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Improvement of Falling Number on Romanian Wheat Flours

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Abstract

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

The study assesses 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 fungal alpha-amylase by different methods: baking tests, Falling Number tests, production and retention gases tests, respectively.

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

Introduction

The quantity of enzymes (amylases) contained in flour determines the rate at which starch is converted to sugar and thus rendered accessible to the yeast. Alpha-amylase is the specific enzyme measured in this test relative to its ability to liquefy starch. Too high an amylase content results in high fermentation sugar values in the dough, whereas too low an amylase content results in dough with little gassing power. "The Falling Number" measures the alpha-amylase activity and its relationship to the bread baking process. Another amylase, beta-amylase is also involved in the breakdown of starch into sugars, especially maltose.

The Falling Number (or Hagberg Index) is indicative of the amylase (especially alpha-amylase) activity and the fermentation process taking place in the wheat flour dough. It is based on the rapid gelatinization of flour suspended in water and measures the degradation of starch made available from alpha-amylase activity in rising temperature conditions similar to those of bread making.

The following Falling Number values are inversely proportional to the amylase activity.

Table 1. Falling Number values and your influence on quality's flours.

Falling Number	Comments
60– 150	Elevated amylase activity. This flour is derived from germinated grain, and its use results in a breadcrumb that remains sticky and under baked. It is nearly unusable unless it is adequately mixed with other flour with a higher Falling Number.
150 – 220	Superior amylase activity to that which is normal. This flour requires a correction by being blended with flours of a higher Falling Number or using particular bread making methods during production.
220 – 280	Normal amylase activity.
> 280 - 300	Weak amylase activity. The use of this flour results in bread that is not well developed, with low volume and too dry a crumb. It requires the addition of diastatic malt.

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

Therefore, the objectives of this research were to determine: 1) baking performances of amilolitics enzymes (malt ingredients, fungal alpha-amylases, maltogenic alpha-amylase) 2) its effect on the Falling Number values and 3) its effect on the gases power and retention 4) improving quality bread.

This study baking into account the influence of fungal amylases on bread quality.

Materials and Methods

Commercial flours were obtained from Plevnei S.A. and Baneasa S.A. The physic-chemicals and rheologicals indicators are given in (**Table 2**) and (**Table 3**).

Table 2. Physic-chemicals indicators of flours.

Qualitative 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 3. Rheological indicators of flours.

Rheological 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 amilolitics enzymes used were the following: Muhlenchemie, Germany, Elton Corporation, Romania and Puratos Prod, Romania supplied fungal alpha-amylase. Pakmaya yeast was used from Rompak Ltd, Romania.

Baking

The enzymes 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 doughs 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 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 the fermentation capacity of flour carbohydrates it is necessary to add amylase enzymes.

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).

Fungal alpha-amylases were added to some dough was 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 fungal alpha amylase- enzymes on bread quality in baking systems have to be optimized in terms of technological parameters and doses of additives.

The Influence of Alphamalt V on bread quality

Table 4. Recipes and technological parameters in baking test

Raw materials	**Direct method**							
	F1				**F2**			
	M	**P1**	**P2**	**P3**	**M**	**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
Alphamalt V, g	-	0.1	0.2	0.3	-	0.1	0.2	0.3
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	55	55	55	55	55	55	55
Baking time, min.	45	45	45	45	60	60	60	60
Baking temperature, °C	210°C				200°C			

The following quantities of Alphamalt V were used: 0.01; 0.02 and 0.03 %, respectively, which correspond with 90, 180 and 270 units SKB/kg flour, respectively.

Table 5. Quality indicators of bread after 24 hours from the baking.

