Improvement of the Falling Number on Romanian Wheat Flours (II)

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Abstract

Romanian flours obtained by annual wheat crop are, in general, flours with a low alpha-amylase activity, with high Falling Number values, respectively. It means that these flours require an improvement of this activity because of bread quality (structure, volume, crust, etc.). An optimal Falling Number leads to higher efficiency on baking production.

The study evaluates the possibility of standardization of Falling Number values.

The flours have the Falling Number values between 62 sec. (in case of flours from sprouted grains) and 500 sec. (in case of flours with very low alpha-amylase activity). The optimal Falling Number is 250 sec. (recommended by Perten Company) or in the range 230…270 sec. (from Institute of Food Bioresources researches).

The improvement of Falling Number can be made by enzymes or malt added.

In our study we tested malt ingredients by different methods: baking tests, Falling Number tests, production and retention gases tests, respectively.

Key words: improvement, falling number, alpha-amylase activity, wheat flours, malt ingredients, etc.

Introduction

The improvement of Romanian flours' Falling Number is a necessity taking into account that more than half of our wheat crop has a low amylase activity.

Therefore, the objectives of this research were to determine: 1) baking performances of malt ingredients (malt meal, malt flour, EMCEmaltex 1000) 2) its effect on the Falling Number values and 3) its effect on gases power and retention 4) improving the bread quality.

This study takes into account the influence of malt ingredients on bread quality.

Materials and Methods

Commercial flours were obtained from Plevnei S.A. and Baneasa S.A. The physic-chemicals and rheological indicators are given in the (**Table 1** and **Table 2**).

Table 1. Physic-chemicals indicators of flours.

Indicators	**UM**	**Values**	
		F1	**F2**
Moisture	%	14.51	14.01
Ash	% s.u.	0.62	0.57
Acidity	degrees	2	2
Wet gluten	%	20.44	25.94
Gluten Index		98	98
Gluten deformation	mm	12.5	3.5
Proteins	% s.u.	10.85	
Falling Number	sec.	468	384

Table 2. Rheological indicators of flours.

Indicators	**UM**	**Values**	
		F1	**F2**
Hydration capacity	%	59.3	58
Development	min.	2.4	1.8
Stability	min.	5.5	12
Elasticity	uB	140	120
Softening	uB	110	70
Power	-	44	53

The following malt ingredients were used: whole malt, malt flour and EMCEmaltex 1000 – private person, Puratos Prod Ltd., Romania and Muhlenchemie, Germany supplied malt ingredients.
Pakmaya yeast was used from Rompak Ltd., Romania.

Baking

The malt ingredients were added to the baking formula during the mixing stage. Breads were made with commercial bread flour 650 type. By the pup loaf formula uses a 90-min. fermentation, straight-dough process (Romanian Standard STAS Baking Test).

The dough were proofed and then baked. The loaf volume of bread was measured using rapeseed displacement.

Physic-chemical indicators of all the breads were determined and the internal and external characteristics evaluated sensorial properties.

Falling Number determination

The Falling Number values for commercial flours were determined with SR ISO 3093:1997. Falling Number analysis was performed with an *1800 Falling Number System*. The wheat flour used had been a high value of Falling Number that means a low amylase activity. To improve fermentation capacity of flour carbohydrates is necessary malt ingredients adding.

Power Gas

The straight-dough formula with 250 g of commercial flour, 5.0 g of salt, 5.0 g of yeast and water were used for the power gas test (it is obtained a strengthen dough).

Malt ingredients were added to some dough in different quantities to notice the optimal doses which can be used for a better quality of bread. The control dough had no additives. Zymotachigraph Chopin was used for power and retention gas.

Results and Discussion

To compare the performance of malt ingredients on bread quality in baking systems technological parameters and doses of additives have to be optimized.

1. WHOLE MALT

1.1. INFLUENCE OF WHOLE MALT ON BREAD QUALITY

Table 3. Recipes and technological parameters in baking test.

Raw materials and technological parameters	**Direct method**							
	F1				**F2**			
	M1	**P1**	**P2**	**P3**	**M2**	**P1'**	**P2'**	**P3'**
Flour, kg	1	1	1	1	1	1	1	1
Water, l	0.593	0.593	0.593	0.593	0.58	0.58	0.58	0.58
Yeast, g	30	30	30	30	30	30	30	30
Salt, g	15	15	15	15	15	15	15	15
Whole malt, g	-	5	10	15	-	5	10	15
Mixing time, min.	3	3	3	3	3	3	3	3
Fermentation time, min.	90	90	90	90	90	90	90	90
Proofing time, min.	55	45	45	45	55	55	55	55
Baking time, min.	45	35	35	35	60	45	45	45
Baking temperature, °C	210°C	220…..240°C			200°C	210…220°C		

The following quantities of malt meal were used: 0.5; 1 and 1.5 %, respectively.

Table 4. Quality indicators of bread after 24 hours from the baking.

