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# The importance of wheat conditioning in the production of wholemeal flours

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**Abstract**

The grinding technique evolved along with the development of mankind and today it has become a real industry. The need to diversify flour assortments has raised the performance of the milling industry and, more than that, the products obtained are of superior quality due to the new machines and techniques for conditioning and grinding. By conditioning we mean the treatment of wheat with water or water and heat. It can be said that, among the technological operations of preparing wheat for mills, conditioning is the one that most influences the technological process of mills, the degree of extraction, the content of mineral substances of the flour, the separation of the germs and implicitly the baking properties of the flour. The essential parameters taken into account in this stage are the moisture content and the degree of hardness of the wheat grain. When determining the degree of extraction, the hectoliter weight has the major impact. Normally, an extraction of over 95% is sought when we talk about wholemeal flours. With the latest generation machines and their control with the help of new technology, 100% wholemeal wheat flours are obtained. The degree of extraction also influences the physico-chemical parameters of the flour and, of course, the ash content. Enzymatic activity of flour depends on the degree of extraction, and wholemeal flour is richer in enzymes than white flour. This difference is primarily due to the distribution of non-uniform enzymes in the wheat grain, starting from the core of the wheat grain to its periphery. Wholemeal flour contains significant amounts of bran and germs – the finer the bran, the darker the color of the flour – so it is important that the bran particles are larger and rarer for the flour obtained from the endosperm to express its characteristics in a meaningful way in the finished product.

**Keywords:** wholemeal flour, wheat conditioning, quality

## 1. INTRODUCTION

Wholemeal flour, derived from the entire grain kernel, provides a nutritious alternative to refined flours, as it retains the bran and germ layers, which contain essential vitamins, minerals, and dietary fiber. Wheat conditioning, an integral stage in the milling process, plays a pivotal role in determining the overall quality of wholemeal flours. Conditioning involves adjusting the moisture content and temperature of the wheat before milling, facilitating desirable physical and chemical changes in the grain structure.

Water content is an important element in storage. If the wheat contains less than 13%, it is stored in good conditions. More than 14% of moisture results in biochemical processes of fermentation that determine the alteration of the wheat grain. Moisture influences the physical properties: resistance to crushing and plasticity of the coating. Therefore, grains with low moisture are crushed strongly, producing semolina and the yield in white flour decreases, at the same time worsening the quality of the flour, whereas those with high moisture demand a high consumption of energy when grinding, and cleaning the semolina is difficult and reduces the yield in flour (Danciu 2001).

Gluten proteins - the wheat grain contains proteins between 9.5 and 17.8% depending on the variety, the average value being 14.5%. These proteins contribute to the unique viscoelastic properties of dough, allowing it to stretch, trap gases, and retain its structure during fermentation and baking. The largest amount of protein is found in the endosperm. The endosperm contains 72.1%, the aleurone layer 18.4%, the embryo 6.6% and the coats only 2.8% (Danciu 2001). Gluten proteins can be categorized into two main fractions: gliadins and glutenins. Gliadins are predominantly responsible for the extensibility and viscosity of the dough, while glutenins contribute to its elasticity and strength. The proportion and composition of these proteins can vary among wheat varieties, impacting the dough's handling characteristics and the final product's texture and appearance (Bordei 2000).

Starch, as a major component of wholemeal flours, plays a crucial role in determining the quality and functionality of the end product. It serves as a key source of energy and a structuring agent in baking processes. The starch present in wholemeal flour undergoes complex changes during conditioning, impacting its behavior and functionality in dough formation and breadmaking. Moreover, the starch in wholemeal flour serves as a readily available energy source for yeast fermentation during breadmaking. The optimal gelatinization of starch through conditioning ensures efficient yeast activity and a desirable volume in the final baked product. By exploring the significance of conditioning, this review paper aims to highlight its crucial role in achieving optimal wholemeal flour production (Costin 1983).

