Bulletin of the *Transilvania* University of Braşov
Series II: Forestry • Wood Industry • Agricultural Food Engineering • Vol. 8 (57) No.1 - 2015

THE EFFECT ON SALT ADDED TO THE DOUGH RHEOLOGICAL PROPERTIES OF THAT AND QUALITY OF WHITE BREAD

C. M. CANJA[1] M. I. LUPU[1]
A. MĂZĂREL[1] V. PĂDUREANU[1]

Abstract: *This paper studies the effect of the added of salt in bread dough on its rheological properties and the quality of white bread. Table salt was added in a percentage varying between 0 and 2.5%, each of them being determined with the help of specific apparatus, the rheological characteristics of dough and physico-chemical indices of the bread resulting from the baking thereof. Following experimental research found that salt has a crucial role in obtaining high quality products, helping to develop loaf volume, conservation status of freshness for a long time and not least helps to improve the taste and aroma.*

Key words: *sodium chloride, salt, flour, volume, conservation, freshness.*

1. Introduction

Bakery products are some of the most consumed food products, which constitute the bottom nutritional, regardless of time or we refer to the applicable parts of the world. Since ancient times, bread was considered sacred food, accompanying her man be born when all key stages of its life. Bread can be considered an important source of energy, protein, micro and macro elements.[7]

Bakery products are the main food resource of the world. Bread, known since 2500 years ago in terms of both preparation and fermentation of dough, and the baking also, is still the subject of research to improve biotechnology; processes taking place are only partially elucidated. In particular the changes that occur in complex colloidal system of kneading dough during fermentation and its, protein complex transformations under various compositions of dough and place in fermentation processes through application baking techniques are studied in many countries. [6]

This study falls into the category of those carried out to obtain bread and bakery products of superior quality, products that can be consumed safely and with pleasure.

Terms of kneading or kneading intensity operation, the amount of energy transmitted to the dough, length decreases with increasing speed kneading arm. Duration of kneading profoundly influence dough properties, could lead to optimal development, incomplete development or overkneading. [4]

[1] Transilvania University of Braşov, Faculty of Food and Tourism

2. Formation of the dough and rheological properties

Formation of the dough and rheological properties are influenced by a number of Factors [7]:

2.1. The quality of the flour

Dough made from flour of poor quality differs from the one prepared from good quality flour. The dough made from flour lean protein skins break easily, even before distributing them evenly into the dough. The dough made from good quality flour proteins are hydrated and elastic, overkneading, protein shows imprints relatively few snags.

2.2. The amount of water

Higher or lower than the water necessary to achieve normal consistency prolongs the kneading. Dough's of low consistency are very sensitive to overkneading, unlike the rich who have a great tolerance.

2.3. Electrolytes, especially salt (NaCl)

Yet neutral salts change the nature and intensity of the hydrophobic interactions of the proteins gluthenic. Increasing ionic strength in the batter following the introduction of salt reduce water retention capacity of the protein. [5]

The salt is incorporated into foods to print a special taste, but it has multiple roles, such as: a good preservative, breeder of the texture, colour enhancer.

3. Rheological properties of dough bakery

According to the definition given by the International Organization of Standardization (IOS Standard 5492/1/1977), rheology of foodstuffs is the science that deals with the study of deformations and flow of raw materials, intermediate products and finished products in food industry.

Rheology of support as the old models with uniform bodies i.e. those whose behaviour is described with the help of linear laws. Perfectly elastic solid (Hooke), perfectly plastic solid (St.Venant) and pure viscous fluid (Newton) are specific rheological properties of bodies.[8]

Rheological properties of deformation as expressed of the dough under the action of external forces are exercised upon him.