Sample/Indicators	**F1**				**F2**			
	M1	**P1**	**P2**	**P3**	**M2**	**P1'**	**P2'**	**P3'**
Weight, g	520	529	517	512	531	523	526	528
Volume, cmc/100 g	271	265	299	299	300	326	317	313
Height, cm	8.5	9.0	9.2	10.3	10	10.7	10.6	10.7
Diameter, cm	16	15.6	15.9	15.7	15.15	15.3	15.5	15.05
H/D	0.53	0.58	0.58	0.66	0.66	0.70	0.68	0.71
Porosity (Crumb structure), %	77	79	81	82	81	83	83	83

Elasticity, %	97	97	98	97	95	95	95	95
Moisture, %	43.81	42.3	43.49	43.2	43.79	44.2	43.89	44.51
Acidity, degrees	1.2	1.4	1.2	1.2	1.1	1.4	1.2	1.4
Bread note	80	79	84	84	84	90	89	88

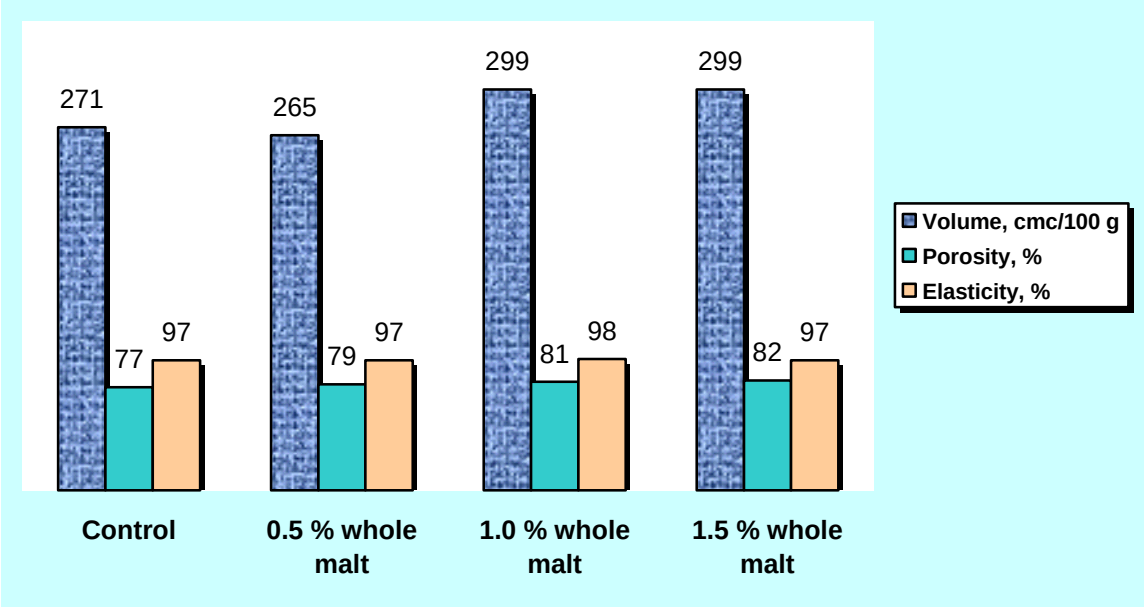

Figure 1. The whole malt influence on physic-chemical parameters of bread (0.5; 1.0 and 1.5 % to flour, respectively) (flour F1).

The sample with 1.0 % whole malt added (P2) the best results presented:

- 10 % volume increasing;
- 5 % porosity improving;
- 5 % note improving.

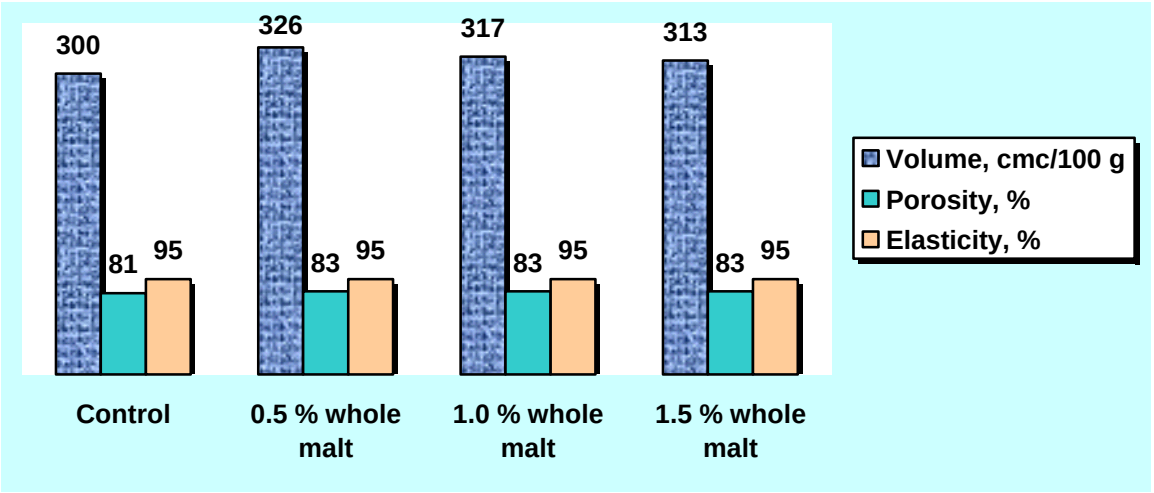

Figure 2. The whole malt influence on physic-chemical parameters of bread (0.5 %; 1.0 and 1.5 % to flour, respectively) (flour 2).

The sample with 0.5 % malt meal added (P1") the best results presented:

- 9 % volume increasing;
- 3 % porosity improving;
- 13 % note improving.

1.2. INFLUENCE OF WHOLE MALT ON FALLING NUMBER

Experiments for Falling Number determinations were made. The whole malt doses were: 0.5; 1.0 and 1.5 % to flour, respectively.

