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CREATING THE CORRELATION MODEL AT FLOUR T-400 AMONG AMYLOGRAPH UNITS AND Γ SLOPE OF MIXOLAB CURVE

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Abstract

Determination of rheological properties of milling products is important because the standard and uniform quality of baking products is provided using flour with optimal quality.

The aim of this study is to to establish significant relationships and to define a correlation model between maximum viscosity expressed in amylograph units obtained using traditional rheological Amylograph device and the γ slope obtained by Mixolab device flour analysis.

In the bread making process, the baking properties depend on the gelatization of the starch in the flours. Amylolytic enzymes have been also proposed as active contributors towards fresh bread quality and staling behaviour during storage. Functional properties of flours greatly depend on the enzyme activity (α-amylase), therefore calculating and predicting the amylase activity of T-400 flour is essential for the bread quality.

The result of this research is the larger number of laboratory testing at the same time, to meet the Miller's main need to anticipate end product quality and to predict the products quality in the baking process.

Key words: *α-amylase, flour, quality, control, correlation model*.

1. Introduction

The quality of baking products significantly depends on the quality of flour. In order to achieve greater stability in baking products, it is necessary to determine gelatinization properties of the flour. The gelatinization process of starch start with temperature increasing (60-80°C) in the presence of water. It is highly related with amylolytic ability of flour, which means as a greater amylase activity of the flour, the greater is ability of gelatinization. At the baking process, in bread is formed starch gel, because the thermal and enzymatic degradation is not completely brought to an end. This gel behaves like a solid elastic material, it has specific physical properties and its structure has held no broken-down water bonds between macromolecular segments. The level of thermal and enzymatic degradation of starch molecules during baking process depends of the starch property and the presence of enzymes, i.e. gelatinization properties of flour. This means that the content of amylolytic enzymes in the flour has significant part in bread quality i.e. moisture, elasticity, crumbliness, porosity and retrogradation (Ковачевиќ [1]).

The traditional method of determining the flour amylase activity on Amilograph is based on monitoring of the suspension viscosity changes. With complete flour characterization on Mixolab, from the curve is determined slope γ, which is the speed of enzymatic degradation (Torbica *et al*. [2]).

In technological processes, the important role has comparison and examination of the reliability between separate properties. It means by measuring of the one property, can be determined another one, without examination (Miles and Shevlin [3]). The creation of the correlation model between the slope γ and amylograph units is necessary for the direct determination of the amylase activity from the Mixolab curve, thereby reducing the time for separate analysis for amylase activity in flour on Amilograph.

2. Materials and Methods

The research is made in Laboratory in Zito Polog AD. One hundred sample of flour T-400 are analyzed. The measured values of flour are obtained using ICC Standard Method No. 126/1 Amylograph, Brabender and Standard Method No. 173 Mixolab, Chopin. The measured values for the maximum viscosity of Amilograph device and speed of enzymatic decomposition (slope γ) of Mixolab device are processed with the Software MINITAB Version 15th.

Analyze on Amylograph device

The amylograph viscosity is the resistance, measured as torque and expressed in Amylograph Units (AU). An

80 g flour and 450 ml water suspension is heated at a constant rate of increase of temperature in a bowl rotating with a specified, constant rotational speed. During heating the viscosity of the forming gel is recorded continuously. The increase in gel viscosity is counteracted to a greater or lesser extent by the increase in temperature, by the mechanical action of stirring and by the liquefying action of alpha – amylase present in or added to the flour. The maximum viscosity attained during the test is a guide to both the alpha-amylase and the gelatinization behavior of the flour and hence to its baking properties. As the higher the maximum viscosity, the amylase activity of the flour is lower (Калуѓерски and Филиповиќ [4]).

