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THE EFFECT OF α-AMYLASE IN REHOLOGY FEATURES OF SOME WHEAT CULTIVARS AND THEIR HARMONIZATION FOR PRODUCING BAKING ACCORDING TO CUSTOMER REQUIREMENTS

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ABSTRACT

The purpose of this study is to study the state of rehology features of douhg with different content of α-amylases which affect in determination of baking products quality. Dough that are very strong, from experiments conducted, do not allow the development of pores and have high density, form of bread with small volume, while dough that are poor can not keep the bubbles, cause large pores in bread and its decline. To improve the quality of baking products are made grinding and harmonization of flours according to quality and value of their rehology. The role of disulfide bonds in the dough rehology control is of utmost importance. If disulfide bonds are reduced by chemical agents, or the quality of flours, we will see a dramatic reduction in the strength of dough that is re-oxidation restore or strengthen it. Adding oxidizing and reducing agents, and their mode of action, affect the exchange of disulfide bonds, and it have great effect. From the survey data is concluded that the use of α-amylase is necessary in flour production by grain without spruge, with a decrease amylasic activity. In this study there is not addition of α-amylase, but is exploiting the high content of α-amylase in wheat F1-984 Macedonian. Their harmonization based on the content of α-amylase and quantified for each cultivar, and the specified radius show that improve quality of bakery products without additional α-amylase.

Key words: Wheat cultivars, quality of flour, dough, α-amylase, bakery products.

1. Introduction

Through knowledge of qualitative characteristics of some types of wheat and flour defined physico-chemical and rehology parameters to find their harmonization in the process of bradmaking without additional of α-amylases, to the final product. Determine factors affecting the dough rehology during extension, weaned and mitigation caused during the harmonization process, are: Deformation of dough, which consists in energy storage in the dough by modifying molecular structures, where blending and harmonizing leads to storage of elastic energy in the dough; achieving maximum resistance during mixing, maximum height increases with decreasing water content, and mixed dough represents a decrease of resistance to extension. Molecular effects of α-amylase may be light, which affect as hydrogen bonds, as well as the digestibility of starch and protein, where both these affect the connectivity of the system. The role of disulfide bonds is important for the mechanism of reactions, as well as the role of covalent linkages in maintaining the network. Impact of α- and β-amylase is important at the dough rehology because convert the starch into sugar and maltose. Only the amount of sugar formed between 25 and 40 °C affects in the fermentation process, while the quality of the dough depends on the activity that enzymes perform between 55 and 80 °C (respectively the temperature of starch freezing and temperature of inactivization own enzymes). β-amylase, which loses its activity in low temperatures relatively, has little influence on the quality of bread during baking. The amount of sugar formed during fermentation depends on the quality of starch damaged during milling. α-amylase is very important in determining the quality in terms of the speed of starch hydrolyzing in destrine, at temperatures between 55 and 80 ° C. The optimum pH for activity in cereal starch is 5.2 - 5.4.

2. Methodology

All wheat cultivars get in the study were respectively: Macedonia (F1-984), Russia (F1-985), Serbia (F1-983) and Hungary (F1-986). From each cultivar was obtained from 15 kg of wheat for milling that are conditioned for 14-24 hours to reach optimum moisture for grinding of 16.5%, and milling of flour (type 55) and production of bread took place in flour factory "Atlas Tirana".

Depending on qualitative and quantitative parameters it is studied the impact of α-amylase at wheat cultivars get in the study in order to improve the rehology properties in dough without addition of α-amylase and production of harmonized bread (Assos 284). Quality assessment of samples is done according to ISO standard, using physical, chemical, rehology and technological methods. For the determination of cereals moisture is referred to S SH 712: 2000, evaluation of wheat flour and characteristics according to S SH 1455: 1987, evaluation of dough and their characteristics S SH 1460: 1987, and determination of bread samples by S SH 1499: 1987 (DPS, catalog 2005). For determination of rehology characteristics are used by 300 grams of flour for each analysis, using analysis:

a. BRABENDER Farinograph - Water absorption (%); dough development (min); stability (min); the degree of attenuation (Bumble) and group classes farinografike quality;

b. Ekstensograph - energy (cm^2), dough resistance, maximum resistance (EU), flexibility (mm) and the index between resistance and resilience;

c. Amilograph - viscosity of water-flour mixture, as a temperature function, where is measured the amylasic activity

of flour or the preparation based by α-amylase;

d. Falling Number - indicative of wheat germination and viability of a flour during fermentation, based on the activity of α-amylase.

e. Decreasing number of Hagberg (Falling Number): Hagberg value indicate whether a sprouted wheat is partially and sustainability of a flour during fermentation, giving the measure of amylase activity, or those enzymes in the coming transform starch into maltose, and then on to alcohol, producing carbon dioxide.