Sample/Parameters	F1				F2			
	M	P1	P2	P3	M	P1'	P2'	P3'
Weight, g	520	517	511	521	531	514	508	515
Volume, cmc/100g	271	296	303	302	300	338	347	356
Height, cm	8.5	9.7	9.3	9.7	10	10.5	10.7	12
Diameter, cm	16	15.6	15.5	15.1	15.15	15.4	15.75	15.15
H/D	0.53	0.62	0.6	0.64	0.66	0.68	0.68	0.79
Porosity (Crumb structure), %	77	81	81	82	81	83	84	84
Elasticity, %	97	97	98	97	95	98	97	98
Moisture, %	43.81	44.29	43.49	43.81	43.79	44.31	44.51	43.99
Acidity, degrees	1.2	1	1	1.2	1.1	1.2	1.2	1.2
Bread note	80	85	84	87	84	90	91	93

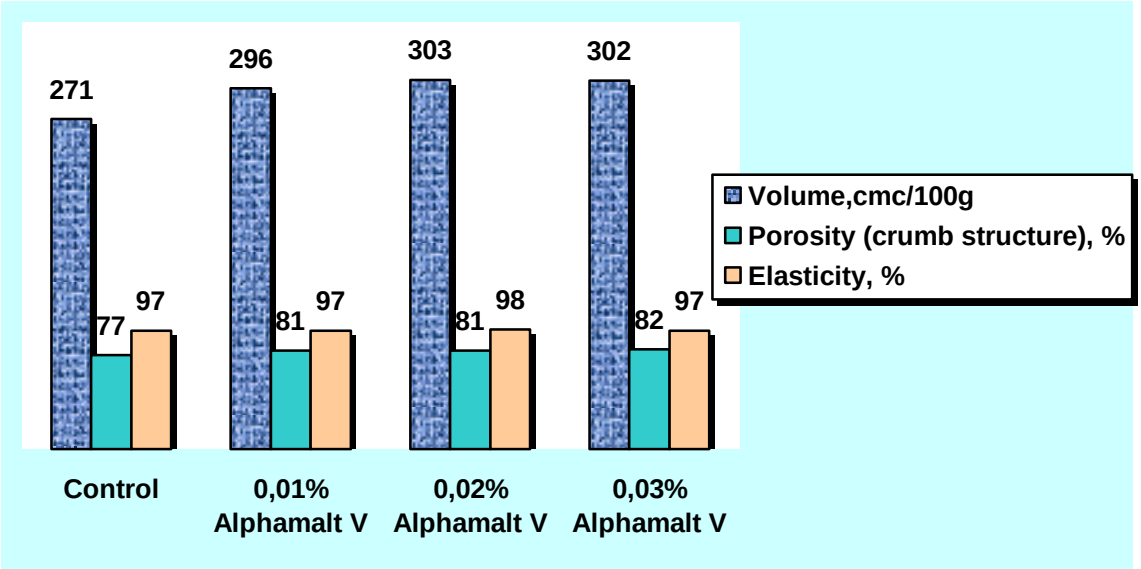

Figure 1. Variation of physic-chemical parameters of bread obtained from baking tests with Alphamalt V (0.01; 0.02 and 0.03 % to flour, respectively) (flour F1).

The sample with 0.02 % Alphamalt V added the best results presented:

- 12 % volume increasing;
- 6 % porosity improving;
- 5 % note improving;

The Influence of Alphamalt V on gas power

Experiments for gas power determinations were made.

Table 6. CO_2 volume and retention surface.

Parameters	Control	P1	P2	P3
Total CO_2 volume , cm^3	2100	2100	1995	2070
Total surface, cm^2	140	140	133	138
Retention surface, cm^2	27	20	20	22
Retention index	0.80	0.85	0.84	0.84
Time, h	4	4	4	4
Temperature, °C	28	28	28	28

From the table above it is noticed that the total volume of CO_2 is not higher than the control sample. Regarding the retention index the samples with Alphamalt added had higher values that the control sample that confirm the technological results.