Analyze on Mixolab device

Mixolab Profiler is uses the standard ICC N°173 protocol for a complete characterization of flours. Its ability to operate under variable temperature and kneading constraints allows it to provide an overview of flour quality (kneading ability, protein quality, gelatinisation and starch gelatine), as well as the effects of numerous enzymes in a single analysis and produces a simplified graphic interpretation of the results. As opposed to amilograph, Mixolab produces results based on measurements on dough and not on a suspension. According to water absorption and moisture content in the flour, software determines the weight of the sample for measuring. With the profile "Chopin+" for the period of 45 minutes at temperature of 30-90 degrees, are determined: Absorption potential, Behaviour in mixing, Gluten strength, Maximum viscosity, Amylase activity, Retrogradation, Stability (min), Amplitude (Nm), Slope α (speed of protein weakening due to heat), Slope β (Starching speed) and Slope γ (enzymatic degradation speed) (Chopin [5]).

3. Results and Discussion

In Table 1 are present the measured values of maximum viscosity express in amylograph units, measured values of slope γ, predicted values of maximum viscosity in amylograph units obtained by calculation according to equitation (1) for flour T-400.

Table. 1. Measured and predicted values of maximum viscosity, measured values of slope γ

Sample No.	Measured value Max. Viscosity (AU)	Enzymatic degradation speed Slope γ (Nm/min)	Predicted value Max. Viscosity (AU)	Sample No.	Measured value Max. Viscosity (AU)	Enzymatic degradation speed Slope γ (Nm/min)	Predicted value Max. Viscosity (AU)
1	830	-0,076	682,9182	51	640	-0,082	652,5973
2	840	-0,044	844,6297	52	860	-0,034	895,1646
3	920	-0,056	783,9879	53	1000	0	1066,983
4	730	-0,042	854,7367	54	980	-0,014	996,2343
5	550	-0,082	652,5973	55	980	-0,006	1036,662
6	750	-0,046	834,5228	56	990	-0,028	925,4855
7	980	-0,034	895,1646	57	720	-0,07	713,2391
8	980	-0,022	955,8064	58	720	-0,066	733,4531
9	920	-0,016	986,1273	59	1000	-0,028	925,4855
10	610	-0,072	703,1322	60	720	-0,098	571,7415
11	650	-0,076	682,9182	61	1000	-0,04	864,8437
12	570	-0,052	804,2019	62	1000	-0,038	874,9507
13	490	-0,078	672,8112	63	580	-0,076	682,9182
14	520	-0,100	561,6346	64	950	-0,042	854,7367
15	720	-0,042	854,7367	65	660	-0,054	794,0949
16	670	-0,066	733,4531	66	740	-0,068	723,3461
17	840	-0,048	824,4158	67	860	-0,066	733,4531
18	840	-0,060	763,774	68	760	-0,086	632,3834
19	730	-0,066	733,4531	69	820	-0,062	753,667
20	840	-0,038	874,9507	70	880	-0,052	804,2019
21	710	-0,080	662,7043	71	870	-0,022	955,8064

22	980	-0,032	905,2716	72	780	-0,058	773,8809
23	600	-0,084	642,4903	73	780	-0,046	834,5228
24	650	-0,090	612,1694	74	880	-0,062	753,667
25	710	-0,092	602,0624	75	530	-0,094	591,9555
26	610	-0,076	682,9182	76	800	-0,086	632,3834
27	510	-0,092	602,0624	77	880	-0,006	1036,662
28	470	-0,096	581,8485	78	830	-0,016	986,1273
29	780	-0,058	773,8809	79	800	-0,062	753,667
30	710	-0,040	864,8437	80	800	-0,042	854,7367
31	780	-0,046	834,5228	81	840	-0,056	783,9879
32	880	-0,046	834,5228	82	960	-0,05	814,3088
33	730	-0,054	794,0949	83	560	-0,076	682,9182
34	800	-0,041	859,7902	84	810	-0,074	693,0252
35	730	-0,052	804,2019	85	760	-0,052	804,2019
36	370	-0,112	500,9927	86	680	-0,062	753,667
37	720	-0,03	915,3785	87	660	-0,09	612,1694
38	530	-0,082	652,5973	88	780	-0,03	915,3785
39	580	-0,076	682,9182	89	740	-0,05	814,3088
40	760	-0,062	753,667	90	880	-0,054	794,0949
41	640	-0,084	642,4903	91	920	-0,034	895,1646
42	900	-0,062	753,667	92	870	-0,018	976,0204
43	630	-0,072	703,1322	93	820	-0,062	753,667
44	690	-0,062	753,667	94	880	-0,04	864,8437
45	650	-0,06	763,774	95	1000	-0,026	935,5925
46	710	-0,084	642,4903	96	980	-0,032	905,2716
47	460	-0,142	349,3882	97	1000	-0,022	955,8064
48	490	-0,09	612,1694	98	1000	-0,018	976,0204
49	610	-0,074	693,0252	99	860	-0,06	763,774
50	560	-0,098	571,7415	100	800	-0,042	854,7367