Table 5. Influence of whole malt added on Falling Number values of tested flours.

Sample/Indicator	**F1**				**F2**			
	M1	**P1**	**P2**	**P3**	**M2**	**P1'**	**P2'**	**P3'**
Falling Number, sec.	468	268	222	202	384	248	194	188

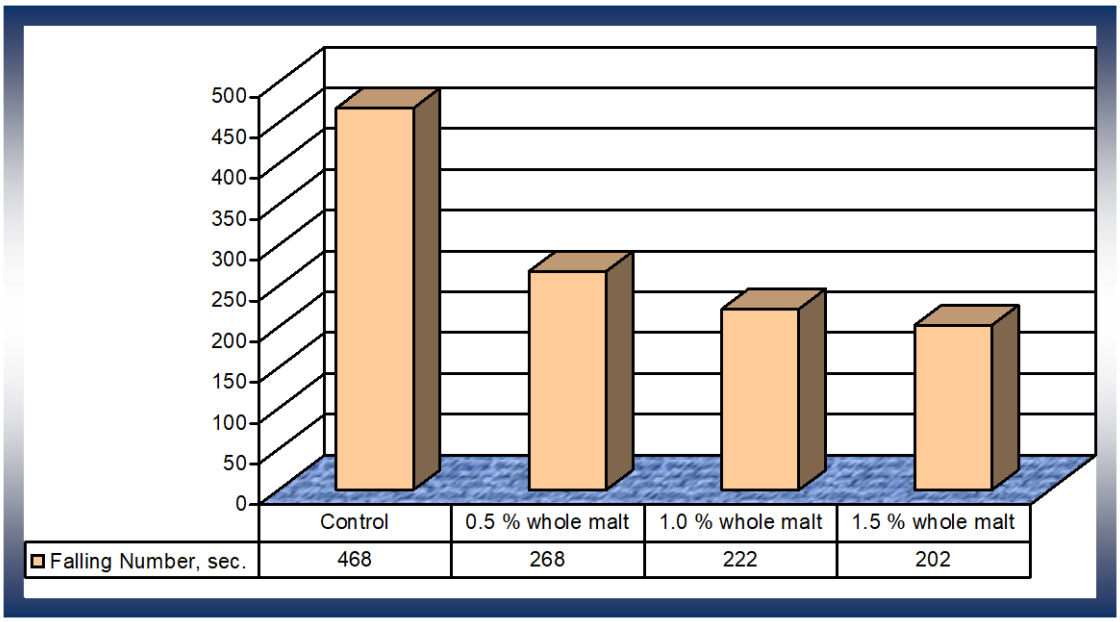

Figure 3. The influence of whole malt added on Falling Number (0.5; 1.0 and 1.5 % to flour, respectively) (flour F1).

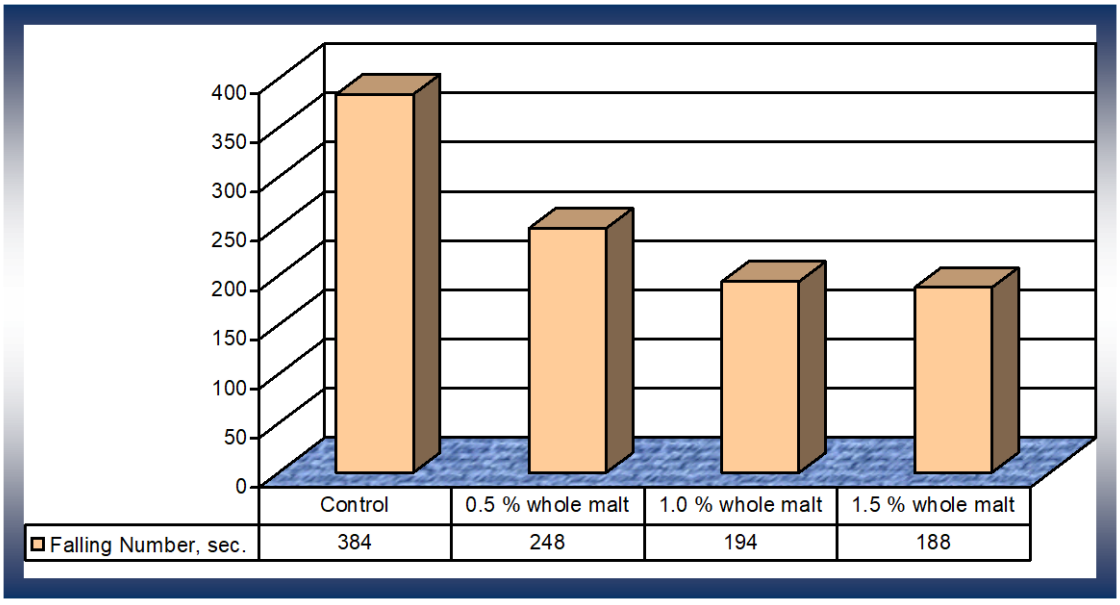

Figure 4. The influence of whole malt added on Falling Number (0.5; 1.0 and 1.5 % to flour, respectively) (flour F2).

The optimal Falling Number is 250 sec. (recommended by Perten Company). According to research of the Institute of Food Bioreources the range of optimal Falling Number is 230...270 sec., in correlation with the other quality indicators of wheat flour. The correction of Falling Number in the lab is not allways the same with those technological, obtained in the baking test.

