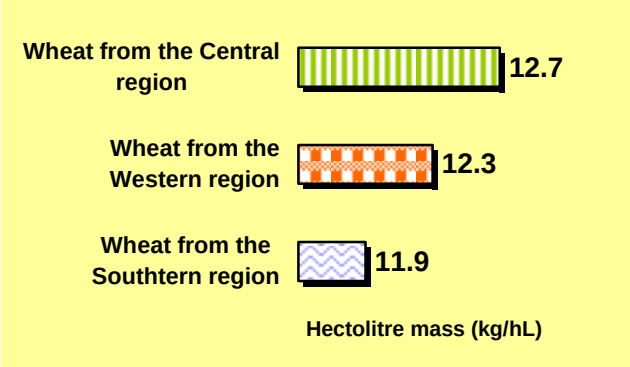

Figure 2. Humidity of analysed wheat samples

It can be observed that the water content of these three wheat samples are in conformity with the limits of the current legal international standard (max. 14%). The registered humidity values framed between 11.9-12.7%. (COMMON CATALOGUE OF VARIETIES OF AGRICULTURAL PLANT SPECIES 1996; COLECȚIE DE STANDARDE MORĂRIT PANIFICAȚIE, 2001)

Total protein content

(*Figure 3.*) shows the results on total protein content of the three analysed wheat samples determined by NIR analyzer.

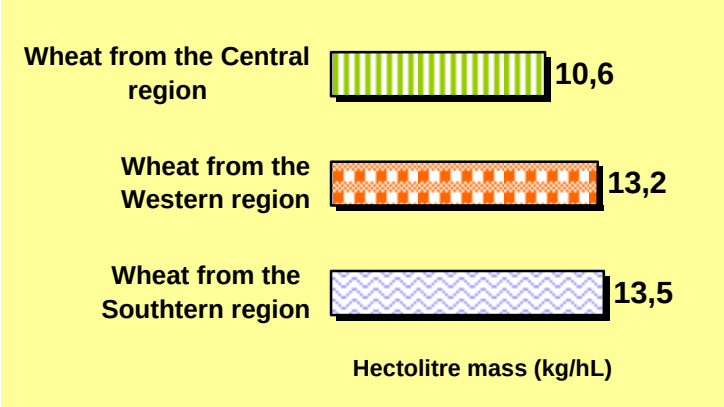

Figure 3. Total protein content of analysed wheat samples

For the three types of analyzed wheat, the highest content of protein was found in the wheat from South (13.5%), followed by the wheat from West (13.2%) and the wheat from Centre (10.6%). The obtained results are similar with literature data specifying the protein content in *T. aestivum* wheat is in range 10-12% (ANJUM ET AL., 1998; AUBRECHT, 1996; COMMON CATALOGUE OF VARIETIES OF AGRICULTURAL PLANT SPECIES, 1996; COLECȚIE DE STANDARDE MORĂRIT PANIFICAȚIE, 2001).

Gluten content

Results for the analysed wheat samples determined by NIR analyzer are showed in (*Figure 4.*).

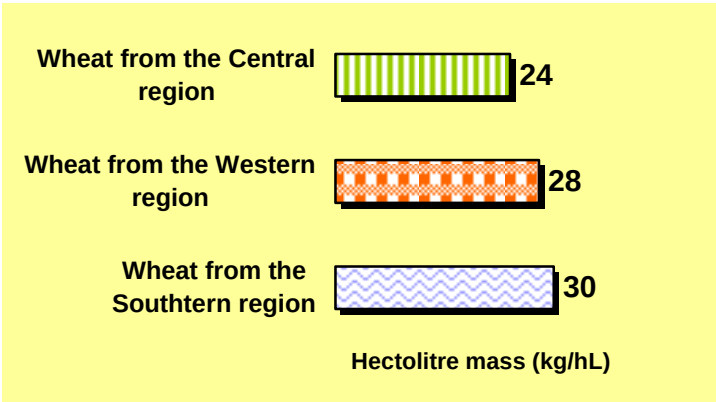

Figure 4. Gluten content of samples

Analyzing data obtained it can be seen that the wheat from South shows the highest gluten content (30%), followed by wheat from West (28%) and lowest gluten content was obtained for wheat from Centre (24%). These results are consistent to the total protein content of wheat samples analyzed.

Deformation index

The values determined by thermostating method for the analysed wheat samples are presented in (*Figure 5*).

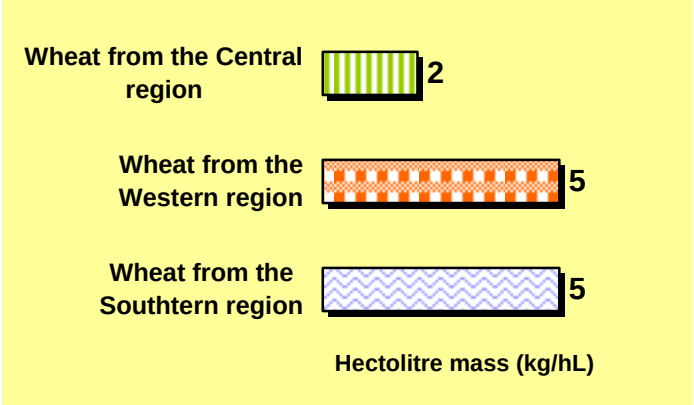

Figure 5. Deformation index of wheat samples

Zeleny sedimentation index

In *(Figure 6)* the Zeleny sedimentation index from the three samples of wheat determined by NIR analyzer are revealed.