Dough made from wheat flour is a non-linear viscoelastic. He possess properties that are characteristic of both solid and liquid, and therefore has a behaviour intermediate between solid bodies and fluids: ideal when subjected to stresses, part of the energy is dissipated, and the other part is stored. [4]

Legally, the dough rheological is characterized by elasticity, viscosity, relaxation, creep. All these properties are due for the most part gluten that forms from the mixer, but also how it interacts with other components of flour and ingredients of the dough. [9]

The elasticity of the dough is conferred by gluten, but especially glutenine, and lies in the fact that the dough deforms reversibly to a specific force applied, after which he is irreversibly disfiguring. The dough is elastic that appears in the instant application of force, and a delayed elasticity, which occurs after removal of the force. [7]

Viscosity is the property of bodies to oppose the warp. The viscosity of dough is apparent viscosity, which unlike the viscosity of liquids depends not only on temperature and pressure, but also a range of other factors such as the speed of shear, the process it has undergone before the dough. [8]

Easing is the process of resorbing, the lowering of the internal tensions of the dough, keeping in shape. Tension expansion driven by gradual transition to elastic plastic strains in global deformation response. Relaxation does not occur until the cancellation of internal tensions, but up to a specified limit, the limit of elasticity under that relaxation does not evolve. [4]

Relaxation time represents the time interval in which the tension in the dough shrinks from 2,7183 times, respectively, the base of natural logarithms = 2,7183.

Creep is the property of a solid body of flowing slowly and continuously under a constant load. [4]

4. Materials and method

Research method consisted in the study of the influence of the quantity of salt (raw) posted on the rheological properties of dough and bread-making quality characteristics.

In order to achieve the primary objective of this research was necessary to navigate the sequential and solving various complementary objectives:

• determination of qualitative raw material subjected to experimental research;

• determination of rheological parameters of dough from the flour used assortment;

• determination of rheological parameters of dough made with salt added in different concentrations.

• determination of qualitative indices of the finished products obtained.

Experimental research on the materials used were: wheat flour type 650, whose characteristics are presented in table 1., compressed yeast for bread-making, food salt, having quality characteristics specified in SR 13360: 1996 and drinking water.

For the preparation of dough was used for indirect method (biphasic). It consists of the preparation of the flour, water and yeast. The dough is prepared from fermented ingredients and remaining flour, water and salt. The kneading of the dough is a 10 minute, 28˚C and the temperature during fermentation is 60 minutes.

To characterize the quality of flour type were used the following methods of analysis:

• determination of organoleptic properties through sensory analysis;

• determination of moisture, according to SR ISO 712: 2005, by drying in an oven at 130 ° C for 60 minutes;

• determination of acidity of the flour according to SR 90: 2007;

• determination of wet gluten, according to SR ISO 21415-2: 2007;

• determination of the ash content, according to SR 90: 2007;

• determination of rheological properties using farinograph and alveograph.

To achieve this type of bread was used for indirect cooking method. It consists of the preparation of flour, water and yeast.

For each of the 6 samples of bread (bread, with variable salt content, and 0%, 0.5%, 1%, 1.5%, 2%, 2.5%.) in hand have made determinations of the following parameters: volume, H/D ratio, porosity, elasticity, moisture and acidity of the core, provided that these analyses were performed at 24 to 48 hours.

For each sample in part it was used: 500 g wheat flour, 270 ml of water, 12.5 g yeast (emulsion) and salt (dissolved).

Experimental research of the working temperature of the flour was 25.2 °C and 27 °C water.

The dough obtained were subjected to 3 research samples containing 0%, 1.5% and 2.5% salt. Rheological characteristics were determined using Alveograph Chopin and Farinograph Brabander, Mixolab.

Table containing the materials and the experimental method Table 1

No crt.	**Feature**	**White flour Type 650**			**The method of analysis**
		Sample no.1	*Sample no.2*	*Media*	
Organoleptic properties					
1.	Color-appearance	White with yellowish tinge strong			Sensory analysis
2.	Odor	Pleasant, particularly flour, without the smell of musty mold or other foreign odor			
3.	Taste	Normal, slightly sweetish, neither bitter, neither sour, no gnashing at mastication (due to mineral impurities: earth, sand)			
Chemical-physical properties					
4.	Moisture content [%]	13.5	13	13.25	SR ISO 712:2005
5.	Gluten, content [%]	32	32.4	32.2	SR ISO 21415-2:2007
6.	Acidity [%]	2.4	2.8	2.6	SR 90:2007
7.	Ash [%]	0.57	0.59	0.58	SR 90:2007
Rheological indicators					
I. Alveogram		Alvegraph Chopin			
8.	Toughness dough (P) [mmH2o]				83
9.	Dough extensibility (L) [mm]				91
10	Swelling index (G) [mm]				21.2
11.	The energy absorbed by the dough (W) [10E-4J]				217
12.	Configuration of the curve ratio (P/L)				0.91
13.	Elasticity index (Ie), [%]				54.3
II. Farinograma		Farinograf Brabender			
14.	Hydration capacity [%]				62.5
15.	Development, [min]				6
16.	Stability, [min]				6.5
17.	Elasticity (E10), [UB]				50
18.	Elasticity (E20), [UB]				110

