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# THE INFLUENCE OF THE KNEADING ARM REVOLUTION ON THE BREAD QUALITY

**L. Ruska*, A. Timar*, Chereji Rodica****

*University of Oradea, Faculty of the Environment Protection
** The Sanitary Veterinary Office and The Food Safety Bihor, Oradea

***Abstract***

*In this paperwork it was determined the influence of the kneading arm revolution on the bread quality at slow kneading and fast kneading. Bread was prepared from flour obtained from wheat harvested in different years, in which the climatic conditions during the growth of plants were different, so there were used two sorts of flour obtained from wheat grown in a droughty year and two sorts of flour obtained from wheat grown in a rainy year. It was found that these climatic conditions influence in a different way the technological qualities of dough obtained from these sorts of flour, respectively the finished products obtained from them. Thus depending on the qualitative characteristics of the sorts of flour, which are directly influenced by the growing conditions (climatic conditions), the way of behaving during processing within the technological process is different.*

**Key words**: wheat, bread preparation, slow kneading, fast kneading.

## INTRODUCTION

The dough is a colloidal dispersion in which different phases are dispersed: gaseous phases, liquid fats, yeast, starch granules and other solid phases included in a continuous protean matrix, with a liquid phase (water) in which the other components introduced by the formula are to be found, soluble or in various forms. (1)

Kneading is an apparent homogenization of the mass consisting of the dough's ingredients. At the beginning of the kneading it is formed a mass like a wet piece with little consistency. Gradually, the consistency grows, the dough develops its elastic properties and starts to emerge outside the mixing vessel. Continuation of kneading makes the dough lighter and apparently drier. Obtaining these desirable properties is called dough development.

If kneading continues, the dough will eventually lose its elasticity, it becomes more difficult to extend and sticky, it acquires a somehow fluid character. The conventional procedure is the mixing of the dough at a moderate speed up to 30 minutes, with an energy of 15 kj/kg, followed by a period of fermentation of one up to several hours. (2,3,4).

**MATERIAL AND METHOD**

There were used 4 genuine varieties of wheat, whose characteristics are shown in the table 1, and the characteristics of the flour obtained from this wheat are shown in the table 2.
G1- Alex wheat; G2- Partizanka wheat; G3- Romulus wheat; G4- Partizanka wheat.
G1 and G2– wheat from the year 2004 harvest
G3 şi G4 – wheat from the year 2005 harvest
2004 was a droughty year and 2005 was a rainy year.

*Table 1*

Wheat's characteristics

| Characteristic | G1 | G2 | G3 | G4 |
|---|---|---|---|---|
| Humidity, % | 13,25 | 12,21 | 12,32 | 13,53 |
| Ash, % | 1,58 | 1,18 | 1,09 | 0,81 |
| Protein content, % | 14,33 | 14,28 | 14,93 | 12,74 |
| Humid gluten, % | 26,2 | 27,8 | 27,6 | 22,3 |
| Humid gluten deformation, mm | 6,5 | 7 | 10,5 | 11,5 |
| Sedimentation value- Zeleny,ml | 50 | 40 | 52 | 38 |
| Gluten value, % | 41,33 | 42,95 | 36,36 | 27,93 |
| Maltose value, mg/10g | 264,56 | 211,51 | 196,56 | 192,56 |
| ***Falling Number:*** | | | | |
| -Falling value | 434 | 383 | 305 | 352 |
| ***Cell graph*:*** | | | | |
| -Energy $W*10^{-4}J$ | 68 | 94 | 110 | 107 |
| -Maximum pressure (P), mm | 96 | 85 | 95 | 88 |
| -Extensibility value, (G) | 8,6 | 11,6 | 11,9 | 12,2 |
| -Extensibility (L), mm | 15 | 27 | 29 | 30 |
| - P/L ratio | 6,46 | 3,12 | 3,34 | 2,94 |
| -Elasticity value (Ev),% | 0 | 0 | 0 | 0 |
| ***Consistency graph*:*** | | | | |
| - Test's humidity ($H_2O$),% | 11,80 | 12,20 | 12,40 | 12,60 |
| - Maximum pressure (Max pr),mb | 2072 | 3106 | 2400 | 2419 |
| - Water absorbed (Wa),%b | 53,1 | 57,7 | 54,6 | 54,7 |
| -Water hydration degree(Hydha),%b | 50,6 | 55,2 | 52,1 | 52,2 |
| - Water absorbed (Wa),%b14 | 54,9 | 59,6 | 56,4 | 56,5 |
| -Water hydration degree(Hydha),%b14 | 52,4 | 57,0 | 53,9 | 54,0 |

