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MIXOLAB® RHEOLOGY OF ENZYMATIC FLOUR AND VALIDATION OF BAKING PERFORMANCE

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Abstract: *The purpose of this research is to justify the way in which flour is added to obtain a quality product, quality seen from the perspective of bakers. Because bakers want to have good and consistent flour, many tests are done in the mills for the addition of flour, tests that are correlated with baking samples. In this study, analyzes are based on the use of enzyme mixtures with influences on the rheology of the flours and the organoleptic properties of the bread resulting from the baking test.*

• Introduction

Although there are numerous studies that deal with the characteristics of wheat, implicitly flour, due to the increasingly frequent occurrence of gluten intolerance among the population, studies from the applicability of other cereals in panicification have gained momentum. The determination of the rheological properties of wheat flour dough as well as dough from other raw materials (rice, corn, buckwheat, amaranth and soy) was carried out by Mixolab. According to the results obtained through Mixolab measurements, the flours from different raw materials presented Mixolab profiles that differ greatly from the profile of wheat flour. However, since there was no tested material that exactly mimics the properties of wheat flour dough, it was concluded that their mixtures would give the optimal rheological profile (Dapčević Hadnađev, T., et.al., 2011).However, traditional bakers still produce bakery products from wheat flour and look for the best variants. That's why mills that grind wheat are still concerned with obtaining optimal flour from a qualitative point of view. In this sense, numerous tests are carried out with enzyme additions, knowing their effects on the rheological properties. There are studies that demonstrate that additions of different percentages of xylanase can modify the CH of the flour and improve the workability of the dough (Jia. C, et.al., 2011)The rheological parameters of flour are not sufficient for the prediction of baking tests. Wheat varieties with different ripening qualities show a specific starch rheology. The starch rheology of individual varieties deepens their mutual differences. Only starch rheology can be used to predict bread height and aspect ratio. Starch rheology can also be used to improve cookie quality estimation. (Dvořáček, V., et al., 2019).

• Material and method

In order to obtain some available data it was used wheat flour types 650 (0, 65% ash), provided by MP Baneasa –Moara SA Ilfov, Romania. The analytical flours quality was determined according to the international standard methods (ash content – ICC104/1, rheological parameters with Mixolab -ICC 173-1). The moisture content of the wheat flour were determined by oven drying at 130 ^{0}C for 1 hour. It was made determination of technological and rheological properties through Mixograph method based on Chopin protocol. The white flour had a 380 second Falling Number index (Ic) and the and the following rheological parameters, on Mixolab: stability 9,6s, CH 57,5%, C1 1,029Nm, C2 0,34Nm, C3 1,544Nm, C4 1,69Nm, C5 2,88Nm, α -0,114Nm/min, β 0,362NM.min, ϒ -0,02Nm/min. Index 4 41 478. The first test consisted of the addition of xylanase and lipase at a same percentage of 5 ppm, in the control sample, marked P1. For the other samples, the constant addition of xylanase and lipase of 5 ppm was kept, but the percentage of alpha-amylase was changed, like this 5 ppm for sample P2 and 10 ppm for sample P3. For each sample, M, P1, P2 and P3, the flour was analyzed in a mixolab, and the Falling Number index was determined. To validate the used enzyme mixtures, baking samples were made and analyzed by laser scanning, with the Volscan device. The Volscan Profiler is a benchtop laser-based scanner that measures the volume, density and dimensional profiles of solid products. The experiments are made in the research laboratory of Stefan cel Mare University of Suceava, Faculty of Food Engineering.

