CORRELATION ANALYSES BETWEEN SOME TECHNOLGICAL PARAMETERS OF SOME ROMANIAN WHEAT VARIETIES GROWN IN THE SUCEAVA AREA

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Received 22 October 2010, accepted 6 February 2011

Abstract: *The wheat technological properties are mainly given by the particularities of gluten structure, by protein compounds respectively.*
The research in the area of gluten was made to identify the gluten protein fractions complex and find out the ratios between those fractions. The establishment of protein fractions of glutenines and gliadines are considered as mainly variables for the bakery potential of grains. Flour quality, proteins content and the ratio between glutenines and gliadines influence to a great extent the rheological properties of dough and the quality of bakery products implicitly.
This paper presents the research results following the selection and characterization, according to quality indexes, of eight wheat varieties, grown in the Suceava area. The objectives of this paper are to study the correlations between some technological parameters (acidity, pH, wet gluten, protein content) from the selected wheat varieties and identify their gluten proteins (gliadines and glutenines). From the statistical analysis significant direct correlations were obtained between raw protein and gliadines (r = 0.649), glutenines (r = 0.720), between wet gluten and glutenines (r = 0.741), gliadines (r = 0.704) and between gliadines and glutenines (r = 0.876).

Keywords: *wheat, gliadines, glutenines, statistical analysis*

1. Introduction

Wheat has always been considered an important source of food during the history of mankind as wheat caryopses satisfy to a great extent the nutritional demands of humans. Wheat is by far the most important cereal in bread making, though in some parts of the world the use of rye is quite substantial.
It is known that the gluten-generating proteins are responsible for the majority of differences occurring in the quality indices of bakery wheat flour. Although the varieties harvested at the Agricultural Research Station from Suceava are improved by a medium value of 14% for gluten proteins, they react differently in bakery.

Flour quality, protein content and the ratio glutenines/gliadines influence significantly the rheological properties of dough [1]. Gluten proteins are largely insoluble in water or dilute in salt solutions. Two functionally distinct groups of gluten proteins can be distinguished: monomeric gliadines and polymeric (extractable and non-extractable) glutenines. Gliadines and glutenines are usually found in more or less equal amounts in wheat. Gliadines represent a highly polymorphic group of monomeric gluten proteins with molecular weights varying between 30000 and 80000. Glutenines are a heterogeneous mixture of polymers with molecular weights varying from about 80000 to several millions.

Quantity and composition give the nutritional quality of grain protein. Protein accumulation in grain depends on several factors, such as wheat species, variety, weather conditions, natural soil fertility and nitrogen fertilizer doses used. Among these factors, climate conditions have a particularly important role, in dry and hot climates, the accumulation of protein in grain is favored, and on the other hand, during training and shorter grain filling, ripening is hastened. The gliadine and glutenine fractions from wheat represent 80 – 85 % from the endosperm proteins and those fractions form together the gluten. Usually both gluten fractions represent – in average – approximately half from the total amount of proteins from wheat. For a good wheat variety, the ratio gliadine/glutenine was found with values of 54.5/45.5. In order to explain the significance of this ratio, some suggestions were made that gliadines act as plastifying agent against gluten [2]. The main compounds of gluten are the glutenines with big molar weight which open themselves and act together, building a net. The glutenines are polymeric proteins with a various number of subunits, not necessarily the same (about 25), intermolecular bounded with disulphide bridges, hydrogen bridges, hydrophobic interactions and other covalent bindings [3]. The gliadines were less studied than the glutenines probably because the research was focused on the dough's rheology (and more precisely on the elasticity of gluten) associated with glutenines. If glutenines are associated with elasticity, the gliadines are associated with viscosity and plasticity of the dough. All gliadines act in the dough by increasing its plasticity, decreasing the kneading time, resistance and elasticity.

The largest part of wheat grain consists of carbohydrates (mostly starch) and this makes variation of grain yield, as well as variation of other grain components concentration, strongly associated with carbohydrates accumulation [4].