The obtained values confirmed the baking tests values. Therefore, the optimal values were 268 and 222 sec., respectively at 0.5 and 1.0 % whole malt added, respectively (flour F1). The technological optimum was at 1.0 %. In the case of Flour F2, which had a higher alpha-amylase activity (FN 384 sec.), 0.5 % whole malt added was sufficient to correct Falling Number value to 248 sec. In this case, the technological optimum was the same with the Falling Number obtained in the lab.

When the alpha-amylase activity increased (Falling Number value decreased), % whole malt added decreased.

1.3. INFLUENCE OF WHOLE MALT ON GAS POWER

Experiments for gas power determination were made.

Table 6. CO_2 volume and retention surface.

Parameters	**Control**	**P1**	**P2**	**P3**
Total CO_2 volume , cm^3	2100	1875	2010	2175
Total surface, S, cm^2	140	125	134	145
Retention surface, cm^2	27	18	25	32
Retention index, R, %	80	85	81	78
Time, h	4	4	4	4
Temperature, °C	28	28	28	28

From the table above it is noticed that total CO_2 volume was higher than control sample in the case of 1.5 % whole malt added (P3). Regarding the retention index the sample with 0.5 % whole malt added had higher value than control sample, value that must be correlated with the gluten network capacity to retain the produced gas. Therefore, the obtained results confirm that in the case of flour with 20.4 % gluten, that in real term is under the minimal limit 26.0 %, in the case of sample P1 (total CO2 volume – 1875 ml), the gas pression on the gluten network was lower, gas retention in dough higher, respectively.

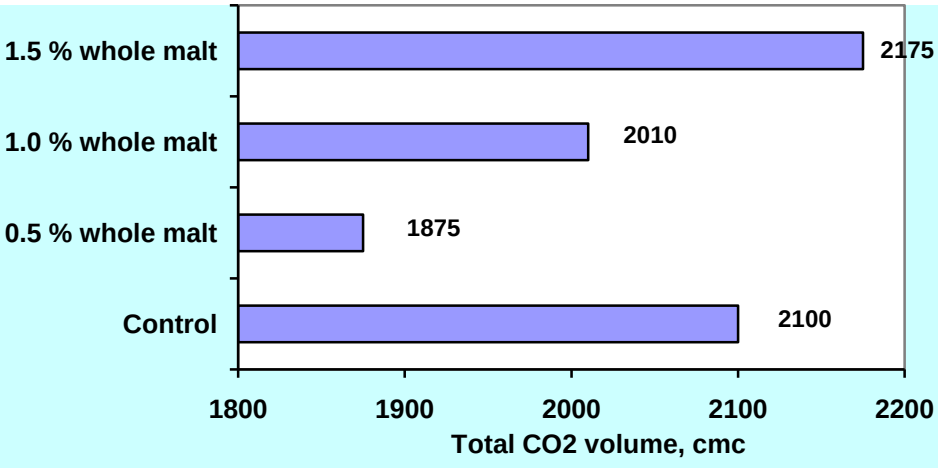

Figura 5. Influence of whole malt added on gas production (0.5; 1.0 and 1.5 % to flour, respectively) (flour F1).

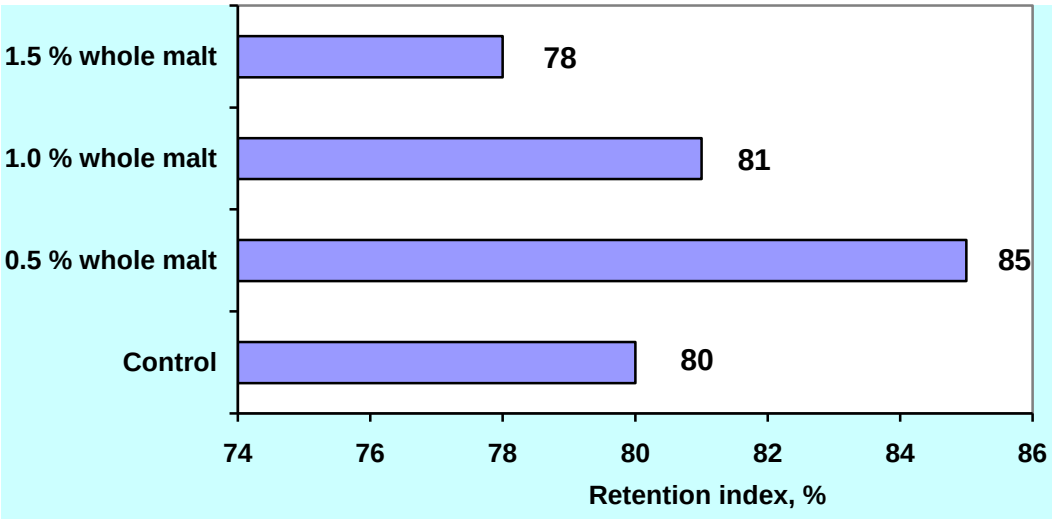

Figure 6. Influence of whole malt added on retention index of gas in dough (0.5; 1.0 and 1.5 % to flour, respectively) (flour F1).

2. MALT FLOUR

2.1. INFLUENCE OF MALT FLOUR ON BREAD QUALITY

The flours described in the Table 1 and Table 2 were used in our tests.

Table 7. Recipes and technological parameters in baking test.