Hagberg value lower than FN 150 s indicates the presence of sprouted grain, high activity amylasitic and risk of soaked bread. When the value is from 250 to 300 s amylasitic activity is normal; over the value 350 s amylasitic activity is weak, so the bread has a volume less developed and very dry pulp. For making a harmonization of wheat whith FN 200 s and value over FN 350 s it is used calculation formula of Falling Number Index (FNI): (FNI_A) and (FNI_B) are wheat with low and high Falling Number Index; (FNI_T) is Falling Number Index desired.

$$FNI=\frac{6000}{FN-50} \quad (1\text{-}1)$$

$$PA=[\ (FNIB)-(FNI\ T\ )]\ (1\text{-}2)$$

$$PB=[(FNIA)-(FNI\ T\ )]\ (1\text{-}3)$$

$$\text{Percentage of grain with FN 200s: } P\%A=\frac{PA}{PA+PB}*100\ (1\text{-}4)$$

$$\text{Percentage of grain with FN 350s: } P\%B=\frac{PB}{PA+PB}*100\ (1\text{-}5)$$

f. Mixolab - measurement of rehology characteristics. For each wheat cultivars will be produced bread which will be analyzed following parameters: Volume; Yield in volume (mm/100gr); Specific volume (cm^3 / 100gm); Height-diameter ratio (H / D); Form; Porosity; Acidity; etc.

3. Results and Analysis

In this study are obtained in study four types of wheat, which are: F1-984 Macedonian, F1-985 Russian, F1-983 Serbian and F1-986 Hungarian. After performing physico-chemical analyzes and rehological analyzes of these wheat is received wheat and flour harmonized "Assos 284", which results to be the optimal value in breadmaking. The qualitative indicators of wheat and flour produced by these grains are (Schedule 1, Schedule 2 and Schedule 3):

Schedule 1 - Hectrolitrice weight and flour radius of wheat cultivars.

Cultivar	**Hectrolitrice weight (kg)**	**Conditioning (hour)**
F1-984 Macedonian	72.4	14
F1-985 Russian	75.6	24
F1-983 Serbian	76.3	16
F1-986 Hungarian	77.1	16
Cultivar	**Flour radius (%)**	**Bran (%)**
F1-984 Macedonian	75.8	24.2
F1-985 Russian	77.6	22.4
F1-983 Serbian	78.9	21.1
F1-986 Hungarian	79.2	20.8

In schedule 1 shows that wheat F1-984 Macedonian has lower hectrolitrice weight (72.4 kg) compared will other wheat, also the lowest radius of flour (75.8%) compared with other wheat.

Schedule 2 - Physico-chemical qualities of flour from wheat cultivars.

Cultivar (flour)	**Physico-chemical qualities of flour with radius73-76**							
	Moisture content (%)	Ash content (%)	Gluten content(%)	Proteine content (%)	Fat content (%)	Amidon content (%)	Acidity degree	Celulose
F1-984 Macedonian	12.6	0.61	23.6	13.22	1.02	-	1.60	1.16
F1-985 Russian	12.4	0.62	24.8	13.84	1.03	-	2.80	0.94
F1-983 Serbian	12.3	0.56	24.9	13.43	1.05	-	2.50	0.72
F1-986 Hungarian	12.4	0.56	27.1	13.87	0.97	-	1.60	0.79
Assos 284 (harmonized flour).	13.0	0.64	26.9	13.76	1.09	-	2.20	0.85