Applying the software a diagram is determinate (Figure 1) as follows:

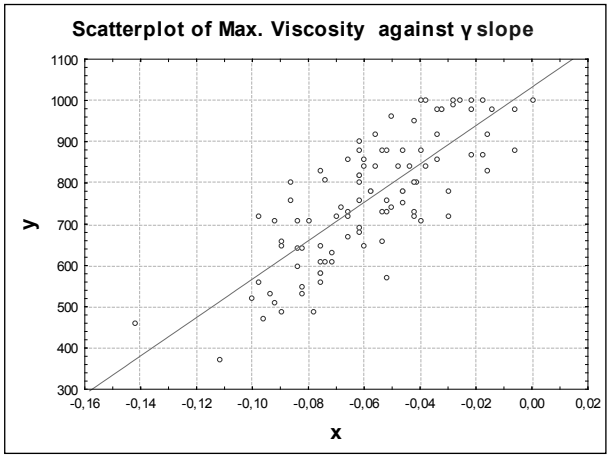

Figure 1. Linear function among maximum viscosity and slope γ

Obtained quantitative equitation as follows:

$$\mathbf{y = 1032,31 + 4652,60x} \quad (1)$$

x - slope γ (enzymatic degradation speed) and

y - maximum viscosity (AU).

The coefficient of regression is R=0.792. It is indicating high confidence in the correlation among maximum viscosity and slope γ. This reduces the time required for calculating the maximum viscosity, rapid intervention in the milling process and prediction the products quality in the baking process.

The chart of deviations between measured and predicted values of maximum viscosity is present on Figure 2.

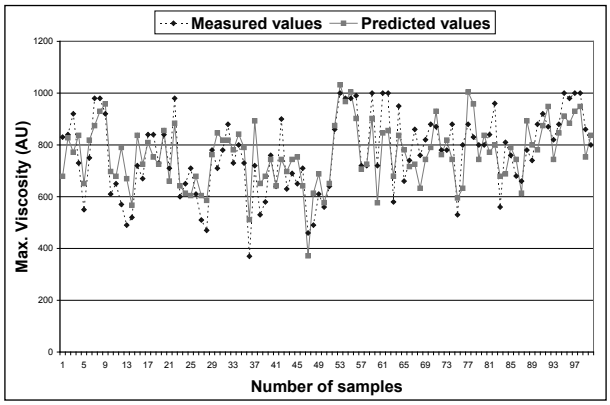

Figure 2. Deviations between measured and predicted values of maximum viscosity

4. Conclusions

- Application of the correlation model allows rapid intervention in the milling process and prediction the flour behavior in the baking process, and thus prediction of baking quality of products. The resulting correlation for characterization of flour with Mixolab device, provides the maximum viscosity without necessarily perform another analysis by Amilograph. The coefficient of correlation is amounts to 0,792.
- It is useful to predict the quality of flour in milling process and stability of the products in a baking process. This correlation formula provides an opportunity for laboratory testing of a large number of samples at the same time, also enables timely information for Millers about flour quality and predicts the products quality in the baking process.

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