Raw materials and technological parameters	**Direct method**							
	F1				**F2**			
	M1	**P4**	**P5**	**P6**	**M2**	**P4'**	**P5'**	**P6'**
Flour, kg	1	1	1	1	1	1	1	1
Water, l	0.593	0.593	0.593	0.593	0.58	0.58	0.58	0.58
Yeast, g	30	30	30	30	30	30	30	30
Salt, g	15	15	15	15	15	15	15	15
Malt flour, g	-	1	3	5	-	1	3	5

Mixing time, min.	3	3	3	3	3	3	3	3
Fermentation time, min.	90	90	90	90	90	90	90	90
Proofing time, min.	55	45	45	45	55	45	45	45
Baking time, min.	45	35	35	35	60	55	55	55
Baking temperature, °C	210°C	220…..240°C			200°C	220°C		

The following quantities of malt flour were used: 0.1; 0.3 and 0.5 %, respectively.

Table 8. Quality indicators of bread after 24 hours from the baking.

Sample/Indicators	F1				F2			
	M1	**P4**	**P5**	**P6**	**M2**	**P4'**	**P5'**	**P6'**
Weight, g	520	525	512	518	531	520	517	515
Volume, cmc/100 g	271	293	318	301	300	314	332	343
Height, cm	8.5	10.1	11.3	11.0	10	10.5	10.6	11.1
Diameter, cm	16	15.55	15.7	16.0	15.15	15.75	15.05	15.2
H/D	0.53	0.65	0.72	0.69	0.66	0.67	0.70	0.73
Porosity (Crumb structure), %	77	82	83	82	81	84	84	86
Elasticity, %	97	98	95	95	95	98	97	97
Moisture, %	43.81	43.9	44.01	43.69	43.79	44.59	45.0	44.21
Acidity, degrees	1.2	1.2	1.2	1.2	1.1	1.4	1.4	1.2
Bread note	80	86	90	89	84	90	92	95

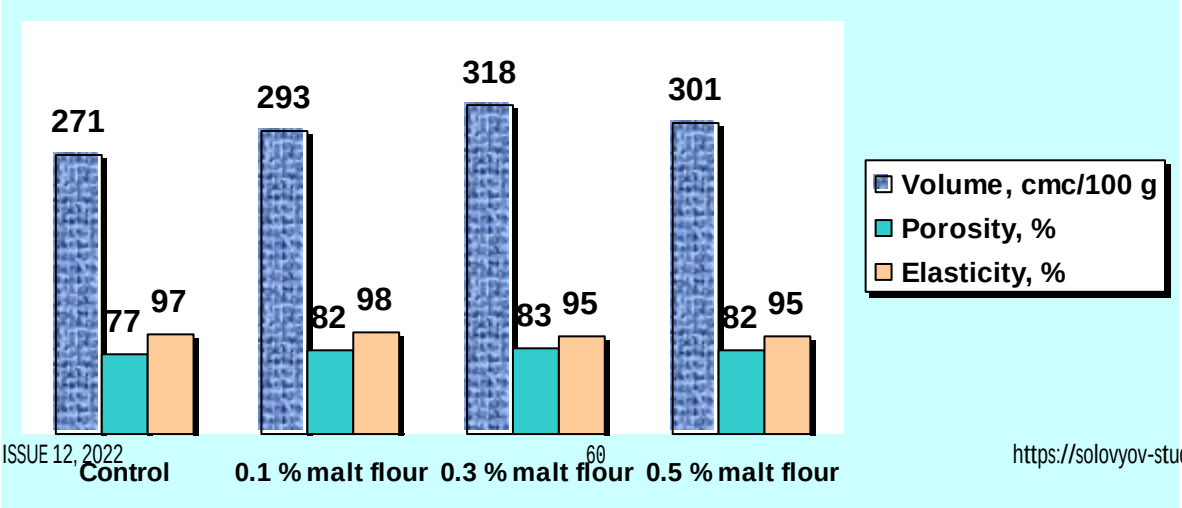

Figure 7. The malt flour influence on physic-chemical parameters of bread (0.1; 0.3 and 0.5 % to flour, respectively) (flour F1).

The sample with 0.3 % malt flour added (P5) the best results presented:

- 17 % volume increasing;
- 8 % porosity improving;
- 13 % note improving.

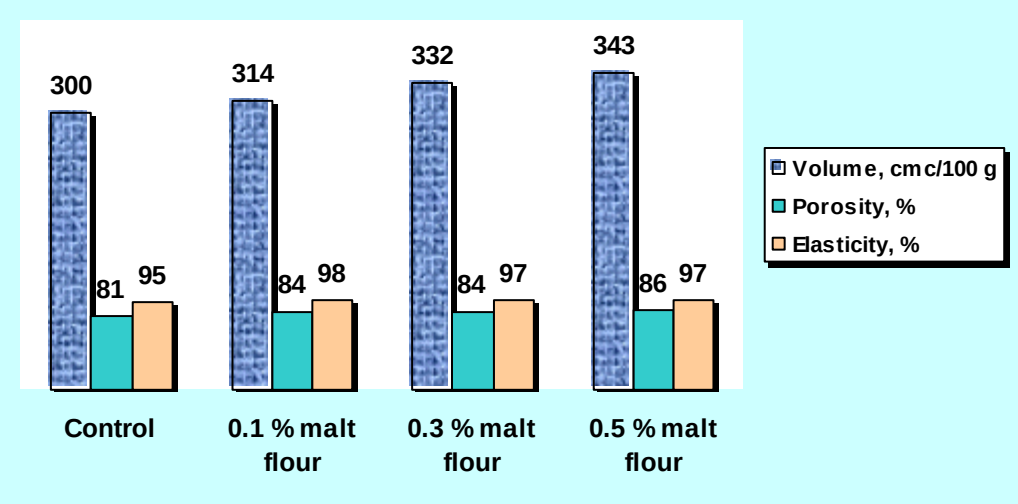

Figure 8. The malt flour influence on physic-chemical parameters of bread (0.1; 0.3 and 0.5 % to flour, respectively) (flour F2).