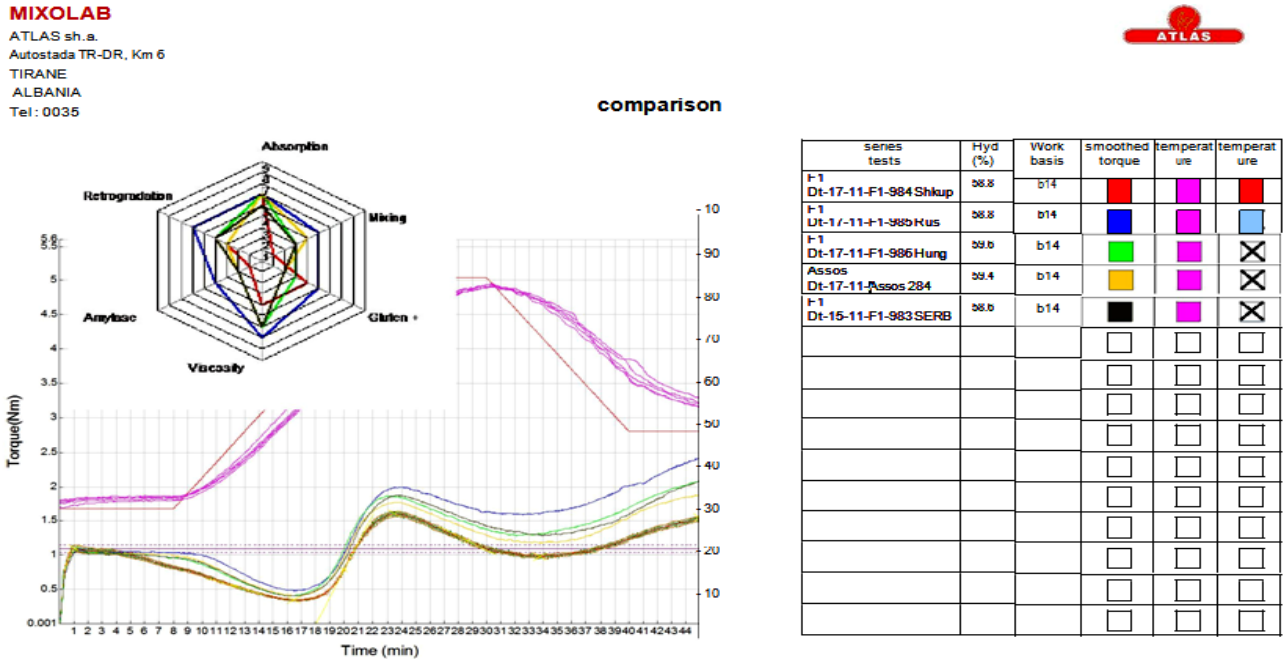
From the data of table 2 seen that the highest content of gluten has F1-986 Hungarian flour with value 27.1% and harmonized flour Assos 284, with value 26.9%, likewise and protein content of 13.87% and 13.76%.

Schedule 3 - Physico-chemical qualities of flour with radius 73-76.

Cultivar (flour)	Water absorption in Extesograph (%)	Water absorption in Pharinigraph (%)	Sustainability in Pharinigraph (min)	Resistance (45 min)	Resistance BU (95 min)	Resistance BU (140 min)	Elasticity (45 min)	Elasticity (95 min)	Elasticity (140 min)
F1-984 Macedonian	54.4	57.1	3.5	154	103	71	139	136	115
F1-985 Russian	54	57.5	11.2	547	547	495	168	147	140
F1-983 Serbian	53.4	57	7.8	297	314	306	146	145	147
F1-986 Hungarian	56.8	59.1	4.5	313	327	307	145	145	137
Assos 284 (harmonized flour).	55	58.1	9	400	523	456	151	134	126

In table 3 shows that F1-984 Macedonian grain has lower power dough, smaller sustainability; also, analyzes indicate that soft grain should be harmonized with other grain taken in study. F1-985 Russian grain, with high strength and durability, it needs to be softened without using of food additives; for this purpose is performed harmonization of grain F1-984 Macedonian, Serbian F1-983 and F1-986 Hungarian. Harmonized product Assos 284 has intermediate water absorption, power and optimal sustain of baked product. As follow are shown the rehology analysis of flours taken for study, compared with harmonized flour Assos 284.

