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STUDY ON THE IMPORTANCE OF USING THE GRADING SYSTEM IN WHEAT BLEND QUALITY MANAGEMENT

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Abstract

Cereals production, storage, processing and commercialization have to be done according to the rules and procedures mentioned in The Food Grain Grading Handbook in order to ensure a high quality along the whole process from raw material to final product. The storage of wheat in separate cells, based on the quality indicators mentioned in the Grading Handbook, facilitates the optimal milling blends, in order to obtain the assortment of flour required by bakery processors. In this context, this study aimed to present the importance of using wheat batches, graded according to the wheat grading system, to obtain milling blends in the technological wheat grinding process. Considering the hectoliter weight (kg/hl) indicator used as a benchmark in the grading process, two wheat samples were used: a grade 1 wheat sample (81.3 kg/hl) and a grade 2 wheat sample (75.2 kg/hl). Also, the research highlights the main quality indicators, which are taken into account when putting together milling blends: moisture, wet gluten, falling number, mechanical work. The use of graded wheat samples and the establishment of the proportion of wheat samples in the milling blend through rheological analyzes and baking tests, led to obtaining the type of flour with the intended bread manufacture properties. If it is not applied the grading system, the consequence is that mixing a small amount of lower quality wheat with a higher quality batch, will depreciate the final quality of the milling blend.

Key words**:** *wheat grading, milling blends, quality indicators*

INTRODUCTION

Cereals production, storage, processing and trading should be carried out according to the specific rules and procedures destined to ensure quality management along the food chain from raw material to final product.

In this respect, quality standards are the key tool put at the disposal of graders in order to fulfil their tasks.

In Romania, there is the Grading Handbook which contains a set of rules and procedures based on the national standards in force. For food grains, the handbook has been in force since 10 July 2017, as approved by Order 228/2017 of the Ministry of Agriculture and Rural Development (MADR) [12].

The Food Grain Grading Handbook is intended for use as a work instrument for graders. It is based on the classifications and grades established by the National Food Grain Grading System in Romania, and it includes information and work methods that the graders need to apply [5].

The biological properties of wheat play an important role in its procurement process [21]. The market value of wheat grain is determined by various factors such as kernel morphology, texture, test weight, and the shape of the germ [13]. Ponce-García et al [16] note that the physical quality of the kernel plays an important role for identifying the engineering characteristics of cereal crop grains, while [15] point out that studies concerning the relationships between wheat kernel physical properties and milling properties have been carried out since the beginning of the cereal processing industry.

Consequently, the quality of cereals is an essential element of the entire value chain, for the storage of cereal, the processing and, eventually, the provision of finished products to the beneficiary.

The monitoring and batching of the cereal received in the milling units is the first step needed to obtain products having a consistently superior quality [7]. This step is very important for the operations to be applied on raw material wheat, as a very good organization of the wheat according to its quality allows the processing unit to make blends so as to streamline both the production process, and the costs for the raw materials [4], [3].

The storage of wheat according to quality starts with the quantitative and qualitative reception [18].

The grading of food grains is the operation consisting of identifying and separating batches of cereals, pulses, and oleaginous seeds according to their appearance and physical condition or according to one of their special characteristics (SR ISO 5527:2002) Cereals. Terminology).

The grading system groups food grains by quality levels, which reduces transaction costs related to their marketing [17].

The grading system allows to protect the quality and the value of products of very high quality. Any failure to apply the grading operation leads to potential depreciation of the final quality of the product when blending a small quantity of low-quality product with a batch of the same product, but having superior quality [10].

The grading system enables better results of the research dedicated to variety improvement [9].

In this context, the purpose of the paper was to study the importance of using the grading system in wheat blend quality management.

MATERIALS AND METHODS

The first stage is the obtaining of the representative sample. The sampling is conducted according to the standard SR EN ISO 24333 Cereals and cereal products. Sampling [6]. Two graded wheat samples were used (a wheat grade 1 sample and a wheat grade 2 sample) which led to an optimisation of working time, while facilitating the obtaining of milling batches.

The blend made from the two wheat samples (*Triticum aestivum L.*), of differing qualities was analysed to determine the optimum mix for obtaining flour type 650, which is most often used to make bread. After the samples were pre-cleaned, the mass per hectolitre (SR EN ISO 7971-3/2010) and the moisture (SR ISO 712:0210) were determined for each wheat sample, using the fast analyser Perten 5200-A. This was followed by the milling of the samples, using two laboratory mills, respectively the Perten hammer crusher and the Chopin CD1 roll mill. The milled samples were then analysed to determine moisture using the Sartorius MA 45 Moisture Analyzer, as well as the wet gluten content (SR ISO 21415-2:2008) via the mechanical method, using the Yucebas Glutomatic System. The Falling Number (SR EN ISO 3093:2010) was determined, using Falling Number Yucebas, and also the rheological properties of the dough with the Chopin Alveograph (SR EN ISO 27971/2008). The Farinograph was also used, for the dynamic testing of wheat dough mixing properties, to assess the quality of the wheat and the processing of properties for this dough. The testing procedure is standardized in the international standards [14] (ICC standard 115/1, ISO 5530-1, AACC standard no 54-24) [1]. Kneading is a fundamental operation in bread manufacture technology. Its role is to render dough that is homogenous, cohesive, non-sticky, tenacious, elastic, and expandable. In the kneading process, the proteins are hydrated, the quantity of incorporated water increases, and the dough improves its consistency and acquires elastic qualities [11].