The sample with 0.5 % malt flour added (P6') the best results presented:

- 14.3 % volume increasing;
- 6 % porosity improving;
- 19 % note improving.

2.2. INFLUENCE OF MALT FLOUR ON FALLING NUMBER

Experiments for Falling Number determination were made. The malt flour doses were: 0.1; 0.3 and 0.5 % to flour, respectively.

Table 9. The influence of malt flour added on Falling Number values of tested flours.

Sample/Indicator	F1				F2			
	M1	P1	P2	P3	M2	P1'	P2'	P3'
Falling Number, sec.	468	308	233	198	384	278	225	183

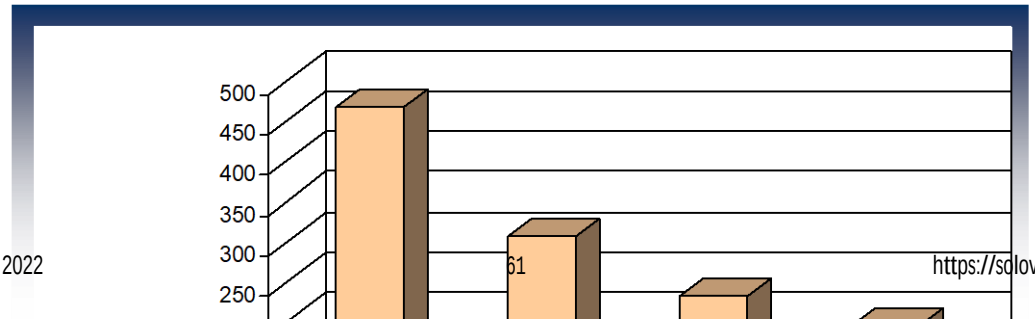

Figure 9. The influence of malt flour added on Falling Number (0.1 %; 0.3 % and 0.5 % to flour) (flour F1).

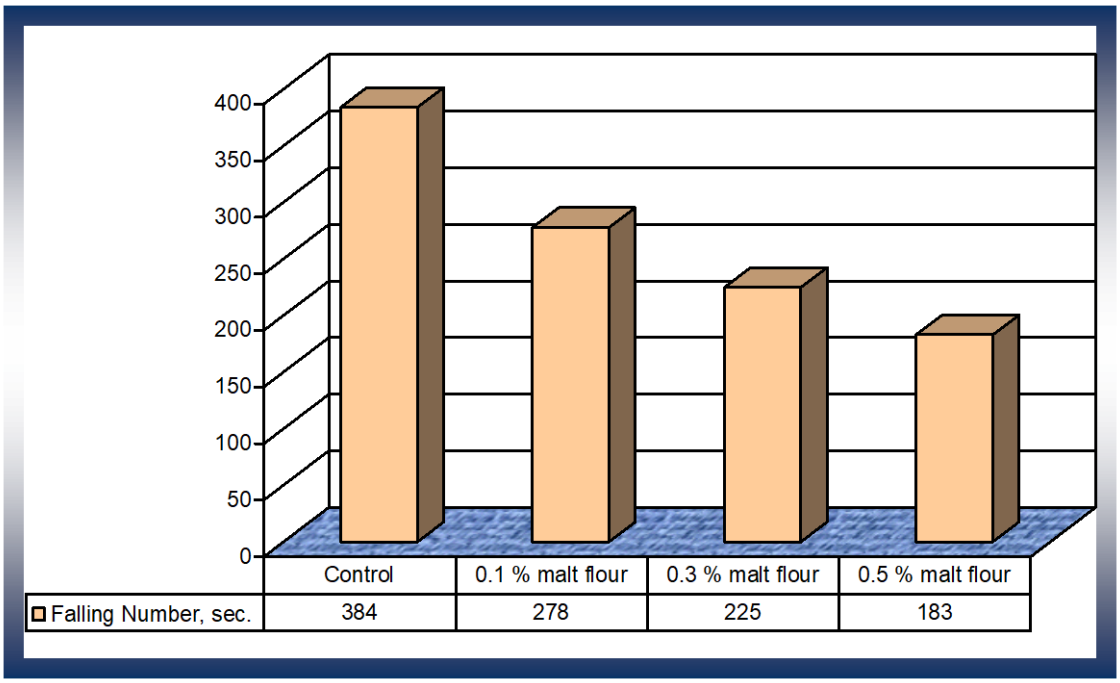

Figure 10. The influence of malt flour added on Falling Number (0.1 %; 0.3 % and 0.5 % to flour) (flour F2).