### 1.1. Conditioning

The conditioning operation consists in adding the optimal amount of water so that, as time passes, the water penetrates the grain. Through the penetration of water into the grain, its cohesion weakens. Of particular importance is the difference in humidity between the peel and the core. This difference is realized by optimizing the resting time of the wheat after wetting. The resting time must be set so that the largest amount of water remains in the shell so that its degree of elasticity increases and it does not crumble when grinding. The optimal humidity resulting from conditioning is influenced by the characteristics of the wheat Leonte.

Excessive wetting leads to a decrease in the production capacity of the machines and an increase in energy consumption; insufficient wetting worsens the grinding process.

The factors that influence grinding can be systematized into several essential groups – the physico-mechanical properties and the rheological properties of wheat, the functional characteristics of the machines and the rheological properties of the wholemeal flour to be obtained.

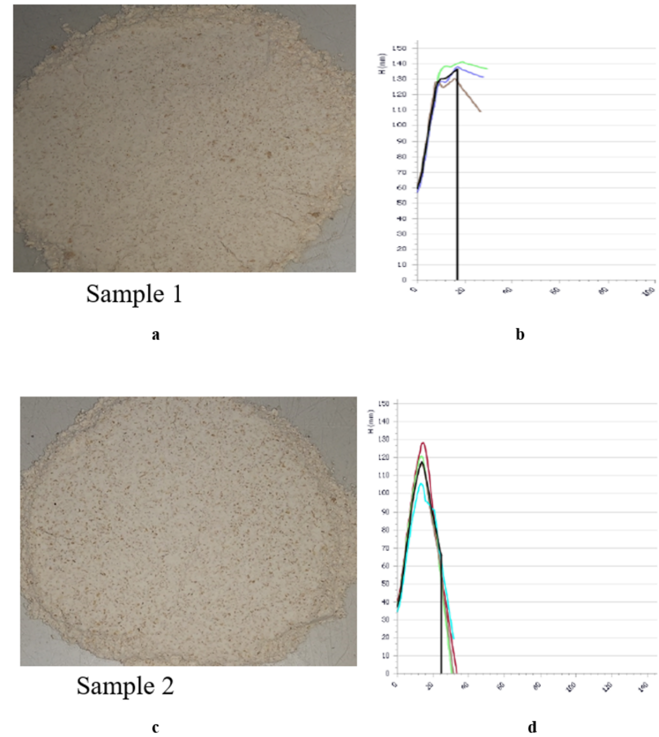


**Figure 1.** Used wholemeal flours with alveograph curves: a) Sample 1- standard wholemeal flour, b) Alveograph curves for sample 1, c) Sample 2 - modified wholemeal flour, d) Alveograph curves for sample 2.

To demonstrate the importance of wheat conditioning in order to obtain wholemeal flour, a batch of 25,000 kg of wheat which was subjected to the test as follows: for sample 1, 12,500 kg of the wheat batch was moistened to a moisture of 15% and kept at rest for 8 hours and milled with the standard version for wholemeal flours. For sample 2, the other 12,500 kg of the same batch of wheat were moistened to 16% moisture and kept at rest for 16 hours and milled with tight rolls 10'. Sample 1 and Sample 2 are apparently the same type of flour, but the milling process was different for each of them. From the laboratory analysis we can realize that these two flours will not have the same behavior during the formation of the dough as shown on Figure 1b vs 1d.

The graphs on the right represent the alveograph curves, and the table below presents the rheological properties for each sample. Obviously, the quality of the two samples differs significantly.