- Rehological analysis of wheat that are taken in study



Schedule 4 - Graph of Mixolab, by correlation.

where: **Retrogradition** - lifetime measurement of bread (starch - as high as retrogradition the lower is lifetime of bread); **Amylase** - the activity of α- (amylopektine) and β- (amyloze) amyloses; **Viscosity** – starch viscosity; **Gluten +** - protein denatyration; **Mixing** - durability / strength of flour; **Water Absorption** - the higher, the more free = as much protein contains the higher the absorption = high quality.

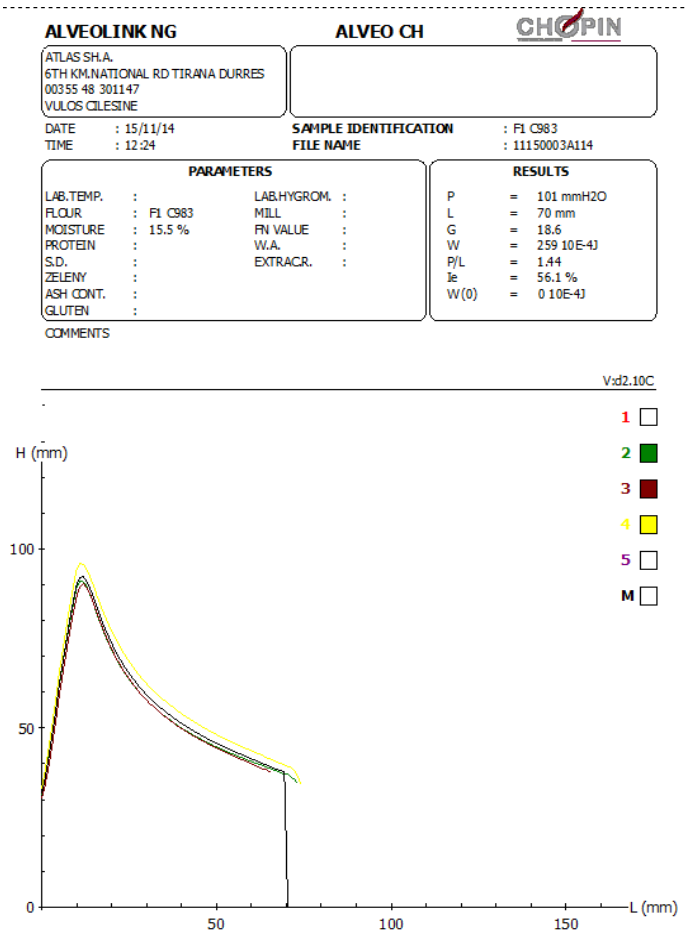
		C1			Amp.	Stab.	C2			C3			C4			C5			α	β	γ
series tests	Protocol:	Time (min)	Torque(Nm)	Dough Temp	Torque(Nm)	Time (min)	Time (min)	Torque(Nm)	Dough Temp	Time (min)	Torque(Nm)	Dough Temp	Time (min)	Torque(Nm)	Dough Temp	Time (min)	Torque(Nm)	Dough Temp	Nm/min	Nm/min	Nm/min
F1 Dt-17-11-F1-984 Shkup	Chopin+	1.07	1.10	30.80	0.10	5.38	16.48	0.35	54.00	23.52	1.61	79.80	33.77	0.98	84.10	45.05	1.55	57.20	-0.064	0.406	-0.102
F1 Dt-17-11-F1-985 Rus	Chopin+	1.37	1.08	32.40	0.11	10.22	16.48	0.48	54.50	23.95	2.00	80.90	32.57	1.59	85.80	45.05	2.42	58.70	-0.102	0.440	-0.058
F1 Dt-17-11-F1-986 Hung	Chopin+	1.20	1.07	31.80	0.09	8.60	16.00	0.41	55.70	23.10	1.86	81.30	32.10	1.28	85.90	45.03	2.08	56.40	-0.100	0.390	-0.072
Assos Dt-17-11-Assos 284	Chopin+	1.25	1.07	32.80	0.10	9.17	16.63	0.41	55.80	23.63	1.78	81.00	33.97	1.18	84.50	45.03	1.89	56.50	-0.096	0.438	-0.076
F1 Dt-15-11-F1-983 SERB	Chopin+	1.38	1.06	32.50	0.10	8.90	16.30	0.40	54.30	23.77	1.88	80.00	33.82	1.29	84.10	45.05	2.09	57.60	-0.092	0.366	-0.088