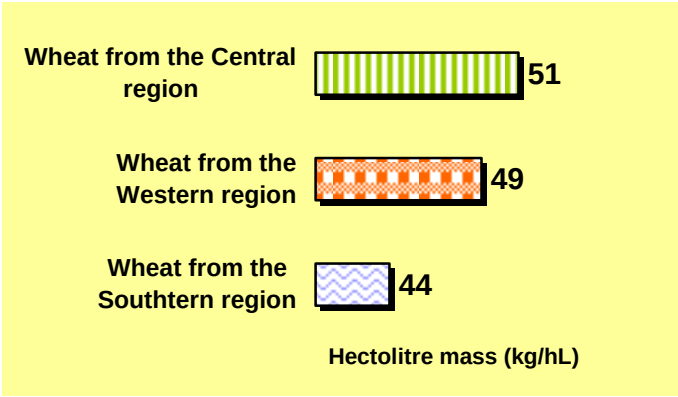

Figure 6. Zeleny sedimentation index of wheat samples

As it can be observed in figure 4, the highest sedimentation index was found in the wheat from Centre (51 mL), while the lowest is registered by the wheat from South (44 mL).

CONCLUSIONS

The analysis results of *T. aestivum* wheat from three Romanian areas, West (Timis county), South (Calarași county) and Centre (Brasov county) lead to the following conclusions:

- The influence of thermal and hydrological regime on wheat quality parameters was found in this study, in according to literature data.
- The results obtained for the studied physical-chemical parameter of samples are consistent with literature (ICC 116/1, 1994; ISO 5529, 1992; COLECȚIE DE STANDARDE MORĂRIT PANIFICAȚIE 2001) data and reveal that the wheat from South is the highest quality followed by the wheat from West and the wheat from Centre.
- The quantity and quality of proteins and gluten respectively found in the wheat from the Southern region and wheat from the Western region, recommend them for pastry industry, where the gluten content must be more than 28% and deformation index between 7-10mm

to allow obtaining the high quality products. [ANJUM F., ET AL., (1998), AUBRECHT E., (1996), COMMON CATALOGUE OF VARIETIES OF AGRICULTURAL PLANT SPECIES (1996), COLECȚIE DE STANDARDE MORĂRIT PANIFICAȚIE (2001)].

- Wheat from the Central region is optimal for bread processing because in order of Romanian standard the gluten content must be minimum 26% and deformation index between 5-12mm in order to obtain products with properly sensorial and physical characteristics such as volume, porosity and elasticity (ANJUM ET. AL., 1998; AUBRECHT, 1996; COMMON CATALOGUE OF VARIETIES OF AGRICULTURAL PLANT SPECIES, 1996; COLECȚIE DE STANDARDE MORĂRIT PANIFICAȚIE, 2001).

REFERENCES

ANJUM, F., BUTT, W., BUTT, M., WAHAB, S. (1998): Protein composition and technological properties of some old and new varieties, Sarhad Journal of Agriculture, v. 14(3), 253-257.

AUBRECHT, E. (1996): Gluten content of foodstuffs available in trade, Elelmezesi Ipar, v. 50(4), 112-115.

BELDEROK, B., MESDAG, H., MESDAG, A., DINGENA (2000): Bread making quality of wheat, A century of breeding in Europe, springer, 338-345

BIROU, A. (2011): Calitatea cerealelor destinate panificatiei si identificarea contaminarii cu pesticide, Teza de doctorat, Cluj Napoca.

BRZEZINSCHI, W. (2006): Electrophoretic patterns of wheat, triticale, barley and oat cultivars registered in Poland.

CARLOS, M. (2008): Discrimination of European wheat varieties using nearinfrared reflectance spectroscopy, Food Chemistry 106, pp. 386–389.

COLECȚIE DE STANDARDE MORĂRIT PANIFICAȚIE (2001)

COMMON CATALOGUE OF VARIETIES OF AGRICULTURAL PLANT SPECIES (1996): 19th complete edition, Official Journal of the European Communities: Information and Notices 39A, C272A.

CONTRACT ADER 8.1.1. (2011-2014): Evaluarea riscului privind contaminarea cu micotoxine a productiilor anuale de grau din Romania, Bucuresti 2012.

FERRANTI, P. (2004): Mass spectrometric approach for the analysis of food protein, Eurp. J. Mass Spectrometry 10, 349-358

IANOSDAN, D.A. (2000): Studii privind calitatea graului panificabil in Banat, Teza de doctorat.

ICC 116/1, (1994): Determination of sedimentation value (acc. To Zeleny) as an approximate measure of baking quality.

ISO 5529 (1992): Wheat-determination of sedimentation index-Zeleny.

KADDOUR, A., MONDET, M., CUQ, B. (2008): Application of two-dimensional cross-correlation spectroscopy to analyze infrared (MIR and NIR) spectra recorded during bread dough mixing, Journal of Cereal Science 48, 678–685

RABA, D., IN., I. TABĂRĂ, V., MENCINICOPSCHI, G., JIANU, I. (2009): Protein profile evaluation for some wheat species, food adulteration identification possibilities, Journal of Agroalimentary Processes and Technologies, *15*(3), 431-436

RABA, D., IN., I V. (2005): Tehnologia moraritului si panificatiei. Metode de analiza, tehnologie si retete de fabricatie, 25-26.

RUIZ, M., CARRILLO, J. (1995): Relationships between different prolamin proteins and some quality properties in durum wheat, Plant-Breeding, v. 114(1), 40-44