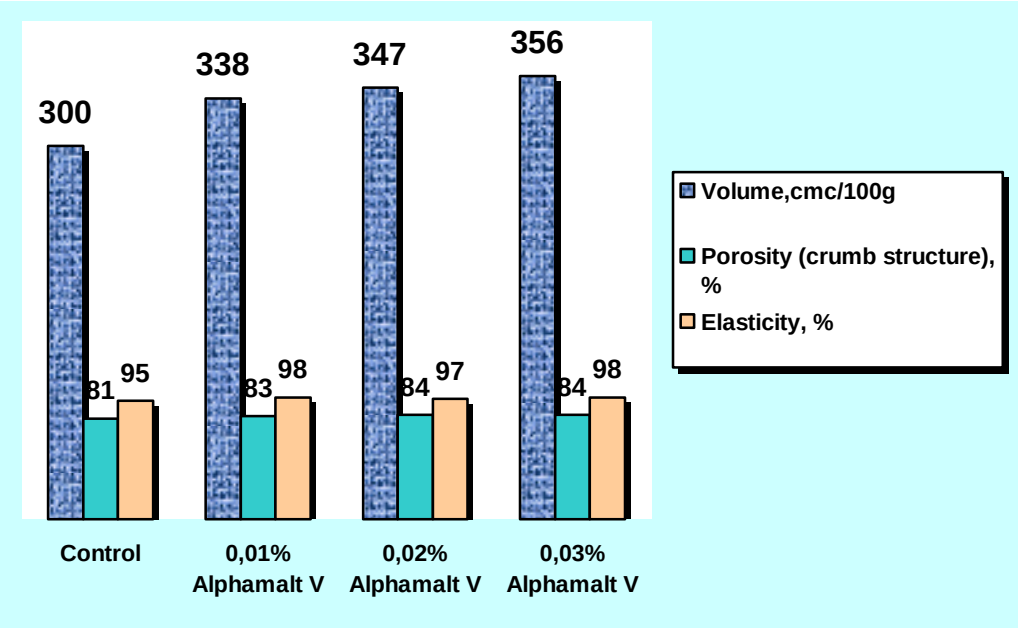

Figure 2. Variation of physic-chemical parameters of bread with Alphamalt V added (0.01; 0.02 and 0.03 % to flour, respectively) (flour F2).

The sample with 0.03 % Alphamalt V added best results presented:
- 19 % volume increasing;
- 4 % porosity (crumb structure) improving;
- 11 % bread note improving;

The Influence of Fermizyme P20 – 450 FAU/g or 5000 SKB/g on bread quality

Table 7. Recipes and technological parameters.

Raw materials	**Direct method**							
	F1				**F2**			
	M	**P4**	**P5**	**P62**	**M**	**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
Fermizyme P20, g	-	0.018	0.036	0.054	-	0.018	0.036	0.054
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	55	55	55	55	55	55	55
Baking time, min.	45	45	45	45	60	60	60	60
Baking temperature, °C	210°C				200°C			

The doses of Fermizyme P20 – 450 FAU/g or 5000 SKB: 0.0018; 0.0036 and 0.0054 %, respectively that correspond to 90, 180 and 270 units SKB/kg flour, respectively.

Table 8. Bread quality after 24 h from baking.

Sample/Characteristics	F1				F2			
	M	P4	P5	P6	M	P4'	P5'	P6'
Weight, g	520	521	518	515	531	507	516	520
Volume, cmc/100g	271	282	300	316	300	342	341	329
Height, cm	8.5	9.7	9.5	10.6	10	11.5	11	11
Diameter, cm	16	15.45	15.4	15.05	15.15	15.65	15.65	15.6
H/D	0.53	0.63	0.62	0.70	0.66	0.73	0.70	0.71
Porosity(crumb structure), %	77	78	82	82	81	84	82	83
Elasticity, %	97	98	98	98	95	97	98	97
Moisture, %	43.81	43.19	44.01	44.1	43.79	44.3	44.0	44.19
Acidity, degrees	1.2	1	1	1.2	1.1	1.2	1.1	1.4
Bread note	80	83	86	91	84	91	90	88