Schedule 5 - Data of mixolab results to harmonized flour.

where: **C1** - Time / time to reach 1:10 Torque; **Torque** - rotation of the machine to dough; **Dough Temp** - temperature of dough; **Amp** - sticky dough; **Stab** - sustainability of dough in C1; **C2** – Denaturation of protein (gluten); **C3** - Viscosity; **C4** –Activity os amylase; **C5** - Retrogradition; **α** - express C1; **β** - express C2; **γ** - express C3.

From the data of Mixolab (Schedule 4 and 5) shown that higher water absorption has F1-986 Hungarian grain, whereas smaller viability has F1-984 Macedonian grain; higher stability has F1-985 Russian grain. Higher denatyration of protein has F1-984 Macedonian 0.35 Torque (Nm), while the lowest has F1-985 Russian grain 0.48 Torque (Nm). Even the final product measurement of protein denaturation is important to study because if denaturation is low the proteins do not allow the bread to pick up volume during baking. Lower viscosity has F1-984 Macedonian grain, while higher viscosity is for F1-985 Russian grain. Viscosity afect directly on the quality of bread; the lower the viscosity be even more watery will be pulp bread, and the higher the viscosity be much drier will be pulp bread, consequently will weathered away and will quickly lose flavor and aroma. The lowest activity of α-amylase has F1-985 Russian grain, whereas the highest activity of α-amylase has F1-984 Macedonian grain. The low activity of α-amylase reduces the volume of bread, crust of bread takes no color, while the high activity of α-amylase gets black bread, pulp stays wet and sticky. Level of higher retogradation has F1-985 Russian grain while the lowest level has F1-984 Macedonian grain. From the data of these analyses results that F1-984 Macedonian grain is with germinate level above normal rates, and consequently higher amylolictic activity; therefore becomes necessary to harmonize it with other grain to achieve the activity of α-amylase required.

- Data analysis in Avleograph of wheat that are taken in study



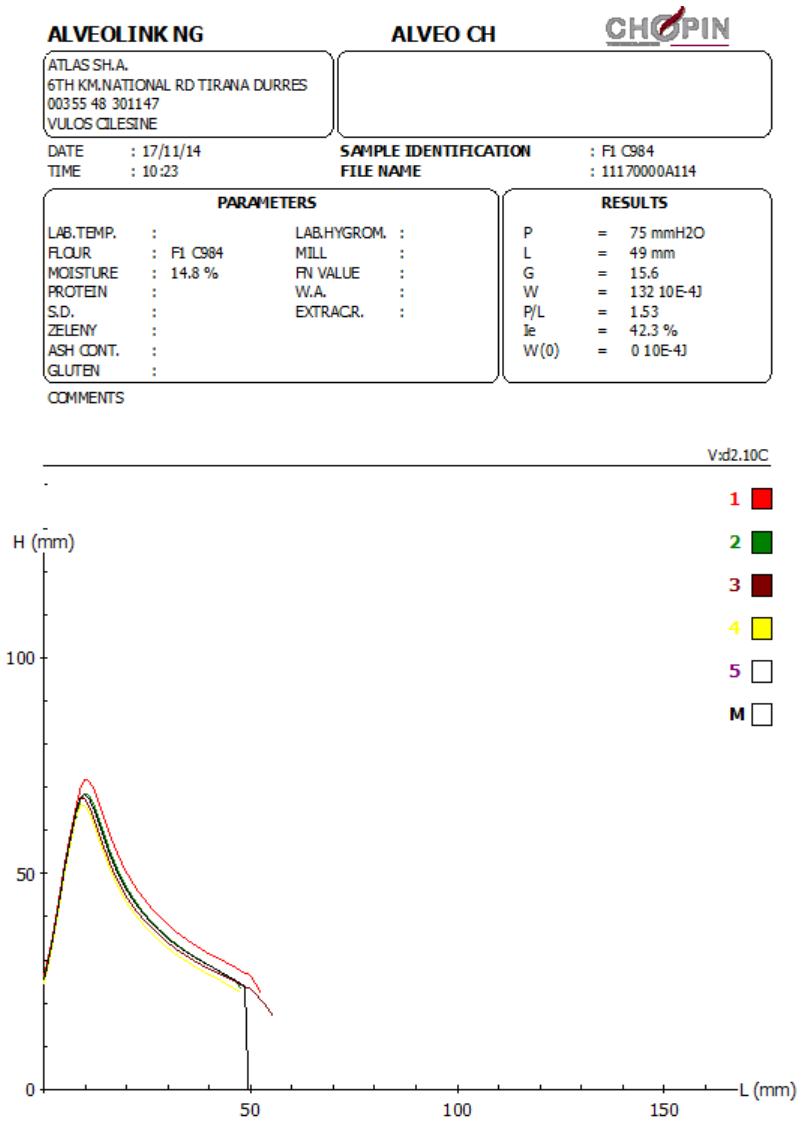
Schedule 6 - Type of flour: F1 983 Serbian.

