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# Study on the influence of flour protein content on the dough rheological properties for bakery products

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#### Abstract

Rheology can be defined as the study of how materials deform, flow or fail when force is applied. Food rheology focuses on the flow properties of single food components, which might already display a complex rheological response function, the flow of a composite food matrix, and the effect of processing on the food structure and its properties. For processed food the composition and the addition of ingredients to obtain a certain food quality and product performance requires deep rheological understanding of single ingredients their relation to food processing, and their final [1]. Full understanding of the rheological behavior of flour dough is of great importance from the practical point of view. Dough rheology affects directly the baking performance of flours, and rheological analyses have been made in order to optimize dough formulation. Although dough rheology has long been investigated, there remains a significant lack of understanding. This lacks of progress is due to the complexity of this biological system. The purpose of this study was to determine the influence of the protein content of the flour on dough rheological properties, and, also on the indicators of quality of the finished product: specific volume index ascorbic acid h / l, core porosity. To carry out the tests in the segment "bread" flour type 650 Baneasa was chosen like witness. The protein content was varied by adding vital gluten, depending on the capacity of hydration, to reach wet gluten content in the same meal 22%, 26% and 30%. This way of working was chosen to eliminate any other influence of other flour parameters on the quality indicators of the finished product. For the relevance of this study, the samples obtained were evaluated by extensograph, farinograph, alveograph and baking tests. The conclusions of the analysis performed on three samples with different content Baneasa flour gluten proteins are the following: it increases the capacity of hydration, increases dough stability, increases energy and decreases dough softening index. These phenomena improve dough machinability and finished product's characteristics.

Keywords: vital gluten, rheological behavior, bakery product

1. Introduction

Wheat proteins have a complex composition. Gluten proteins represent almost 85% of flour protein total and are reserve proteins of endosperm. The primary structure of gluten proteins includes almost 20 amino acids. Among these, polar and non-polar amino acids are present

in approximately equal proportions (40% each), while the ionizable ones (acid and basic) in proportion of almost 8%. The biggest proportion of the amino acid total is held by glutamic acid (approx. 40% present especially in the form of glutamine, its amide) and proline (approx. 15%), and in the smallest proportion: lysine (2,1%), arginine (1%), tryptophan (1,1%) and cystine (1,9%). In the secondary

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structure, polypeptide chains of gluten proteins have reduced spiraling degree, most of them being in non-spiraled form, fact due to the presence of proline in a greater proportion, which by means of nitrogen atom in pyrrolidine nucleus hinders the free rotation of peptide bonds.

Gluten proteins influence decisively the development of technological process and bread quality. They participate in the following processes: while kneading they bind almost half of the water absorbed by flour; after hydration and mechanical action of kneading, they form the gluten network of protein films which most of the dough rheological properties depend on such as: resistance, extensibility, elasticity, consistency; while fermenting, the gluten network retains fermentation gases leading to loosened products.

Rheological testing has become a powerful and preferred approach to examine the structure and the fundamental properties of wheat flour dough because of its characteristic and sensitive response to the structure variation of wheat flour dough. Food rheology focuses on the flow properties of single food components, which might already display a complex rheological response function, the flow of a composite food matrix, and the effect of processing on the food structure and its properties. For processed food the composition and the addition of ingredients to obtain a certain food quality and product performance requires deep rheological understanding of single ingredients their relation to food processing, and their final discernment [1].

The link between dough rheology and baking quality has been already established mainly due to empirical evidence from manual assessments such as kneading or stretching of dough by bakers after mixing. However, the results from conventional descriptive methods and fundamental rheological studies on doughs have often given disappointing correlations with baking quality, mainly because the deformation conditions in these tests are very different from those occurring during proof and baking [3].

Dough rheology is of considerable importance in bread and biscuit manufacturing as it influences the machinability of dough and the quality of end product [2].

The quality of baked products is governed by rheological properties of dough [6]. This preceding rheological evaluation of the dough is good indicator of dough handling properties. Dough rheology characterization is an important parameter in the evaluation of biscuit wheat quality and indicates dough handling properties and the tendency of the dough to contract [4]. Several methods including mixograph, farinograph and extensograph are used for characterization of the rheological properties of biscuit dough [5]. and proteins present in wheat flour governed these rheological properties. Molecular size and structure of the gluten polymers that make up the major structural components of wheat are related to their rheological properties via modern polymer rheology concepts. The purpose of this study was to determine the influence of flour protein content on dough rheological properties, and, also on the indicators of quality of the finished product: specific volume, ascorbic acid index h / l and core porosity.

## 2. Materials and method

To make the tests in the segment "bread manufacture", the 650-type Baneasa flour was chosen where the protein content varied. The present study aims to focus on the influence of flour protein content on dough rheological properties and on other quality parameters of the finished product: specific volume, ascorbic acid index h / l and core porosity. After having made the choice, certain quantities of vital gluten were added to flours, depending on its hydration capacity to reach wet gluten content in the same flour of 22%, 26% and 30%. This way of working was chosen to eliminate any other influence of other flour parameters on the quality indicators of the finished product. As can further on be noticed, some quality parameters of flour and of dough made from this flour respectively will be improved by higher protein content. For the relevance of this study, the samples obtained were evaluated by extensograph, farinograph, alveograph and baking

# 3. Results and Discussion

**3.1 Assessment of quality chosen flours:** Three flour samples were analyzed, the results being shown in figures 1 and 2.