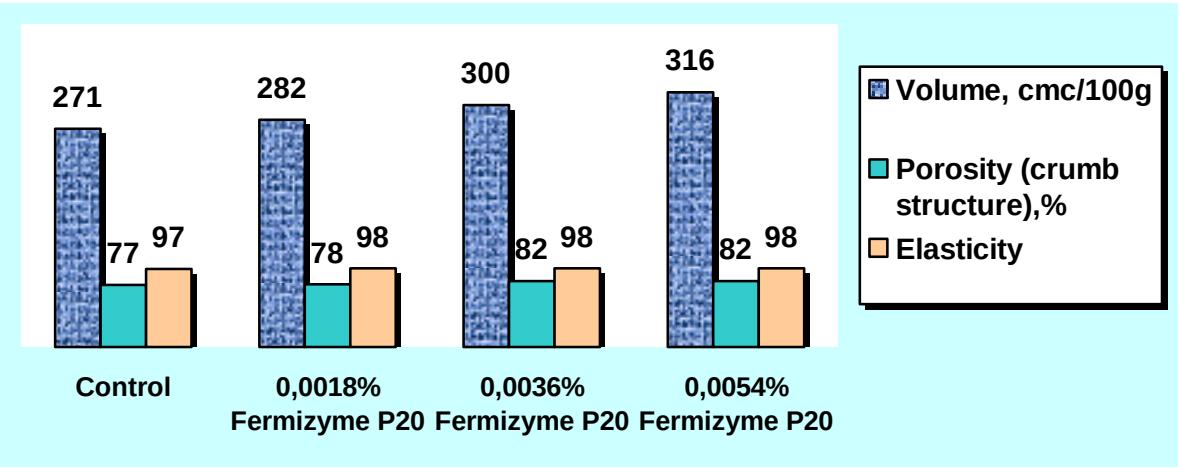

Figure 3. Variation of physic-chemical parameters of bread with Fermizyme P20 (0.0018, 0.0036 and 0.0054 % to flour, respectively) (flour F1).

The best results were obtained for the sample with 0.0054 % Fermizyme (P6):

- 17 % volume increasing;
- 6 % porosity improving;
- 14 % bread note improving.

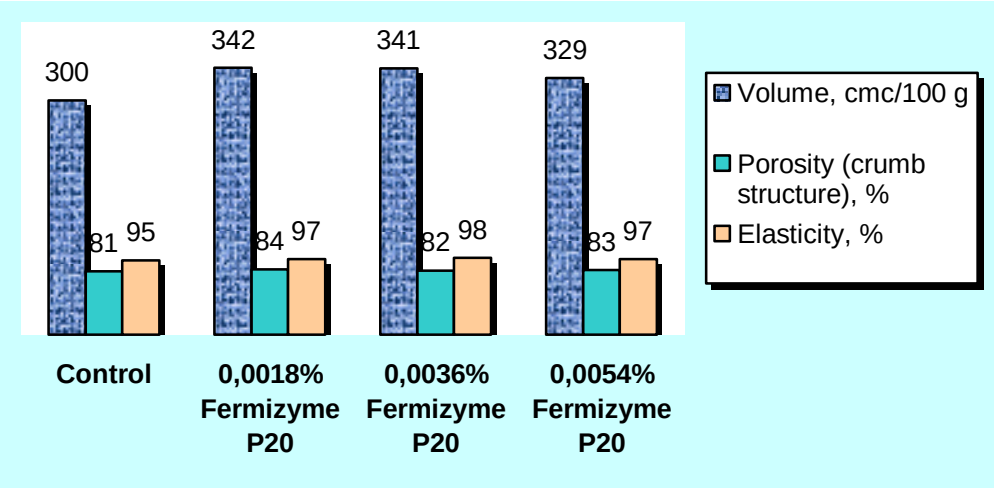

Figure 4. Variation of physic-chemical parameters of bread obtained with Fermizyme P20 (0.0018; 0.0036 and 0.0054 % to flour, respectively) (flour F2).