Rheological characteristics of dough Table 2

No. Crt.	**Rheological characteristics**	**Dough white bread with added salt, [%]**		
		0	**1**	**2.5**
Chopin Alveograph				
1	Toughness dough (P) [mm]	83	85	99
2	Dough extensibility (L) [mm]	91	105	104
3	Swelling index (G) [mm]	21.2	22.8	22.7
4	The energy absorbed by the dough (W), 10E-4J	217	266	329
5	Configuration of the curve ratio (P/L)	0.91	0.81	0.95

Chopin Mixolamu				
6	Water absorption [u m]	8	5	3
7	Mixing, reaction to [u m]	6	5	5
8	Gluten + [u m]	5	5	5
9	Viscosity, [u m]	4	2	2
10	The amylasic activity, [u m]	9	8	9
11	Relegation, [u m]	8	7	8
Brabender Flourgraph				
12	Development time, D [min]	6	7.5	10
13	Stability, S, [min]	6	10	13
14	The degree of softening, [U.F.]	110	30	10
15	Tolerance index, 5 min [U.F.]	50	40	30
16	Tolerance index, 10 min [U. F.]	30	40	50
17	Elasticity, 10 min [U.F.]	50	10	10
18	Elasticity, 10 min [U.F.]	110	50	20
19	The ability of hydration, CH, [%]	62.5		
20	Moisture	13		

5. Results and discussion

The tenacity of the dough is influenced by the amount of salt added, observing its growth is directly proportional to the amount of salt added.

Extensibility and the swelling index grow (1 ... 1.5% salt), then begin to fall.

The energy absorbed by the dough rises in direct proportion to the amount of salt added.

The configuration of the curve has very high values in the first and last case, and it is observed a decrease in its value for 1% salt added, is coming to the optimal value of the dough for bread-making (0.65).

Analysing the target profiles generated can be drawn the following conclusions:

The addition of salt in the dough falls flour capacity to absorb water, due to the dehydrating action that the gluten.

Reaction to mixing of the dough is influenced by the addition of salt; the amount of salt added increases with both the dough stability decreases.

The amount of salt added does not affect the strength of the gluten during the technological process.

The viscosity of 200 step is not much influenced by the increase in the quantity of salt added, however around the concentration of 1% [...]1.5% salt, there is a slight decrease in viscosity.

The amylase activity is strongly influenced by the presence of salt. At a concentration of 1% [...]1.5% salt it can be seen that the amylase activity reaches a peak, following that .1after this value to amylase activity.

The relegation of the starch index provides information on the shelf life of the product. Thus it appears that the amount of salt added 1%, while the maximum validity is 2,5%?.

Comparing target profiles obtained with the typical profile for the manufacturing of white bread that:

- for the dough with 0% added salt, all pointers are between the minimum and maximum values, the exception makes the index 5-Amilza, which exceeds the maximum value of a unit which means that the activity of amylase is lower;
- If the dough with 1% salt is seen posting lower values of the indices, although both the first show (water absorption) and the fourth (viscosity) are below the minimum limit proposed by profile typical of white bread, the other indices values fits within the standard, which means that this profile is closest to the typical