Gluten proteins play the main part in dough formation. In the presence of water, they swell up and, under the influence of the mechanical kneading action, they are joined together and make up the gluten. Its structure resembles a continuous network of protein-based films, which incorporate the starch granules and which lead to obtaining a dough capable of expanding under the pressure of fermenting gases. The gluten formation process is a complex one, and it occurs progressively in the dough [14].

To form the structure characteristic to the dough, intermolecular reactions are necessary. This is possible during kneading, when, as a result of protein hydration and of the energy transferred to the dough, the bonds conditioning the globular shape are broken.

In properly kneaded, high-quality dough, the protein film is homogenous and uniformly distributed around the starch granules [2].

The intensive kneading is characterized by a vigorous kneading of the dough, achieved at high rotative speed of the kneading arms. Such intensive kneading is aimed at increasing the number of sulfhydryl groups in the gluten proteins, which are capable of interacting with the intramolecular disulphide bonds. Thus, a network of gluten fibres is formed, having extremely fine openings, with high tensile strength [8].

After the mixing time ends, the dough is taken out of the mixer, it is let to rest for 5 minutes, and afterwards it is divided. The 45 minutes spent in the dough proofer are followed by the 15 minutes of baking time at 220°C in an electric oven.

RESULTS AND DISCUSSIONS

Table 1 indicates the results of wheat sample analyses. Samples 1(from wheat grade 2) and 2 (from wheat grade 1) are the initial samples, and the sample named *"wheat blend"* is a blend made up of 60% sample 1 wheat and 40% sample 2 wheat.

Table 1. Wheat sample quality indicators

Quality indicators for wheat	Wheat sample 1 (wheat grade 2)	Wheat sample 2(wheat grade 1)	Wheat blend
Moisture, (%)	12.3	11.3	11.8
Wet gluten, (%)	22.5	32.5	26.4
FN	435	458	450
W (J)	119	341	210
P/L	1.54	0.57	1.1
Mass per hectolitre, (kg/hl)	75.2	81.3	78.8

Source: original results.

The blend was selected according to Table 2, which contains the quality indicators of the two wheat samples. This table substitutes the standard calculation method for obtaining the milling batches. It is a much faster system, allowing for the identification of an accurate percentage. First the analyses for the wheat batches intended for use in production are input and, using the entered formulas, the appropriate parameters are selected to obtain the desired flour.

Table 2. Average analysis of wheat blend

Cell	Wheat sample 1(wheat grade 2)	Wheat sample 2(wheat grade 1)	Average analysis
Blending ratio (%)	**60**	**40**	**100**
Wet gluten, (%)	22.5	32.5	26.5
G index (%)	97	75	88.2
FN	435	458	444.2
P	71	88	77.8
L	46	115	73.6
G	15.1	27.6	20.1
W (J)	119	341	207.8
P/L	1.54	0.57	1,152
Ie	39.5	50	43.7

Source: original results.

According to Figure 1, upon analysing the most important parameters of the wheat samples (wet gluten, flour strength - W, mass per hectolitre), it can be noted that the 60/40 ratio is accurate, as the resulting parameters can be found mid-way between the values of the two samples from which the wheat blend was made, and the minimum quality requirements for milling are met.

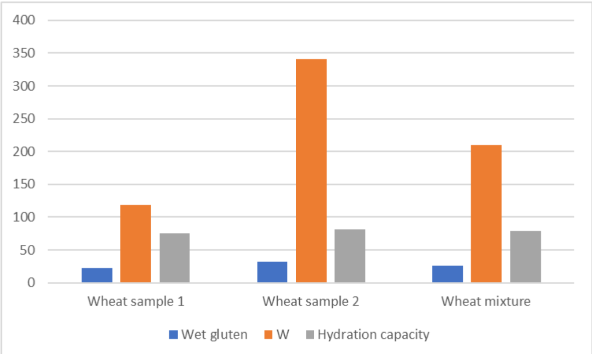

Fig. 1. Quality indicators determining the optimum make-up of the wheat blend
Source: original results.

Three flours obtained have no variation in colour or appearance, according to the ash content in Table 3.

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Table 3. Quality indicators of flours obtained from the wheat samples

Quality indicators for flour	Flour from wheat sample 1	Flour from wheat sample 2	Flour from wheat blend
Moisture	14.4	13.8	14.3
Wet gluten	24	33.6	27.8
FN	378	418	395
W	137	304	245
P/L	1.17	0.85	1.37
CH	52.5	62.8	61.5
Stability	5.32	9.42	7.49
Resistance (135 min)	404	744	614
Extensibility (135 min)	2.33	6.46	3.23
Ash	0.67	0.63	0.65

Source: original results.