*Table 2*

The sorts of flour's characteristics

| **Wheat of origin** | **G1** | **G2** | **G3** | **G4** |
|---|---|---|---|---|
| **Characteristic** | **F1** | **F2** | **F3** | **F4** |
| Humidity, % | 14,60 | 13,77 | 14,08 | 14,42 |
| Ash, % | 0,64 | 0,48 | 0,55 | 0,38 |
| Protein content, % | 13,25 | 13,44 | 13,37 | 10,60 |
| Humid gluten, % | 28,5 | 29,5 | 30 | 23,7 |
| Humid gluten deformation, mm | 5 | 5,5 | 9,5 | 8,5 |
| Sedimentation value- Zeleny,ml | 48 | 37 | 44 | 36 |
| Gluten value, % | 47,73 | 48,45 | 41,47 | 34,30 |
| Maltose value, mg/10g | 290,18 | 253,36 | 253,45 | 217,93 |
| Acidity, % | 2,5 | 2,6 | 2,4 | 2,3 |
| ***Falling Number:*** | | | | |
| -Falling value | 451 | 394 | 296 | 270 |
| ***Cell graph*:*** | | | | |
| -Energy W*$10^{-4}$J | 104 | 185 | 108 | 223 |
| -Maximum pressure (P), mm | 72 | 81 | 69 | 101 |
| -Extensibility value, (G) | 15 | 19,1 | 15,8 | 18 |
| -Extensibility (L), mm | 46 | 74 | 50 | 65 |
| - P/L ratio | 1,58 | 1,09 | 1,39 | 1,55 |
| -Elasticity value (Ev),% | 27,4 | 44,6 | 30,7 | 48 |
| ***Consistency graph*:*** | | | | |
| - Test's humidity ($H_2O$),% | 14,60 | 13,80 | 14,10 | 14,40 |
| - Maximum pressure (Max pr),mb | 2807 | 3045 | 3072 | 3117 |
| - Water absorbed (Wa),%b | 56,4 | 57,4 | 57,6 | 57,8 |
| -Water hydration degree (Hydha),%b | 53,9 | 54,9 | 55,1 | 55,3 |
| - Water absorbed (Wa),%b14 | 58,2 | 59,3 | 59,4 | 59,6 |
| -Water hydration degree (Hydha),%b14 | 55,7 | 56,8 | 56,9 | 57,1 |

**Yeast** – Pakmaya (commerce)
**Salt** – extra soft table salt (commerce)
**Water** – drinking water from the water supply

**The operational program for obtaining the dough was the following:**
-preparing the ingredients (flour, water, yeast, salt);
-weighing: flour 500 g, water according to CH, yeast 10 g, salt 10g);
-salt dissolution: it is taken a part from the weighed water according to CH and the salt is dissolved;
-yeast dispersion: it is taken the amount of water left and it is put in it the weighed amount of yeast and it is mixed until the pieces of yeast disappear;
-dosage: to the flour is added the water solution in which the yeast was dispersed
-mixing;
-the solution in which salt was dissolved is added;
-kneading.

In preparing the dough it was measured the flour temperature and, according to it, it was heated the water that it is included in the dough. The dough temperature before kneading must be between 26-28$^0$C.

Baking was made in forms (stainless steel baking tin) and between the dough and the form will be put baking paper in order to avoid the sticking of the product after baking.

Baking was done in a laboratory oven.

**The operational program for obtaining the products was the following:**

- *with slow kneading,*

it was kneaded with a mixer with spiral at low speed for 18 minutes, then it was left to rest for 20 minutes, it was modeled, put in the form, left to leaven (final fermentation) for 50 minutes, then the baking was done at 230$^0$C for 35 minutes, cooling in the form 2 hours, it was taken out of the form and cooled 2 more hours.

- *with fast kneading*

it was kneaded with a mixer with spiral at low speed for 2 minutes, then it was mixed at high speed for 8 minutes, it was left to rest for 20 minutes then it was modeled, put in the form, then the final fermentation was done for 50 minutes, it was baked at 230$^0$C for 35 minutes, it was left to cool in the form for 2 hours, it was taken out of the form and cooled 2 more hours.

**RESULTS AND DISCUSSIONS**

In tables 3,4,5,6 are shown the influences of the kneading arm revolution on the bread quality obtained from the sorts of flour F1, F2, F3, F4 at slow and fast kneading of bread (dough).