The best results were obtained for P5'sample (0.0018 % Fermizyme P20 to flour):
- 14 % volume increasing;
- 4 % porosity improving;
- 7 % bread note improving.

The Influence of Fermizyme P20 adding on CO_2 volume and gas retention in dough

Were made experiments for testing CO_2 eliminated and retention index determination in dough, for control and the samples with Fermizyme P20.

Table 9. CO_2 volume and retention index of dough

Parameters	**Control**	**P4**	**P5**	**P6**
CO_2 total volume, cm^3	2100	2175	1980	2175
Total surface, cm^2	140	145	132	145
Retention surface, cm^2	27	23	23	23
Retention index	0.80	0.84	0.82	0.84
Time, h	4	4	4	4
Temperature, °C	28	28	28	28

It was observed that CO_2 volumes for samples with Fermizyme P20 are higher than control.

Retention gas index was improved for samples with Fermizyme P20.

The Influence of Alphamalt VC 5000 adding on quality parameters of bread

Table 10. Recipes and technological parameters.

Raw materials	**Direct method**							
	F1				**F2**			
	M	**P7**	**P8**	**P9**	**M**	**P7'**	**P8'**	**P9'**
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
Alphamalt VC 5000, g	-	0.018	0.036	0.054	-	0.018	0.036	0.054
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	55	55	55	55	55	55	55
Baking time, min.	45	45	45	45	60	45	45	45
Baking temperature, °C	210°C	230°C			200°C	210...220°C		

The Alphamalt VC 5000 doses used was 0.0018; 0.0036 and 0.0054 % to flour, respectively, corresponding to 90, 180 and 270 units SKB/kg flours, respectively.

Table 11. Quality parameters of bread after 24 hours.

Sample/Characteristic	F1				F2			
	M	**P7**	**P8**	**P9**	**M**	**P7'**	**P8'**	**P9'**
Weight, g	520	523	511	510	531	533	523	512
Volume, cmc/100g	271	278	282	300	300	300	329	352
Height, cm	8.5	9.2	9.2	10.4	10	10.1	10.8	11.1
Diameter, cm	16	15.5	15.9	15.75	15.15	15.45	15.55	15.65
H/D	0.53	0.59	0.58	0.66	0.66	0.65	0.69	0.71
Porosity, %	77	81	82	82	81	82	83	83
Elasticity, %	97	98	98	97	95	98	98	97
Moisture, %	43.81	44.61	43.81	43.50	43.79	43.79	44.2	44.11
Acidity, degrees	1.2	1.2	1.2	1	1.1	1.4	1.2	1.2
Bread note	80	84	84	86	84	87	91	91