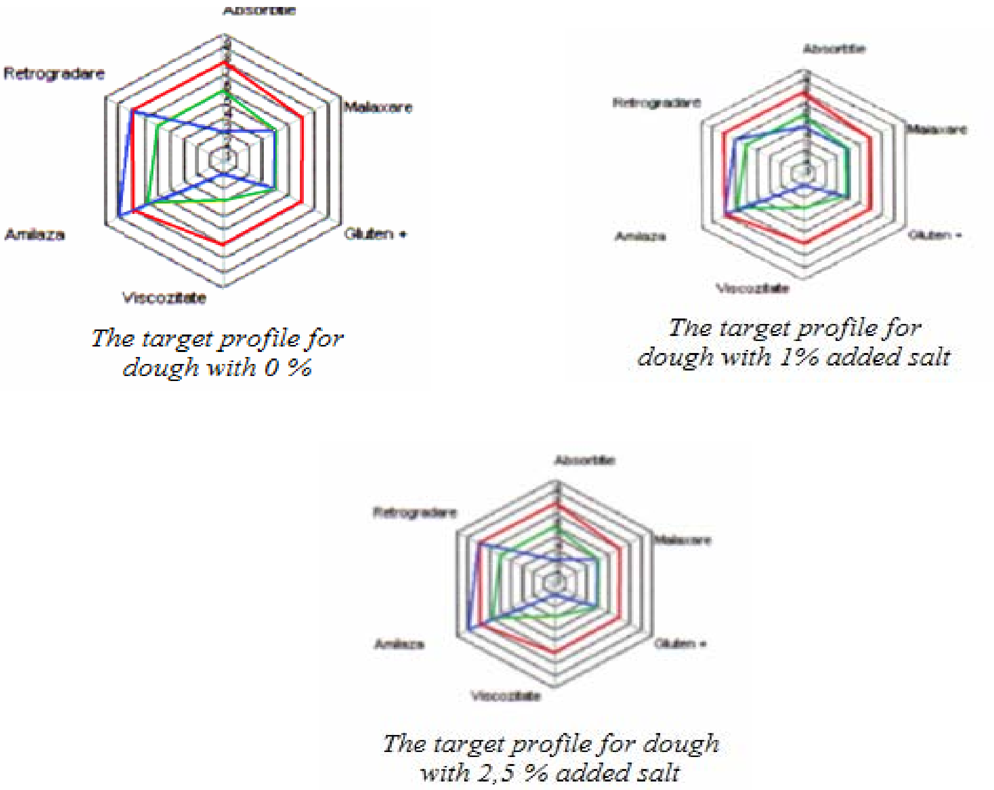

Fig. 1. *The target profile for dough with added salt*

The minimum limit proposed by profile typical of white bread, the other indices values fits within the standard, which means that this profile is closest to the typical.

If the target profile obtained by the addition of 2.5% salt index values are significantly different from those of optimal, which means that it is completely unsatisfactory for white bread.

By comparing the values obtained from the interpretation of farinograms, can be drawn the following conclusions:

1. Both development time and stability of dough rise in direct proportion to the increase in concentration of salt added.

2. The degree of softening decreases inversely proportional to the increase in concentration of salt added, the maximum value obtained when the dough without salt is approximately 10 times greater than in the case of the dough with 2.5% salt added.

3. Tolerance index shows how quickly it leaves the dough when it is overkneaded. Analyzing the values obtained, shows that the value of the tolerance index at 5 minutes after the addition of the water decreases with increasing salt content added.

4. The maximum amount of elasticity is obtained if the dough without salt, after which it drops sharply to 1% salt added and should be kept constant over this value.

Table 3

No. crt.	Salt content %	Volume m3/100 g product	The ratio H/D	Elasticity [%]	Core porosity [%]	Core humidity [%]	Acidity [° C]
1.	0	320	0.64	91.7	83.1	43	2.2
9+9+2.	0.5	253	0.61	90	75.4	45	2.3
3.	1	232	0.51	88.3	81.1	42	2.2
4.	1.5	249	0.51	88.3	74.7	42	2.2
5.	2	291	0.55	90	73.3	42	2.1
6.	2.5	282	0.54	88.3	67.7	42	2.1

The influence of salt content of bread volume is illustrated in the previous tables. It is observed that the maximum volume of the bread if bread without salt. As you increase the addition of salt 1 to 2% volume increase slightly, bread values over which the volume bread remains relatively constant.

From the chart above shows that the elasticity of the bread crumb decreases with increasing salt content added, up to a concentration of 2% salt added after elasticity which is kept constant.

As a result of the carried out research has shown that up to a concentration of 2% salt, the values obtained for the minimum value in excess of core porosity standard (73%).