where: P - height (101 mm); L-length (70 mm); G - unit of energy measurement in dough 18.6; W-energy (256 J); P / L height / length 1.44; Le - surface air (56.1%).

From data analysis in Falling Number - FN 293 s - were taken the bread (Schedule 5).

Figure 1 - Samples of bread from F1-983 Serbian.

Bread produced from FN 293 s grain (F1-983 Serbian) has amylasitic activity higher than a normal grain; seen that there is the desired volume, and close crust has hollow streaks indicating that proteins are poor quality.



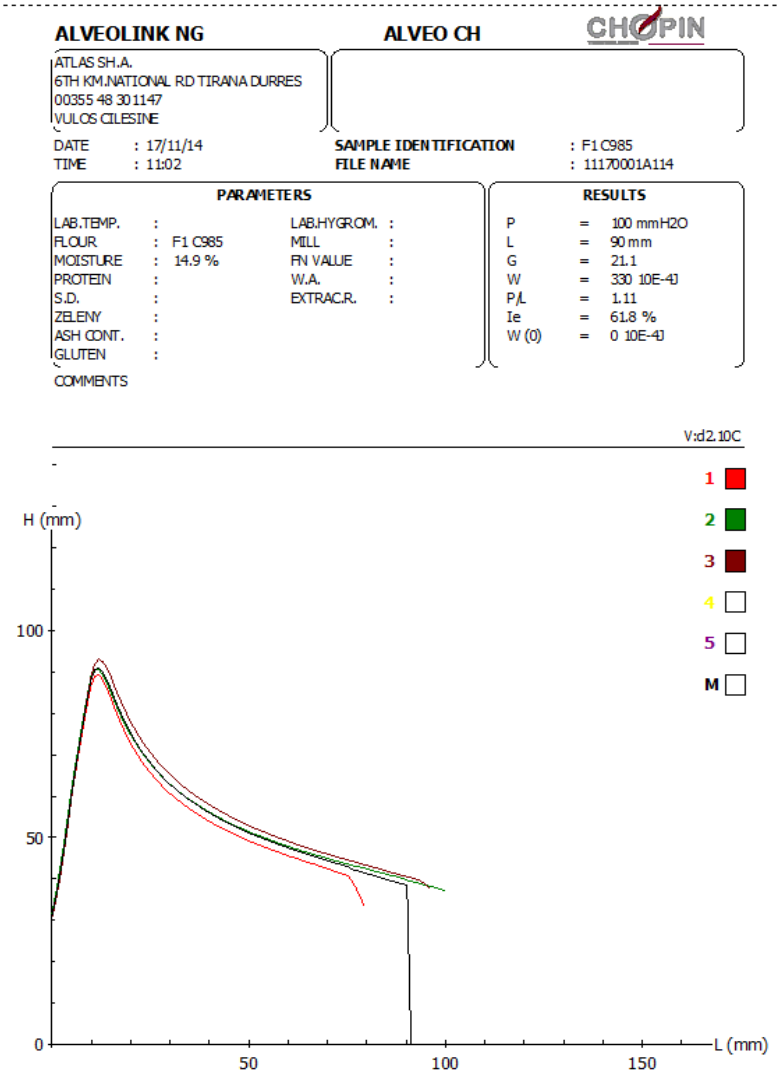
Schedule 7 - Type of flour: F1 C984 Masedonian.

where: P - height (75 mm); L-length (49 mm); G - unit of energy measurement in dough 15.6; W-energy (132 J); P / L height / length 1.53; Le - surface air (42.3%).