This negative correlation is caused by the fact that the most of yield is represented by carbohydrates (starch) and so the genotypes or the conditions that encourage the obtaining of high yields are bound to the capacity to accumulate higher amounts of starch in the grain, and that dilutes the protein content [5].

2. Materials and methods

Materials. The seeds' material used was represented by eight wheat grain varieties: Gasparom, Magistral, Enesco, Dropia, Flamura 85, Drobeta, Voronet, SV 2071-00, coming from SCDA Suceava experimental farms (harvested in 2008).

Methods. Flour quality tests were accomplished according to Romanian or international standard methods: ash content [6], moisture content [7], and wet gluten content [8]. The gliadine and glutenine content was determined, in conformity with the method described by [9] which separated them, based on the solubility of different solvents through an excessive extraction. The total nitrogen (%), raw protein (%) and gliadines and glutenines content were determined according to Kjeldahl method and consisted of sample mineralization by heating with 96% sulfuric acid in the presence of a catalyst. Following desegregation of proteins and other compounds containing nitrogen, free ammonium ions that react with sulfuric acid to form ammonium sulfate acid, were used. Ammonia released by strong alkalinization with NaOH 30% was distilled and then titrated with 0,1N H_3BO_3 in the presence of phenolphthalein. In this work, the titratable acidity, expressed as degrees (˚T), according to standard 90/1988, and the pH values, according to standard 8201/82 were determined.

Data analysis. Statistics 6.0 (Stat Soft Inc., USA) was used for data analyzing.

3. Results and discussion

The Table 1 shows the values of chemical parameters in grain belonging to eight wheat varieties. As can be seen, there were small differences between samples, especially between values of wet gluten, protein and water content.

Table 1
Chemical parameters for wheat variety analyzed
(mean ± standard deviation of analyses performed in triplicate)

Wheat variety	Water [%]	pH	Acidity [%]	Wet gluten [%]	Ash [%]	Raw protein [%]	Protein class			
							Gliadines [%]	% of grain protein total	Glutenines [%]	% of grain protein total
Gasparom	13.65±0.05	6.2±0.1	4.8±0.1	27.8±0.1	2.19±0.01	14.85±0.09	5.80±0.1	39.2	6.49±0.03	43.9
Magistral	13.70±0.1	6.6±0.1	4.2±0.1	28.8±0.1	2.2±0.01	15.20±0.1	6.01±0.05	39.6	6.70±0.12	44.1
Enesco	13.90±0.1	6.5±0.1	3.9±0.1	26.6±0.1	2.18±0.02	14.60±0.1	5.49±0.03	37.6	6.23±0.03	42.7
Dropia	13.50±0.1	6.7±0.1	4.6±0.1	28.9±0.1	2.14±0.02	15.30±0.1	5.83±0.04	38.1	6.55±0.05	42.8
Flamura 85	13.20±0.1	6.8±0.1	4.1±0.1	28.1±0.1	2.31±0.03	14.90±0.1	5.66±0.03	38.0	6.42±0.02	43.1
Drobeta	13.63±0.08	6.2±0.1	4.7±0.1	27.9±0.3	2.21±0.01	13.95±0.15	5.55±0.05	39.78	6.03±0.02	43.22
Voronet	14.08±0.08	6.3±0.1	4.6±0.1	28.3±0.5	2.25±0.01	13.95±0.15	5.35±0.05	38.35	6.09±0.04	43.65
SV 2071-00	14.15±0.05	6.4±0.1	4.4±0.1	27.9±0.3	2.29±0.01	13.70±0.1	5.45±0.05	39.56	6.05±0.05	44.16

The gluten proteins (between 80 and 85% of wheat protein total) are the major storage proteins of wheat. Gluten proteins are found in the endosperm of mature wheat grain where they form a continuous matrix around the starch granules. The first factor is the gliadine/glutenine ratio of gluten proteins. This is a direct consequence of the fact that, within the visco-elastic gluten protein network of wheat flour doughs, gliadines and glutenines play a different role.