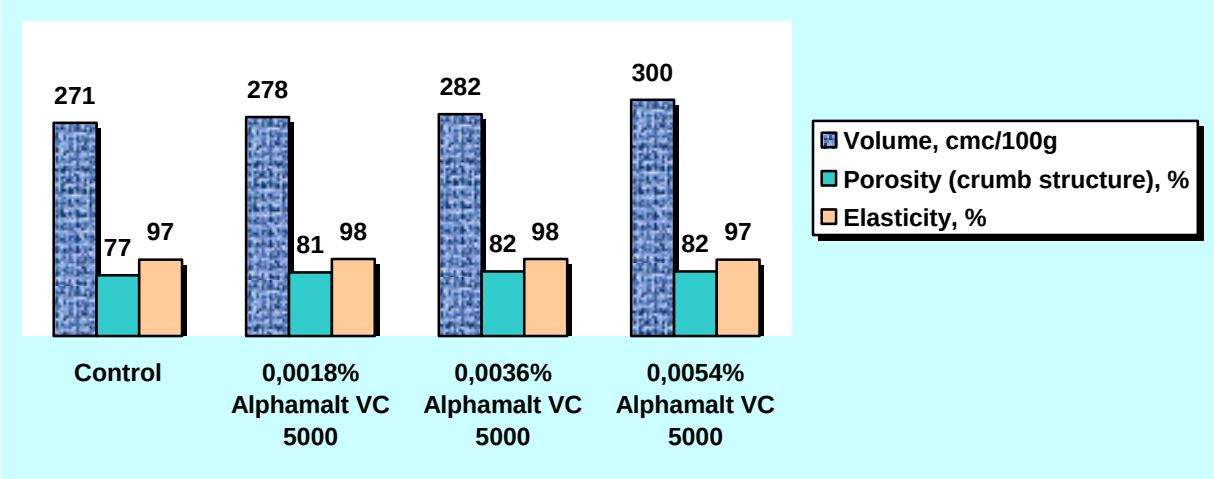

Figure 5. Variation of physic-chemical parameters of bread with Alphamalt VC 5000 (0.0018; 0.0036 and 0.0054 % to flour, respectively) (flour F1).

The best results were obtained for 0.0054 % (to flour) Alphamalt VC 5000 added (P9):

- 10 % volume increasing;
- 6 % porosity improving;
- 8 % bread note improving.

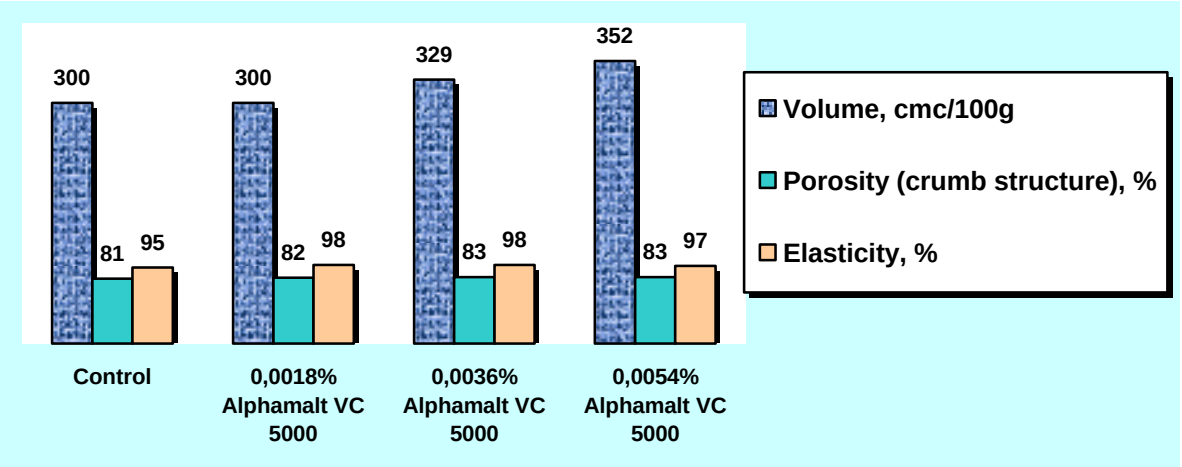

Figure 6. Variation of physic-chemical parameters of bread with Alphamalt VC 5000 (0.0018; 0.0036 and 0.0054 % to flour, respectively) (flour F2).

The best results were registered by P9', the sample with 0.0054 % Alphamalt VC 5000:
- 17.3 % volume increasing;
- 2.2 % porosity improving;
- 8 % bread note improving;

The Influence of Alphamalt VC 5000 adding on CO_2 volume and gas retention in dough

The tests for CO_2 volume and retention index in dough for control and the samples with Alphamalt VC 5000 have the results in table below.

Table 12. CO2 volumes and retention index in dough.

Parameters	**Control**	**P7**	**P8**	**P9**
CO_2 total volume, cm^3	2100	2085	2325	2010
Total surface, cm^2	140	134	155	134
Retention surface, cm^2	27	22	27	18
Retention index	0.80	0.84	0.85	0.86
Time, h	4	4	4	4
Temperature, °C	28	28	28	28

The results show that the highest volume of CO_2 it was obtained for P8 sample.