*Table 3*

The influence of the kneading arm revolution on the bread quality at slow and fast kneading from flour F1

| Test from flour F1 | SLOW KNEADING | FAST KNEADING |
|---|---|---|
| Volume | 305 | 315 |
| Porosity | 74 | 76 |
| Elasticity | 94 | 94 |
| Acidity | 2.6 | 2.6 |
| Organoleptic estimation | Taste and smell specific to the product, golden yellowish peel, crumb with a uniform porosity | Taste and smell specific to the product, golden yellowish peel, crumb with a uniform porosity |

*Table 4*

The influence of the kneading arm revolution on the bread quality
at slow and fast kneading from flour F2

| **Test from flour F2** | **SLOW KNEADING** | **FAST KNEADING** |
|---|---|---|
| Volume | 315 | 330 |
| Porosity | 75 | 78 |
| Elasticity | 94 | 94 |
| Acidity | 2.6 | 2.6 |
| Organoleptic estimation | Taste and smell specific to the product, golden yellowish peel, crumb with a uniform porosity | Taste and smell specific to the product, golden yellowish peel, crumb with a uniform porosity |

*Table 5*

The influence of the kneading arm revolution on the bread quality
at slow and fast kneading from flour F3

| **Test from flour F3** | **SLOW KNEADING** | **FAST KNEADING** |
|---|---|---|
| Volume | 310 | 330 |
| Porosity | 78 | 78 |
| Elasticity | 94 | 94 |
| Acidity | 2.5 | 2.5 |
| Organoleptic estimation | Taste and smell specific to the product, golden yellowish peel with a darker shade, crumb with a uniform porosity | Taste and smell specific to the product, golden yellowish peel with a darker shade, crumb with a uniform porosity |

*Table 6*

The influence of the kneading arm revolution on the bread quality
at slow and fast kneading from flour F4

| **Test from flour F4** | **SLOW KNEADING** | **FAST KNEADING** |
|---|---|---|
| Volume | 325 | 280 |
| Porosity | 78 | 74 |
| Elasticity | 94 | 88 |
| Acidity | 2.6 | 2.6 |
| Organoleptic estimation | Taste and smell specific to the product, brown yellowish peel, crumb with a uniform porosity, slightly breakable | Taste and smell specific to the product, brown yellowish peel, crumb with a uniform porosity |

## RESULTS AND DISCUSSIONS

After the analysis of the results, it is found that the changing of the mixer's arm revolution, with which the dough kneading takes place, influences the physico-chemical characteristics of the finished product. By comparing the products obtained through higher revolution of the mixer's arm with the ones obtained through a slower kneading (low revolution of the mixing arm), it has been noticed that the changes are influenced by the amount of gluten and its qualities. Thus, at the products obtained from flour F1, F2, F3 through mixing at a higher revolution, it is noticed an improvement of the characteristics, like volume and porosity, while at the products obtained from flour F4 it can be noticed a significant decrease of these qualitative parameters.

The growth in volume and porosity of the tests obtained from flour F1, G2, F3 through mixing at a higher revolution is due to the higher content of gluten. Characteristic of the mechanical development of the dough is the quantity of energy and the speed with which it is transmitted to the dough. The specific energy consumption for the sorts of flour with a higher content of proteins is bigger (25-35 kJ/kg dough). The most significant growth could be noticed at the products obtained from flour F1 and F2. This can be explained through the fact that these sorts of flour, besides the higher content of gluten, they have a lower deformation value, which denotes a tighter connection between gluten proteins, which, when more intensely kneaded, they were in a small extent fragmented, in this way increasing the dough's elasticity. At the same time, by increasing the mixing arm's revolution it is achieved a finer dispersion of the air in the dough and respectively, a more intimate contact with the dough's components and, as a consequence, the oxidation processes in the dough are much more intense. Similarly, by more vigorous shaking of the dough due to the increasing of the mixing arm's revolution during kneading, it is accompanied by the increasing in the number of pores formed in the dough, which lies at the basis of forming the porosities in the bread, knowing the fact that during kneading there are formed no more pores, and around these nuclei it is formed the carbon dioxide resulted from the fermentation.

In the case of the products obtained from flour F4 at a higher revolution of the mixing arm, it could be noticed a considerable decrease of the qualitative parameters (volume, porosity), because of the lower protein content. The specific energy consumption for these sorts of flour is smaller (10-20 kj/kg dough), and by increasing the mixing arm's revolution it is

induced a greater energy than it is necessary, overcoming the critical value, which leads to the degradation of the links between gluten proteins, the partial destruction of the gluten microfilm which results in a substantial decrease of the capacity to retain the fermentation gases and the finished product has a lower volume and a flattened, unrisen shape.

## CONCLUSIONS

The preparation method influences a lot the organoleptic characteristics of the finished product, thus those obtained by slow kneading are much more superior from this point of view (taste, aroma) but in the case in which some technological qualities of the flour are inferior (gluten's quantity and quality), the finished products obtained through this method are much more reduced qualitatively (volume, porosity).

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