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• Results and discussions

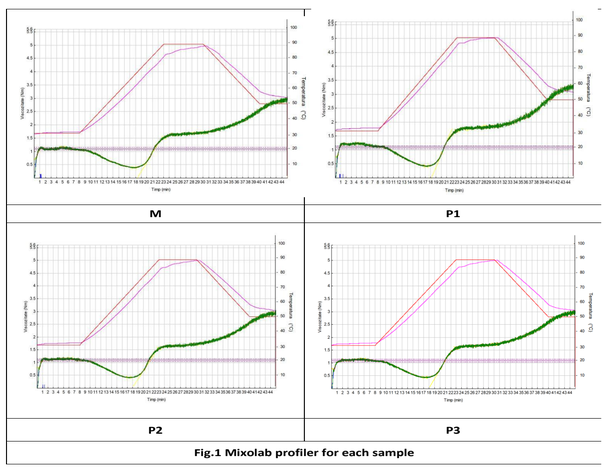

Fig.1 Mixolab profiler for each sample

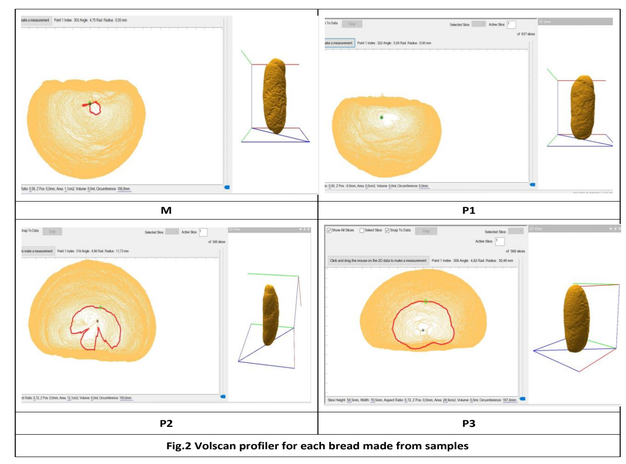

Fig.2 Volscan profiler for each bread made from samples

Tab. 1. Mixolab results for tests

Nr crt	Denumire proba	CURBA MIXOLAB C+											
		Stab (min)	Ampl (Nm)	CH %	C1 (Nm)	C2 (Nm)	C3, (Nm)	C4, Nm	C5, Nm	α (Nm/min)	β (Nm/min)	γ (Nm/min)	Index
1	M	9.6	0.086	57.5	1.029	0.34	1.544	1.69	2.88	-0.114	0.362	-0.02	4 41 478
2	P1	9.9	0.059	55.0	1.129	0.363	1.472	1.755	3.031	-0.114	0.314	0.002	2 51 288
3	P2	9.7	0.043	57.2	1.121	0.417	1.547	1.684	2.950	-0.112	0.290	0.022	3 51 378
4	P3	10.4	0.063	56	1.061	0.299	1.418	1.645	2.832	-0.118	0.338	0.024	2 51 278

Tab. 2. Volscan results for backing tests

Sample ID	Volume (ml)	Specific Volume (ml/g)	Volume-Yield η (ml/100 g flour)	Density (kg/m^3)	Aspect Ratio at Max Height	Max Circumference (mm)
M	1872	5.071	748.9	197.2	0.56	372.4
P1	1948	5.574	779.2	179.4	0.66	372.7
P2	1918	5.362	767.2	186.5	0.67	349.3
P3	1793	4.955	717.1	201.8	0.59	353.5

The aim of this research was to establish an optimal profile of the enzyme flour in order to obtain bread with the best organoleptic properties, for a falling index of 350 s. Reference is made to volume, but also to other parameters such as the ratio H/ D, density, maximum circumference.

We start from a flour with certain rheological parameters, from which we obtained bread with a specific volume of 5.071 ml/g through the baking probe, as seen in table 1.

By adding the xylanase and lipase enzymes, a flour is obtained, with good stability, the high C2 couple, which characterizes the protein quality and as seen in table 2, is correlated with the bread volume, 5.574 ml/g, for P1.

If we keep constant the addition of xylanase and lipase and vary the percentage of alpha-amylase, it is observed that for samples P2 and P3, the C2 couple decreases, which translates into an increased rate of protein degradation, and a decrease in specific volume.

The torque C3, which refers to the maximum consistency of the starch gel, is maximum in sample P1, without the addition of alpha-amylase. The starch gel has maximum viscosity at P2 and the rate of gelatinization, β, is the lowest.

The volume is good and the H/D ratio of 0.67, the highest of all samples, shows that the bread does not tend to flatten.

ϒ, which has the capacity of enzymatic degradation, is the largest sample P3, with the addition of 1 ppm of alpha amylase. The maximum consistency of the gel is obtained in sample P1, without the addition of alpha amylase. The C5 torque, which indicates the maximum gel consistency, is maximum at P1, indicating that the bread will age faster than the other samples.

• Conclusions

The influence of the addition of these enzyme combinations on the rheological parameters was monitored and it was observed that as the amount of alpha amylase increased, there was a decrease in FN with little change in the other parameters. Since the basic flour (the control) was one with above-average baking properties, the baking samples were not negatively influenced by the increase in the percentage of alpha-amylase, characteristics also supported by the addition of xylanase and lipase. As a result of experimental research and taking into account the correlation between the falling index and dough workability, the most affordable mixture could be 10 ppm alpha amylase and 5 ppm xylanase and lipase, but it depends on the quality of the wheat flour. for each batch of raw material.