The Influence of Bel'Ase A75 adding on quality indicators of bread

Table 13. Recipes and technological parameters.

Raw materials	**Direct method**							
	F1				**F2**			
	M	**P10**	**P11**	**P12**	**M**	**P10'**	**P11'**	**P12'**
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
Bel'Ase A75, g	-	0.0014	0.0026	0.0036	-	0.0014	0.0026	0.0036
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	55	55	55	55	50	50	50
Baking time, min.	45	45	45	45	60	55	55	55
Baking temperature, °C	210°C	230°C			200°C	220°C		

The Bel'Ase A75 doses had been: 90, 180 and 270 units SKB/kg flour, respectively.

Table 14. Quality parameters of bread after 24 h.

Sample/Characteristics	F1				F2			
	M	**P13**	**P14**	**P15**	**M**	**P13'**	**P14'**	**P15'**
Weight, g	520	514	512	516	531	514	514	518
Volume, cmc/100g	271	266	284	292	300	303	320	315
Height, cm	8.5	9.5	9.3	10	10	10	11.5	10.2
Diameter, cm	16	15.6	15.45	15.85	15.15	15.35	15.25	15.45
H/D	0.53	0.61	0.60	0.63	0.66	0.65	0.75	0.66
Porosity (crumb structure), %	77	80	80	80	81	82	82	81
Elasticity, %	97	97	98	97	95	95	97	97
Moisture, %	43.81	43.70	44.19	43.89	43.79	44.3	44.4	43.69
Acidity, degrees	1.2	1.2	1	1	1.1	1.2	1.2	1.3
Bread note	80	82	82	88	84	86	90	89

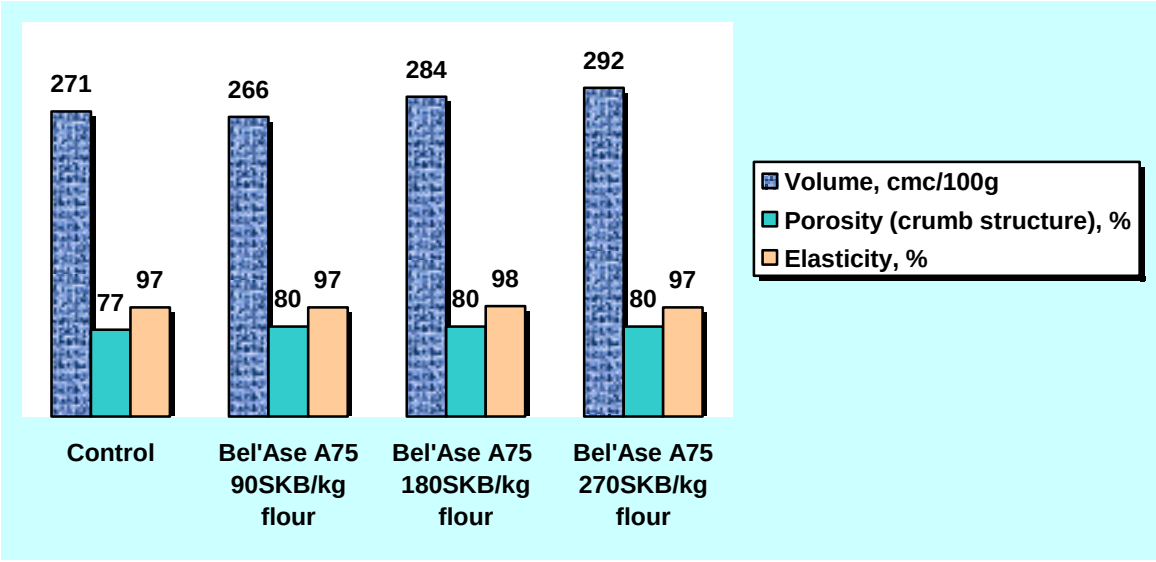

Figure 7. Variation of physic-chemical indicators of bread with Bel'Ase A75 (90; 180 and 270 units SKB/kg flour , respectively (flour F1).