Quality indicators determining the optimum composition of flours obtained from the wheat samples are shown in Fig. 2.

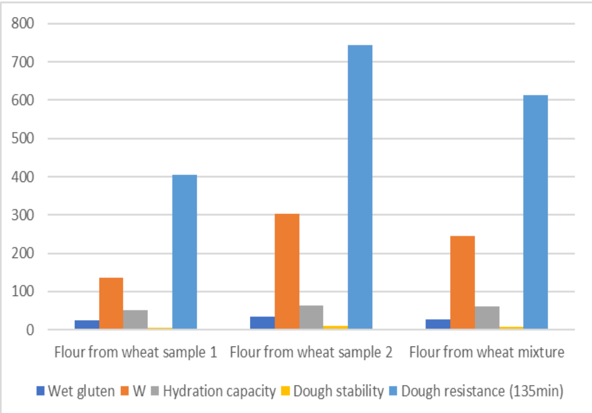

Fig. 2. Quality indicators determining the optimum composition of flours obtained from the wheat samples
Source: original.

The physical and chemical testing of the samples was followed by the baking test for each flour type. The recipe presented in Table 4 was used.

Table 4. Recipe for bread obtained from the wheat blend

Bread recipe	**Investigational flour test/kg**
Flour	100
Yeast	2.4
Salt	1.8
Water	55

Source: original.

This dough has a sticky consistency, with a shiny appearance, high extensibility, the dough gives very easily, and it is hard to process.

The wheat from the sample 2 flour has a very cohesive, strong consistency, it is very hard to process, the dough resists processing, and breakage effects occur on its surface.

The dough using the blend of the two wheat samples is a cohesive dough, with a smooth appearance, easily extensible, it does not resist processing, it improves its tenacity and gas retention capacity, it is highly tolerant upon proofing.

After the 45 minutes spent in the dough proofer, we can notice the behaviour of the dough by looking at the slit and the behaviour of the dough [19],[20]: in the case of the wheat flour originating from wheat sample 1, the slit is not straight, it is not sufficiently proofed, and in the case of the dough made from sample 2 wheat flour, we can note slight over fermentation and, upon slitting it, the knife sticks to the dough and it rendered the slitting difficult.

In the case of the dough obtained from the wheat blend flour, we noted proper proofing, the knife moved easily upon slitting, with no sticking marks.

Photo 1. Section in the bread obtained from wheat sample 1
Source: original.

The bread obtained from the flour milled from wheat sample 1 is a bread having poor volume, it is flattened, it seems slightly sodden, its surface is whitish, the core has small dense pores. The height of the bread is just at 6 cm, and its width is of approximately 10 cm (Photo 1).

The bread obtained from the milled flour of wheat sample 2 seems to be a bread that was forced to proof, it broke on the edges, and the colour of the crust is dark brown in patches, the core has non-uniform pores.

The part that was in contact with the tray is packed and the phenomenon called "bottom crust" was created. The height of the bread is 7.3 cm, the width is 9 cm (Photo 2).

Photo 2. Section in the bread obtained from wheat sample 2
Source: original.

The bread obtained using the flour milled from the wheat blend 60% wheat 1 and 40% wheat 2 is one that has a uniformly baked crust, a core with non-uniform, but loose pores (Photo 3).

Photo 3. Section in the bread obtained from the blended wheat sample
Source/original

CONCLUSIONS

The grading of wheat as a raw material is an essential instrument in determining purchase price. The application of the grading system included in the Grading Handbook is a guarantee of the fact that the manufacturers will obtain a fair price for their product, according to its quality. Thus, the manufacturers will be encouraged both in terms of yield, and in terms of quality. The application of the grading system secures the constant quality of the stored food grains, sustaining internal and international transactions.

The grading system allows silo managers and transporters to organize the storage system for food grains in a more efficient manner. It improves the manufacturing/sales costs ratio and the price of food grains.

The preliminary tests performed on wheat in the laboratory provide clear and accurate information on its quality and they facilitate the storage/batching process.

The determination of moisture in the raw material is one of the key factors for establishing how it is stored.

The quantity and quality of moist gluten provide clear information on the properties of the intermediate product, namely the dough.

The hydration capacity is directly influenced by the grinding grade and the quality of the flour gluten, providing clear information on the stability of the intermediate product, the dough, in the manufacturing process.

The determination of mechanical work helps the milling facility classify the wheat so that it may be stored according to its quality, so that the flour milled from the respective wheat to be of good quality;

The baking test is the key element that accurately indicates the behaviour of the flour during the technological process. A flour type may have the same physical and chemical parameters, but a completely different behaviour in the dough.

The storage of wheat in batches, according to its grade, leads to an optimisation of working time, of the available storage area, while facilitating the obtaining of milling batches. The importance of milling batches consists of the fact that a product of uniform quality is obtained, and this has a positive influence on the clients' perception regarding the finished product.

The analysis of the blends clearly highlighted the importance of milling batches for obtaining flour of target quality for the finished product.

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