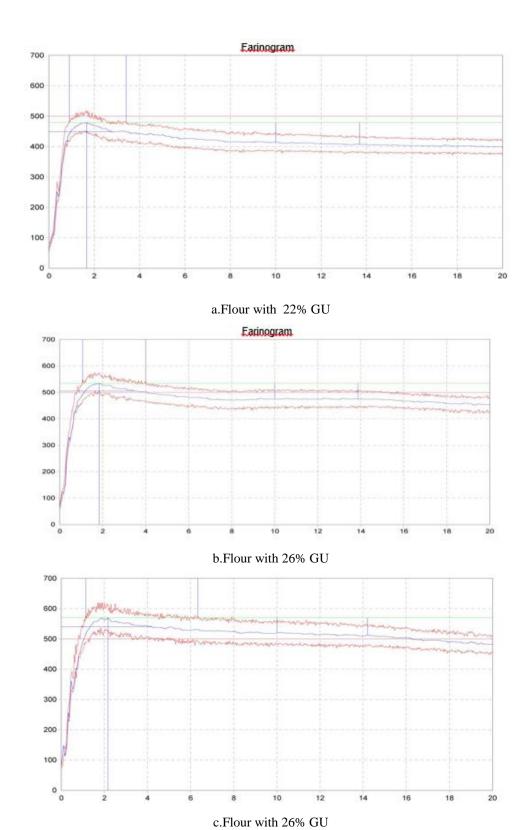


Figure 1. Farinograph curves for flour samples with wet gluten (GU) varied content

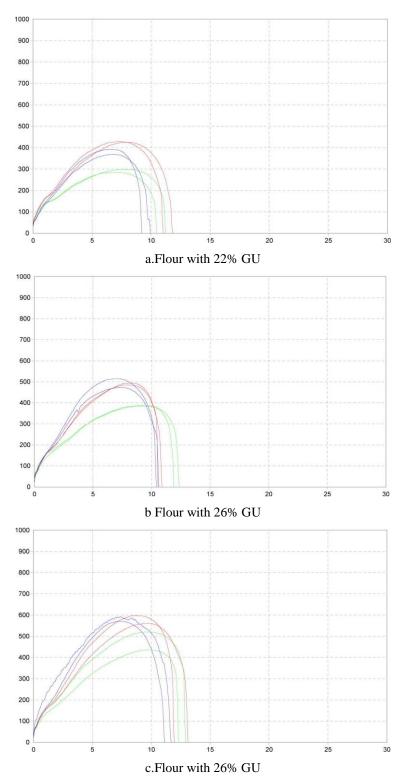


Figure 2. Extensograph curves for flour samples with GU varied content

Table 1. Technological profile of flour samples

BĂNEASA FLOUR 22% GLUTEN		BĂNEASA FLOU	JR.	BĂNEASA FLOUR		
		26% GLUTEN		30% GLUTEN		
Wet Gluten , %	22	Wet Gluten, %	26	Wet Gluten , %	30	
Deforming index, mm	2	Deforming index, mm	2.5	Deforming index , mm	2	
CH, %	60	CH, %	61.4	CH, %	62.3	
Dough stability, min	2.5	Dough stability, min	2.9	Dough stability, min	5.2	
Energy (la 45 min )	44	Energy (la 45 min )	63	Energy (la 45 min )	78	
F.N.	358	F.N.	348	F.N.	363	
Softening index, UF	72	Softening index, UF	60	Softening index, UF	58	

Table 2. Manufacture recipe of 300g bread loaf

Info: Protein influence		Subject:		Subject:		Subject:	
Room Temp	33°C	F Baneasa	22 %	F Baneasa 2	6%	F Baneasa 30 %	
Environment humidity	35%						
Ingredients		g	%	g	%	g	%
Flour		1000	100	1000	100	1000	100
Water		600	60	610	61	620	62
Salt		15	1.5	15	1.5	15	1.5
Yeast		25	2.5	25	2.5	25	2.5
Sugar		0	0	0	0	0	0
Fat/ Oil	·	0	0	0	0	0	0

Table 3. Profile of baking samples obtained from the three flour samples

Dough firmness (1-3)	1		2		3			
Dough elasticity (1-3)	1		2		3			
Dough clamminess (1-3)	3		2		1			
Core porosity	87%		87%		88%			
H/L	0.49		0.67		0.7			
Specific	597 loaf	453	628 loaf	462	671 loaf	495 shock		
volume		shock	shock					
Observations								
Dough rest	Flattened a	and soft						
Modeling	Sticky and soft		Very good behavior		Very good behavior			
Fermenting	Flatte	ned	best volume					
			Good shape		best shape			
Shock tray	All flattened and with lower volume							
Baking	Low, a little flattened		Corresponding volume		Best volume, with slight			
-	volur		and sh		shrinking tendency			

The results obtained from the analysis of curves are shown in table 1. The conclusions of the analysis performed on three samples with different content Baneasa flour gluten proteins are the following: it increases the capacity of hydration, it

increases dough stability, it increases energy and decreases dough softening index. These phenomena improve dough machinability and finished product's characteristics.

### 3.2 Baking tests

In order to obtains some available data, it were making baking test. The formula for bread is shown in table 2.

After baking, the samples were cooling 6-8 hours in controlled atmosphere (UV lamps). In order to be exam from sensorial point of view (after 24 hours), the samples were sliced for packed in plastic bags.

The results obtained are shown in table 3. From the data obtained one can notice that bread volume is directly proportional with the gluten protein quantity present in flour.

Low gluten protein content in flour determines difficult machinability of dough on the technological chain and leads to non-corresponding products both from the point of view of shape and of volume.

The ratio h/l offers information on the shape of finished product:

- first sample flattening tendency;
- second sample corresponding shape,
- third sample slight shrinking tendency.

It can also be noticed that porosity of bread core is very little influenced by gluten protein content. **Compliance with Ethics Requirements.** Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human / or animal subjects (if exist) respect the specific regulation and standards.

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