To increase the concentration of salt is added above the 2% that porosity falls below minimum value allowed.

From the analysis of the graph shows that the humidity of the core of bread without salt or with added 0.5% salt in excess of the maximum permissible value (43%), while other samples were obtained values of constant humidity, which fall within the acceptable limits.

From the chart above shall be construed that the highest value of a core of acidity of bread containing 0.5% salt and low acidity values in the case of bread containing more than 2%. Note that all values fall within the maximum permissible limit (4%).

Indicators of quality of bread at 48 hours after removal from the oven Table 4

No. crt.	Salt content%	Volume m3/100 g product	The ratio H/D	Elasticity [%]	Core porosity [%]	Core humidity [%]	Acidity [°C]
1.	0	301	0.63	90	82.5	41.8	2.1
2.	0.5	206	0.60	89	72.9	43	2.3
3.	1	204	0.53	88	71.9	39.9	2.2
4.	1.5	209	0.61	85	71.1	42	2.2
5.	2	180	0.60	82	73.7	40	2.1
6.	2.5	205	0.61	88	67.7	41.9	2.2

In the previous figure graph it is observed that the ratio H/D determined in 48 hours after removal from the oven is properly given values over 50% in all 6 cases. It should be noted that the minimum value was obtained in the case of bread with salt added 1%, which indicates a defective development of the bread at this concentration.

Following the determinations on the elasticity of the core bread made from 48 hours after removal from the oven that was found at a concentration of 1% salt has been added to the maximum amount of elasticity, and the minimum value was obtained in the case of bread with 2% salt added, what demonstrates that the dough is even more tenacious, as it contains a larger amount of salt.

Comparative analysis of the main characteristics of bread caused at 24, and 48 h following removal from the oven

Comparative analysis of bread volume determined at 24 or 48 hours after removal from the oven.

The previous figure shows the evolution of the volume of bread in 24 hours after removal from the oven at 48 hours. As you can see the amount of bread at 48 hours after removal from the oven is smaller compared to those determined at 24 hours, the biggest difference is obtained in the case of bread with added salt is greater than 2%.

Watching the evolution of the core bread and elasticity by comparing the values obtained at 24 or 48 hours after removal from the oven, it was found that although at 48 hours values were lower than at 24, the differences were not very high which indicates that the bread does not have major changes of the product properties. The smallest difference was obtained in the case of bread with salt added 1% and the highest at the bread with 2% salt added.

As a result of a comparative analysis of the results obtained for the determination of the voids of the core of the bread was made from previous figure graph. As in the case of elasticity or voids where there have been large variations in the values, which indicate that the porosity remained approximately constant.

6. Conclusions

Following discussions on the results obtained the following conclusions may be issued:

How to add a larger amount of salt, the bread, the finished product properties are more skewed.

How much salt is added to the batter later with both its beneficial effects on the rheological properties of dough and bread-making quality characteristics are worse.

The percentage of salt that is added to the bakery products shall be so fixed as not to damage the health of consumers. Thus, according to the FAO, a daily intake of salt for a healthy consumer is 6 g-day.

Acknowledgements

This paper is supported by the Sectorial Operational Programme Human Resources Development (SOP HRD), financed from the European Social Fund and by the Romanian Government under the project number POSDRU/159/1.5/S/134378.

References

1. Banu C. et al., 2000. Additives and ingredients for the food industry. (in Romanian). Technical Publishing House, Bucharest.
2. Banu C., 2000. Handbook engineer food industry. vol II. (in Romanian). Technical Publishing House, Bucharest.
3. Bordei D., 1976. Technology and Equipment bakery. University of Galati. Overseers' course.
4. Bordei D., 2004. Modern technology of bakery. (in Romanian). Bucharest AGIR. 447 p.
5. Cuq B., Abecassis J., Guilbert S., 2003. State diagrams to help describe wheat bread processing. International Journal of Food Science and Techology 38, 759-766.
6. Codina G.G., Bordei D., 2008. The effect of different doses of gluten on Rheological behaviour of dough and bread quality. Romanian Biotechnological Letters, 13 : 37-42.
7. Rus Fl., Bică (Canja) C.M, Şerban E., 2008. Unit operations, mixing and crowding. University of Braşov.