The obtained Falling Number values confirm the technological results. Therefore, the optimal Falling Number (233 sec.) and the technological optimum were at 0.3 % malt flour added (flou F1). In the case of flour F2, which had a higher alpha-amylase activity (FN 384 sec.), 0.1 and 0.3 % malt flour added, respectively corrected Faliing Number values: 278 and 225 sec., respectively. In this case the technological optimum had been at 0.5 % malt flour added.

2.3. INFLUENCE OF MALT FLOUR ON GAS POWER

Experiments for gas power determination were performed with flour F1.

Table 10. CO_2 volume and retention surface.

Parameters	**Control**	**P4**	**P5**	**P6**
Total CO_2 volume , cm^3	2100	2025	2400	2325

Total surface, S, cm^2	140	135	160	155
Retention surface, cm^2	27	18	24	23
Retention index, R, %	80	86	85	85
Time, h	4	4	4	4
Temperature, °C	28	28	28	28

As noticed from the table above total CO_2 volume was higher than control sample in the case of 0.3 % malt flour added (P5), which was the technological optimum. Regarding the retention index the sample with 0.1 % malt flour added (P4) had a higher value than the control sample, value that must be correlated with the gluten network capacity of retaining the gas produced. Therefore, the obtained results confirm that in the case of flour with 20.4 % gluten, that in real term is under the minimal limit 26.0 %, in the case of sample P4 (total CO2 volume – 2025 ml), the gas pression on the gluten network was lower, gas retention in dough higher, respectively. Also even total CO_2 volumes were higher than the control sample, therefore the retention index obtained was higher than the control sample.

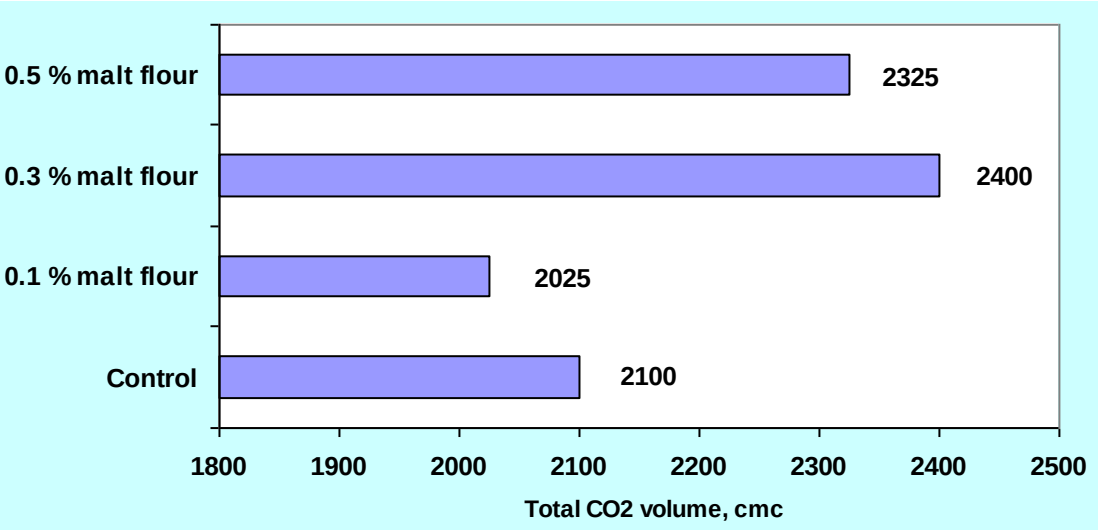

Figure 11. The influence of malt flour added on gas production in dough (0.1; 0.3 and 0.5 % to flour, respectively) (flour F1).

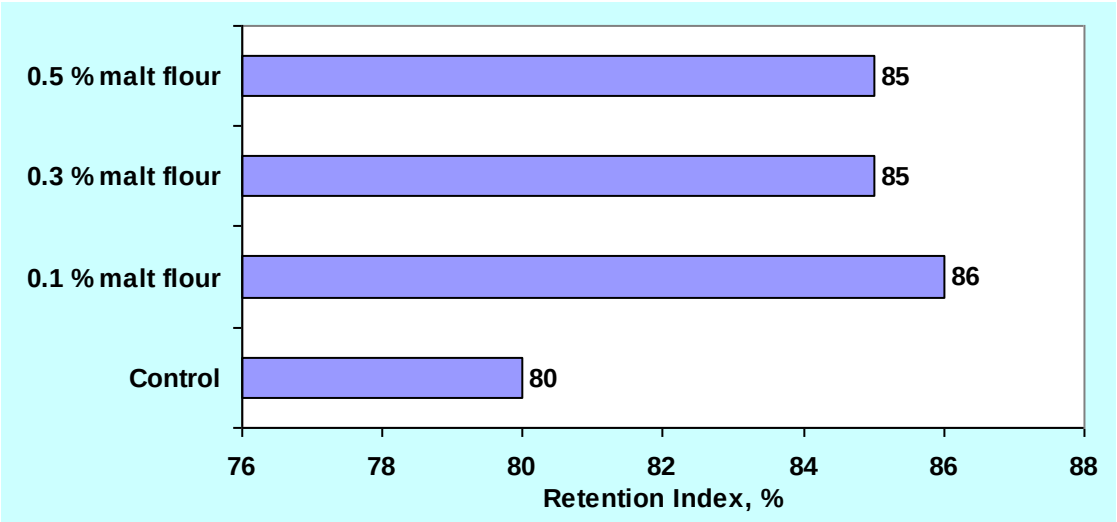

Figure 12. Influence of malt flour added on retention index of gas in dough (0.1; 0.3 and 0.5 % to flour, respectively) (flour F1).