The study of statistical links between the technological parameters of the analyzed sample of wheat indicates significant direct correlations: between raw protein and gliadines (r = 0.649), glutenines (r = 0.720), between wet gluten and glutenines (r = 0.741), gliadines (r = 0.704) and between gliadines and glutenines (r = 0.876).

By analyzing the obtained data, it can be concluded that all the eight types are of superior quality. The content of raw protein has very good values with an average of 14.53, varying between 13.70, the minimum value and 15.30 the maximum value. Likewise, the content of wet gluten has very good values, with an average value of 28.03, a minimum of 26.60 and a maximum of 28.90.

The positive correlation of raw protein and gliadine and glutenines respectively shows that an increase of raw protein will lead to an increase of the content of gliadines and glutenines. Likewise, the increase of wet gluten will lead to the increase of the content of glutenine and gliadine.

Figure 1 shows a graphical representation of the variation of wet gluten depending on glutenines and gliadines for all the eight types of wheat; and figure 2 shows the variation of raw protein depending on glutenines and gliadines.

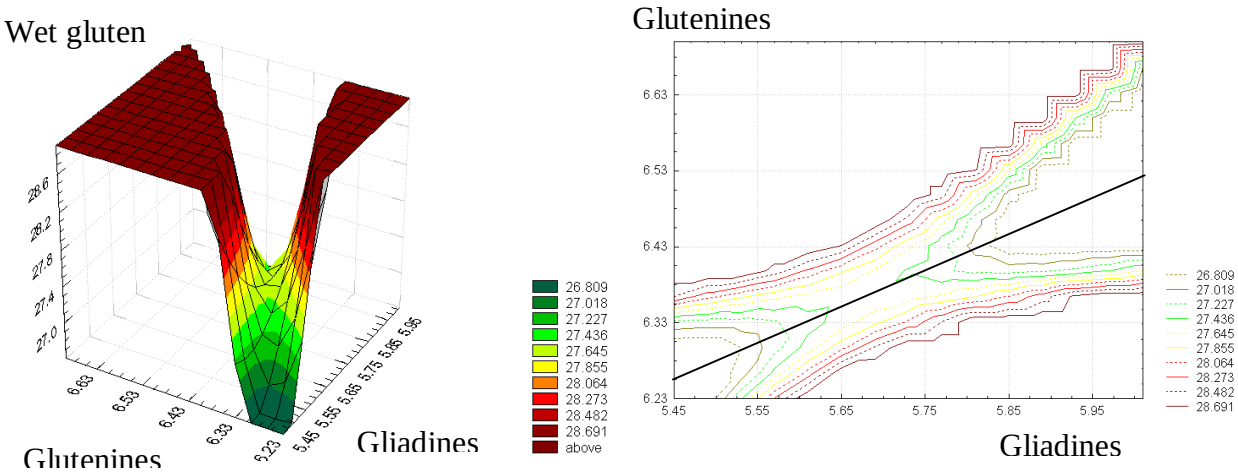

Figure 1.The graphical representation of addiction wet gluten = f (glutenines, gliadines): a) Spatial representation; b) representation of the dimension line.

The graphical representation of the values of wet gluten in relation with the glutenines and the gliadines are given in Figure 1.

The representation shows two bounds for the maximum value for wet gluten depending on glutenines. The first bound is reached when the gliadines have the value of ≈ 5.60% and the glutenines reach the value of ≈ 6.23%, and ≈ 6.01 for the gliadines and ≈ 6.38 for glutenines. The second bound is reached when the content of gliadines is 5.45% and the glutenines reach the value of ≈ 6.36%, ≈ 6.68% for glutenines and ≈ 6.01% gliadines.