At the mill, the first action is carried out through a series of steps that separate the good grain from everything else (other seeds, straw and dust, stones, metal parts, etc.). Hard impurities such as stones and metal objects must be removed to avoid damaging the rollers the grinding machine. The same rule applies in the labora-

**Table 1.** Rheological and physical-chemical analyses of whole meal flours.

| Parameters | Sample 1 | Sample 2 |
|---|---|---|
| Moisture,% | 13.3 | 14.2 |
| Ash,% | 1.2 | 1.5 |
| Wheat gluten,% | 27.5 | 28.8 |
| Power, P | 152 | 130 |
| Extensibility, L | 16 | 25 |
| Strain energy, W | 153 | 192 |
| P/L | 9.5 | 5.2 |

tory where, again, the sample must be cleaned before any further action. The "grindable" parts are most often composed of other seeds that are removed during cleaning according to their size or density. The objective is to ensure the purest wheat flour possible, without including foreign seeds that may also be harmful.

The second phase consists of conditioning the wheat. The objective is to temper the grain to facilitate the separation of the bran from the inner endosperm (the floury core) from which the flour is extracted. This is an essential stage for obtaining the maximum amount of flour (extraction rate) of a defined quality (through ash rate). The amount of water to be added depends on the initial moisture content of the wheat – the drier it is, the more water will need to be added, sometimes in two stages, and the amount to which the wheat will be milled (which will influence directly the moisture content of the flour).

Wheat conditioning is a crucial step in the production of wholemeal flour. It involves the controlled application of moisture to wheat grains before milling, to achieve an optimal milling process and produce high quality flour. The importance of wheat conditioning lies in its ability to improve the physical properties of wheat grains, making them easier to grind and reducing the production of flour with unwanted particles or impurities. Conditioning also helps to preserve the bran and germ of the wheat kernel in the milling process, which is essential for the production of wholemeal flour. By applying moisture to the wheat kernel, the outer layers of the kernel become more flexible and easier to separate from the endosperm, the starchy center of the kernel that is used to make flour. This reduces the amount of bran and germ that is lost during milling and results in a higher yield of wholemeal flour. In addition to improving yield, conditioning wheat also helps produce a more consistent and uniform product. By controlling the moisture content of the wheat kernels, the milling process can be more finely tuned, resulting in flour with a more consistent particle size distribution, color and flavor.

In general, wheat conditioning plays a crucial role in the production of high-quality wholemeal flours. Without it, the milling process would be less efficient and the resulting flour would be of lower quality. Therefore, it is essential that wholemeal flour producers invest in high-quality wheat conditioning equipment and carefully control the moisture content of wheat grains throughout the milling process (Francis. 2000).

## 1.2. Factors Affecting Wheat Conditioning

Several factors influence the effectiveness of wheat conditioning. Moisture content, grain temperature, conditioning time, and grain variety are key parameters that must be carefully controlled to achieve desired outcomes. Moisture content directly affects the milling process by influencing the breakage and separation of grain components. Appropriate grain temperature is crucial as it influences the water absorption and enzymatic activity during conditioning. Conditioning time must be optimized to ensure proper water distribution and minimize excessive energy consumption. Furthermore, different wheat varieties possess unique characteristics that impact their response to conditioning, making it essential to consider these factors for consistent wholemeal flour production (Dziki D 2005).

## 1.3. Effects of Wheat Conditioning

### 1.3.1. *Effects on Physical Properties*

Wheat conditioning significantly influences the physical properties of wholemeal flours. Proper moisture absorption ensures adequate tempering, leading to improved milling efficiency, reduced breakage, and enhanced bran retention. Conditioning also affects the rheological properties of the dough, influencing its viscoelasticity, extensibility, and handling characteristics. By optimizing the conditioning process, millers can achieve the desired particle size distribution, water absorption, and dough development, ultimately affecting the texture and appearance of the final wholemeal flour products (Morris 2004).

### 1.3.2. *Effects on Chemical Properties*

Chemical changes occur during wheat conditioning, impacting the nutritional composition and functionality of wholemeal flours. Enzyme activity is activated or deactivated depending on the conditioning conditions, affecting the degradation of starch, proteins, and lipids. Optimal conditioning promotes enzymatic activity that enhances the availability of nutrients, improves dough stability, and contributes to the development of desirable flavor compounds. Additionally, conditioning plays a crucial role in controlling the oxidative rancidity of the wheat germ, which preserves the flour's sensory quality and shelf life (Morris 2004).