3. EMCEmaltex 1000

3.1. INFLUENCE OF EMCEmaltex 1000 ON BREAD QUALITY

The indicators of wheat flour used are presented in (**Table 11** and **Table 12**).

Table 11. Physic-chemicals indicators of flour.

Indicators	**U.M.**	**Values**
Moisture	%	14.20
Ash	% s.u.	0.34
Wet gluten	%	26.8
Gluten deformation	mm	2.0
Falling Number	sec.	528

Table 12. Rheological indicators of flour.

Indicators	**U.M.**	**Values**
Hydration capacity	%	57.5
Development	min.	2
Stability	min.	6
Elasticity	uB	140
Softening	uB	50
Power	-	52

Table 13. Recipes and technological parameters in baking test.

Raw materials and technological parameters	**Direct method**		
	M	**P1**	**P2**
Flour, kg	1	1	1
Water, l	0.575	0.575	0.575
Yeast, g	30	30	30
Salt, g	15	15	15
EMCEmaltex 1000, g	-	2	3
Mixing time, min.	3	3	3
Fermentation time, min.	90	90	90
Proofing time, min.	60	60	60
Baking time, min.	45	45	45
Baking temperature, °C	230°C		

The following quantities of EMCEmaltex 1000 were used: 0.2 and 0.3 %, respectively.

Table 14. Quality indicators of bread after 24 hours from the baking.

Sample/Parameters	M	P1	P2
Weight, g	543	534	538
Volume, cmc/100 g	297	297	301
Height, cm	10.3	9.3	9.8
Diameter, cm	16.0	15.8	15.65
H/D	0.63	0.59	0.63
Porosity (Crumb structure), %	76	77	78
Elasticity, %	98	98	100
Moisture, %	44.01	44.10	44.71
Acidity, degrees	0.6	0.6	0.6
Bread note	83	80	82

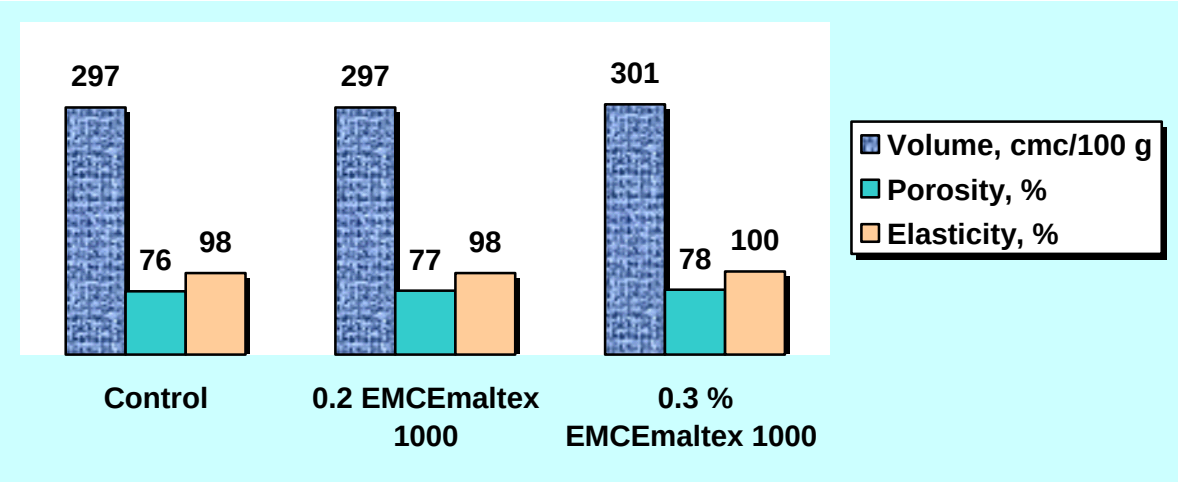

Figure 13. The influence of EMCEmaltex 1000 added on bread quality (0.2 and 0.3 % to flour, respectively).

A slight improvement was obtained for volume, porosity and elasticity of bread.

EMCEmaltex 1000 has no influence on quality indicators, like volume, porosity, elasticity, but on bread flavor and taste, especially.

Conclusions

1. The following malt ingredients were identified.

Table 15. Malt ingredients used in experiments.

Name product	Activity	Flour Falling Number, sec.		Optimal dose (to flour)	
Whole malt	62 sec.	468	384	1 %	0,5 %
Malt flour	62 sec.	468	384	0,3 %	0,5 %
EMCEmaltex 1000	Whithout activity	528		not optimal dose (0.2-0.3 % - use dose)	

2. Different malt ingredients doses were tested as a function of their activity:

- For whole malt: 0.5; 1.0 and 1.5 % to flour, respectively;
- For malt flour: 0.1; 0.3 and 0.5 % to flour, respectively;
- For EMCEmaltex 1000: 0.2 and 0.3 % to flour, respectively.

3. All quality parameters have improved (volume, porosity, elasticity, bread note, etc.).

4. The sensorial indicators have also improved, crust and crumb colour, especially.

5. The falling number values decreased with whole malt, malt flour adding, respectively (increasing of alpha-amylase activity), in concordance with optimal doses obtained in technological tests.

6. Total CO_2 volume and retention index were well correlate with technological results. It is very important to take account influence of gluten network of used flour.

Acknowledgements

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