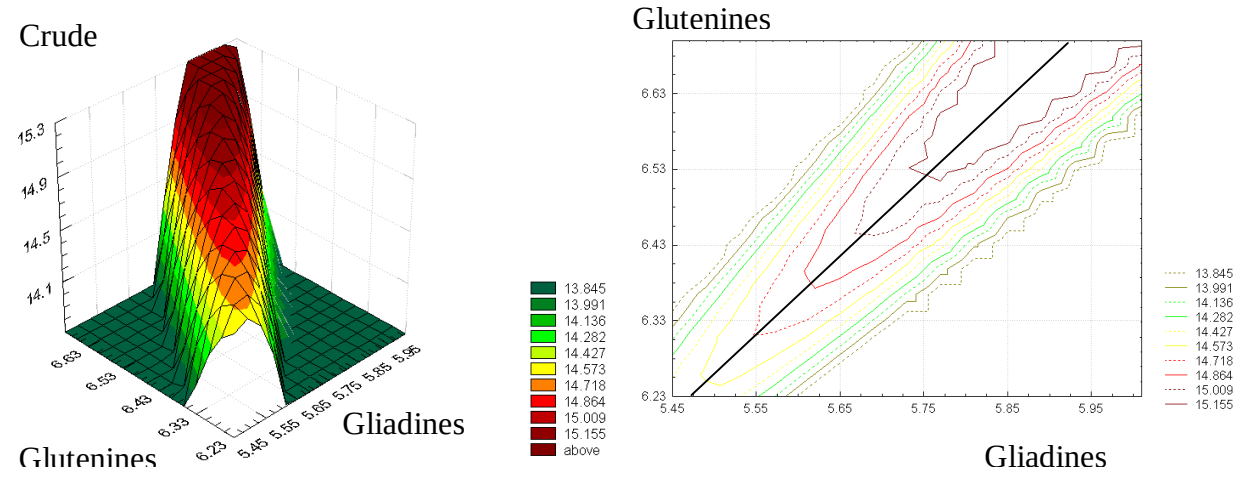

Figure 2.The graphical representation of addiction crude protein = f (glutenines, gliadines): a) spatial representation; b) representation of the dimension line.

Figure 2 shows that the raw protein parameter can have two values for the minimum bound depending on the value of gliadines and glutenines parameters. The first minimum bound is obtained when the gliadines reach the value of ≈ 5.6% and glutenines reach the value of ≈ 6.23%, gliadines - ≈ 6.01% and glutenines ≈ 6.60%. The second minimum bound is obtained when the gliadines represent 5.45% and glutenines ≈ 6.35%, gliadines represent ≈ 5.73% and glutenines ≈ 6.7%.
Likewise, it can be observed that at the value of ≈ 5.60% for gliadines and of ≈ 6.35% for glutenines, there is an inverse relation: the content of wet gluten is minimal while raw crude protein has a maximum value. The same of inverse relation is observed as well for the coordinates represented by the pair of points 5.45% for gliadines and ≈ 6.35% of glutenines. Maximum values of ≈ 30% for wet gluten and of ≈ 13.7% for content of raw protein are obtained for the above mentioned values for gliadines and glutenines.
The variation of wet gluten and raw protein depending on the content of gliadines and glutenines can be correlated easier using the equations of statistical models.

4. Conclusions

The analysis of the obtained data shows that the percentage of gliadine has a maximum value of 39.78% of the total content of proteins and the percent of glutenine has a maximum value of 44.16% of the total content of proteins. Of all the types of grain considered, it can be remarked that the best type from the point of view of the gliadines/glutenine ratio is the type Magistral, created at S.C.D.A. Suceava; similar results were obtained also for the type Gasparom.

The significant direct correlations between the technological parameters of types of grain indicate that an increase of raw protein will lead to an increase of gliadines and glutenines. Likewise, the increase of the content of wet gluten will trigger the increase of the content of glutenines and gliadines.
In the case of variation of raw protein depending on the two components, the angle of dependence between gliadines and glutenines is higher than the angle of dependence between gliadines and glutenines in the case of variation of wet gluten depending on gliadines and glutenines.

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