The best results were obtained for P15 sample with 270 units SKB /kg flour

- 8 % volume increasing;
- 4 % porosity improving;
- 10 % bread note improving.

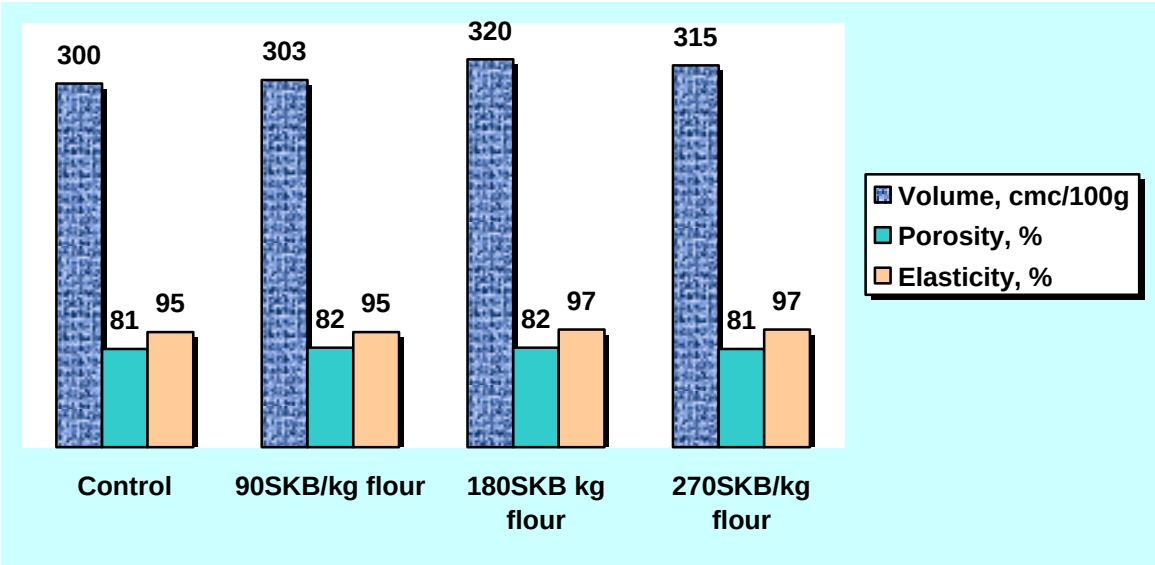

Figure 8. Variation of physic-chemical parameters of bread with Bel'Ase A75 (90; 180 and 270 units SKB/kg flour, respectively (flour F2).

The sample with 180 units SKB/ kg flour (P15') the best results presented:

- 7 % volume increasing;
- 10 % bread note improving.

Conclusions

A table is shown to spotlight the differences between the enzymes used and the type of flour.

Table 15. Influence of fungal amylase enzymes on flour quality and optimal doses

Name of cemmercial product	Activity	Fallig number of flour, sec.		Optimal dose (to flour) Units SKB/kg faina	
Alphamalt V	900 SKB/g	468	384	180	270
Fermizyme P20-450 FAU/g sau 5000 SKB/g	4550 SKB/g	468	384	270	90
Alphamalt VC 5000	5000 SKB/g	468	384	270	270
Bel'Ase A75	75000 SKB/g	468	384	270	180

All quality parameters have improved (volume, porosity, elasticity, bread note, etc.)
The sensorial indicators have improved, also.
The retention index of samples with enzymes were always higher than control.

Acknowledgements

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References

1. SR ISO 3093:97. Falling Number Method
2. Romanian Standard 90-77. Baking Test.
3. Zymotachigraphic Method.