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TEMPERATURE INFLUENCE ON DOUGH'S BEHAVIOUR

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Abstract

Specialty literature considers that optimum temperature for dough is 28-30ºC. During the process of kneading, the temperature of dough increases one hand thanks to the heat produced by hydration of flour particles, and the other hand thanks amount of mechanics energy who is transformed in thermal energy. If optimum temperature is get over, the elasticity and firmness is changed because fermentative activity are crowing. If temperature is below the optimum the plasticity of dough is decreases and that affect the quality of finite products.
Keywords: *optimum temperature, increases, elasticity, firmness, plasticity.*

Introduction

As it's known, the temperature is a parameter very important because it affects all the dough process (enzymes activity, rheological properties). It affects rate of reaction of enzymes and that's why their activity increases till optimum activity. Temperature also affects multiplication and fermentation (Bordei, 2004).

Knowing that optimum temperature for yeast multiplication (25…26ºC) is different by fermentation optimum temperature (30…35ºC), we can use this parameter for adjust multiplication activity in precursory stages of dough and also fermentation activity.

Temperature increase leads to a increase of acidity activity because there are enlarge conditions of temperature. Regarding all this facts (temperature influence on enzymes and microbiotic activity, rheological properties of dough) we can tell that for strong flour temperature is bigger and for soft flour temperature is smaller.

For soft flour, low temperature leads to a delay of macromolecular hydration and growing protein, reduces enzymatic a microbiological

activity (Ceapoiu, Giurea 2002). For strong flour, temperature leads to increase proteins growing, enzymatic and protheolitic activity.

Experimental

For studying temperature effect on dough, we made tests with Chopin Alveograph and Consistograph. Measurements were made using the same flour, white flour TIP 650 with characteristics from table 1.

Table 1. Flour characteristics

Parameter	Unit	Value	STAS
Humidity	%	14.2	SR ISO 712:1999
Ashes	%	0.645	STAS 90-88
Acidity	grade	2.1	STAS 90-88
Humid gluten	%	24.5	SR ISO 7495:1998
Formation number	mm	5	STAS 90-88
Falling number	sec	275	SR ISO 3093:1997

Mixing temperature is changed to the following values: 18ºC, 20ºC, 22ºC, 24ºC, 26ºC, 28ºC, 30ºC and 32ºC. For all tests, the concentration of sodium chloride solution is 2.5%.

We used a Chopin Consistograph comprised of two elements: the kneader equipped with a pressure sensor to determine the consistency of the dough during kneading, and the curve recorder (Alveolink).

Tests made on Consistograph are effectuate in order to study the influence of temperature on the maximum pressure (Pr MAX) measurement at constant hydration (CH), on dough behaviour during mixing at adapted hydration (AH), on the Alveographic parameters at CH and AH. For each concentration, these tests are made in two ways: with constant hydration test and adapted hydration test.

On the Consistograph we have made these two tests and we discover that constant hydration test is made in order to measure the maximum pressure (Pr MAX), thus the water absorbtion capacity using to obtain a target consistency. The amount of sodium chloride solution which is added depends of the flour moisture content. For each test, the hydration is the same, only the temperature changes. The maximum

pressure is the main parameter because it is directly linked to the water absorbtion capacity of the flour.

Adapted hydration test is used in order to be sure the target consistency is obtained and to study the dough behaviour during mixing (time necessary for maximum pressure (T Pr MAX), Tolerance, 250 seconds Drop and 450 seconds Drop).

The hydration could be different; it depends on the water absorbtion capacity which is determined during constant hydration Consistograph test for each temperature.

For our tests we also used Chopin Alveograph and we can tell that constant hydration test is made in order to determinate the evolution of parameters: P (tenacity, maximum pressure required to reshape the sample), L (dough's extensibility, curve length), G (extensibility number), W (baking strength), P/L (curve configuration ratio), Ie (P200/P elasticity, P 200 represented pressure at 4 cm from the beginning of the curve), as a function of temperature.

Results and Discussions

After tests made on Consistograph, in constant hydration (CH) and adapted hydration (AH), we obtained the results from table 2.

Table 2. Consistograph values in constant and adapted hydration

Protocol	Parameters	20ºC	22ºC	24ºC	26ºC	28ºC	30ºC	32ºC
CH	Pr MAX(mb)	3240	3120	2640	2400	2080	1870	1790
CH	T Pr MAX (sec)	169	170	168	164	170	173	171
AH	HYDHA	56.4	55.2	53.7	52.8	51.7	50.3	50.0
AH	T Pr MAX HA (sec)	164	159	155	150	146	132	127
AH	TOLERANCE (sec)	204	199	193	187	183	175	170
AH	D 250 (mb)	290	317	150	498	515	521	530
AH	D 450 (mb)	1080	1098	1115	1126	1134	1148	1159

As we see, the HYD HA is also lower and temperature increase leads to a decrease of Pr Max. We also discover that T for Pr Max at constant hydration remains stable (on the average) but T for Pr Max at adapted hydration tends to increase.

An important fact is that tolerance decreases and 250 drop increases when temperature increases.

The increase of temperature induces a weakening of dough. This leads to a loss in absorbtion capacity. In the same time we observed a loss of plastic properties of dough. Because of this phenomenon, if a baker wants to work with tougher dough, he can decrease dough mixing temperature.

With Alveograph, in constant hydration (CH) and adapted hydration (AH), we have obtained results presented in table 3.

Results obtained show us that G value decreases when temperature increases and elasticity increases when temperature increases. Important is that there is no noticeable differences on pressure and baking strength increases. At adapted hydration, general tendencies are an increase of tenacity, a decrease of the extensibility. Here also, baking strength increases.

Temperature modifies plastic qualities of dough. Generally speaking, when temperature increases during mixing, P (tenacity) increases.

Conclusions

Plastic properties variations due to temperature are noticeable and measurable on the Consistograph. Increase of temperature on the mixing step leads to a weakening of the dough. On the Alveograph, variations are noticeable, dough gain in elasticity but loose on the extensibility while temperature increases. It is important to respect carefully temperature control while testing dough on Consistograph, Alveograph or any quality control equipment.

References

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Table 3. Alveograph values in constant and adapted hydration

Protocol	Parameters	18ºC	20ºC	22ºC	24ºC	26ºC	28ºC	30ºC	32ºC
CH	P	101	103	102	104	104	105	106	108
CH	G	22.4	21.2	20.4	19.2	18.5	17.1	16.6	16.1
CH	P/L	1.42	1.50	1.59	1.68	1.74	1.86	1.98	2.02
CH	Ie	56.2	57.3	58.1	58.8	59.3	59.7	59.9	61
CH	W	242	248	237	226	217	211	204	201
AH	T	63	75	89	95	101	107	112	118
AH	Ex	24.2	23.5	22.0	21.4	20.6	19.1	18.0	16.8
AH	T/A	0.60	0.83	0.96	1.40	1.73	1.84	1.93	2.01
AH	lec	58.1	58.5	59.8	59.4	59.8	60.1	59.7	59.5
AH	Fb	220	225	231	236	240	243	247	251