#### 1.3.3. *Effects on Functional Properties*

The functional properties of wholemeal flours, such as water absorption, dough development, and bread volume, are strongly influenced by wheat conditioning. Adequate moisture content ensures optimal water absorption, enabling the development of a well-structured dough with desirable viscoelastic properties. Conditioning also affects the gelatinization of starch, contributing to the overall texture and crumb characteristics of baked products. Understanding and controlling the conditioning process can help millers achieve improved functional properties, allowing for the production of wholemeal flours with enhanced baking performance and consumer appeal (BĂISAN 2021).

## 2. METHODS FOR QUALITY CONTROL IN WHOLEMEAL FLOUR PRODUCTION

### 2.1. Moisture determination

This analysis is carried out according to EN ISO 712:2010, being the reference method used in the case of litigation. Rapid methods using metrologically verified equipment are usually used.

We can say that moisture is the mass loss suffered by a product. To determine the moisture in wheat, it is necessary to grind the wheat under conditions that allow a result to be obtained corresponding to the one obtained by the absolute method described in the standard.

To carry out this analysis, an oven that maintains a constant temperature between 130 °C and 133 °C is necessary (ASRO 2017c).

### 2.2. Content of wet gluten

In general, the alternative techniques specified in the ISO 21415 standard for the separation of wet gluten, namely manual washing and mechanical washing, do not give equivalent results. This is because, for the complete development of the gluten, it is necessary to leave the dough at rest. That is why, in general, the result obtained by manual washing is higher than that obtained by mechanical washing, especially in the case of wheat with a high gluten content. In conclusion, the technique used must always be specified (ASRO 2017a) Grau si faina de grau. Continut de gluten. Partea 2).

### 2.3. Determination of mechanical work – Alveograph method

The behavior during the deformation of the dough obtained by homogenizing the flour sample with salt water is evaluated. A piece of dough is subjected to a constant stream of air; in the first moments it resists the pressure, then depending on its extensibility, it swells in the form of a bubble and breaks. This evolution is recorded in the form of a curve called alveogram (ASRO 2017b) Cereale si prod use cerealiere. Grau comun).

## 3. CONCLUSIONS

The management of the conditioning operation always takes into account the type of flour to be ground. In the case of wholemeal flours, conditioning is carried out with water, with a lower percentage than for white flours. For each type of wheat there is an optimal humidity, at which the milling process proceeds normally. Not knowing and not respecting the optimal values leads to an inappropriate technological process with negative influences on the quantity and quality of the products. Wheat conditioning is the process of adjusting the moisture content of wheat grains before they are stored or processed. This process is important to prevent deterioration and loss of quality of the wheat grains, as well as to ensure a constant quality of the flour obtained from them.

The process of conditioning wheat involves exposing the grain to steam or water to increase its moisture to an optimal level. This optimum moisture level may vary depending on the subsequent storage or processing conditions of the wheat. Typically, the desired moisture content of wheat grains varies between 15 and 16%, depending on the conditions of storage and subsequent use.

Proper wheat conditioning leads to numerous beneficial effects on the physical, chemical, and functional properties of wholemeal flours. It enhances milling efficiency, bran retention, and dough rheology, ultimately impacting the texture, appearance, and baking performance of the final products. Additionally, wheat conditioning influences the enzymatic activity, nutrient availability, and oxidative stability of wholemeal flours, contributing to their nutritional value and sensory attributes. By understanding and implementing effective wheat conditioning techniques, millers, researchers, and food technologists can meet the growing consumer demand for wholemeal flours while ensuring the production of healthier and more appealing food options.

In conclusion, wheat conditioning is an essential process in flour production and wheat grain storage. This process helps maintain the quality of the wheat grains and ensure a high flour yield, making the flour production process more efficient and economical.

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