By data analysis in Falling Number - FN 224 s - were taken the bread (Schedule 7).

Figure 2 - Samples of bread from F1-984 Masedonian.

Bread produced from FN 224 s grain (Fig. 2) has very high amylasitic activity, sticky pulp, low volume, and disconnect the crumb from the crust. From the analysis in Alveograph seen that there is more strength, energy is W 132 J, and low volume; for this reason it is necessary to harmonize it.



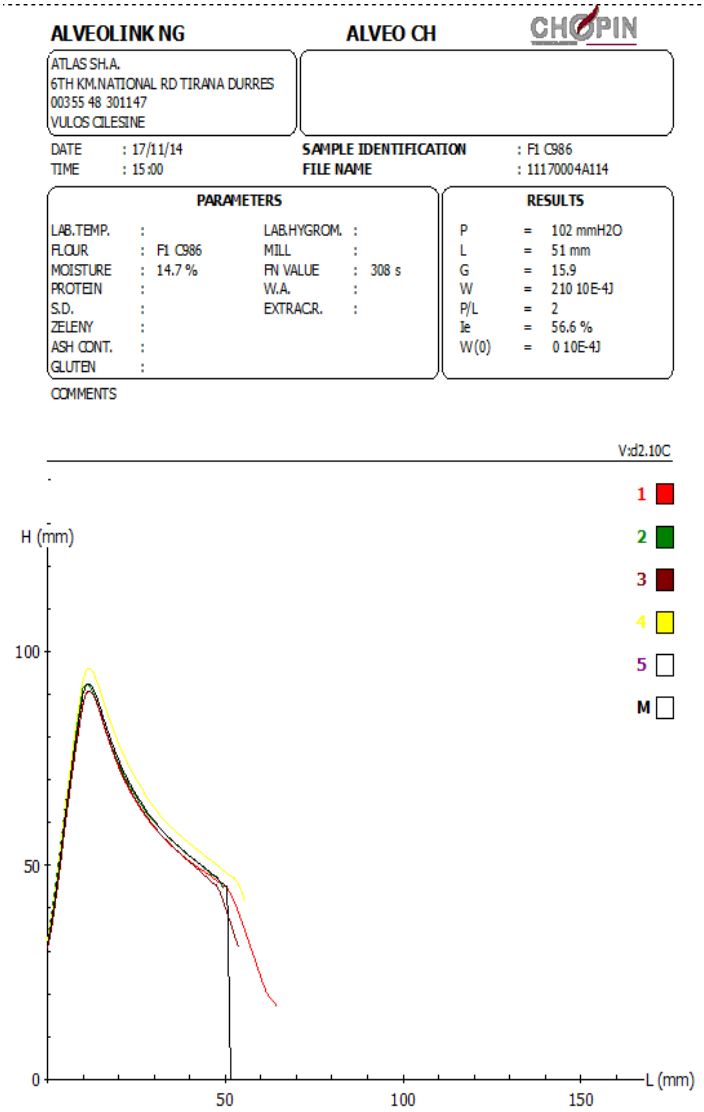
Schedule 8 - Type of flour: F1 C985 Russian.

where: P - height (100 mm); L-length (90 mm); G - unit of energy measurement in dough 21.1; W-energy (330 J); P / L height / length 1.11; Le - surface air (61.8%).

From data analysis in Falling Number - FN 355 s - were taken the bread (Schedule 8).

Figure 3 - Samples of bread from F1 C985 Russian.

Bread produced from FN 355s grain (Fig. 3) has low amylasitic activity, porosity pulp congestion and pale crust. From the analysis in Alveograph (energy W 330 J) seen that has a strong flour and harmonization is needed to it.



Schedule 9 - Type of flour F1 C985 Hungarian.

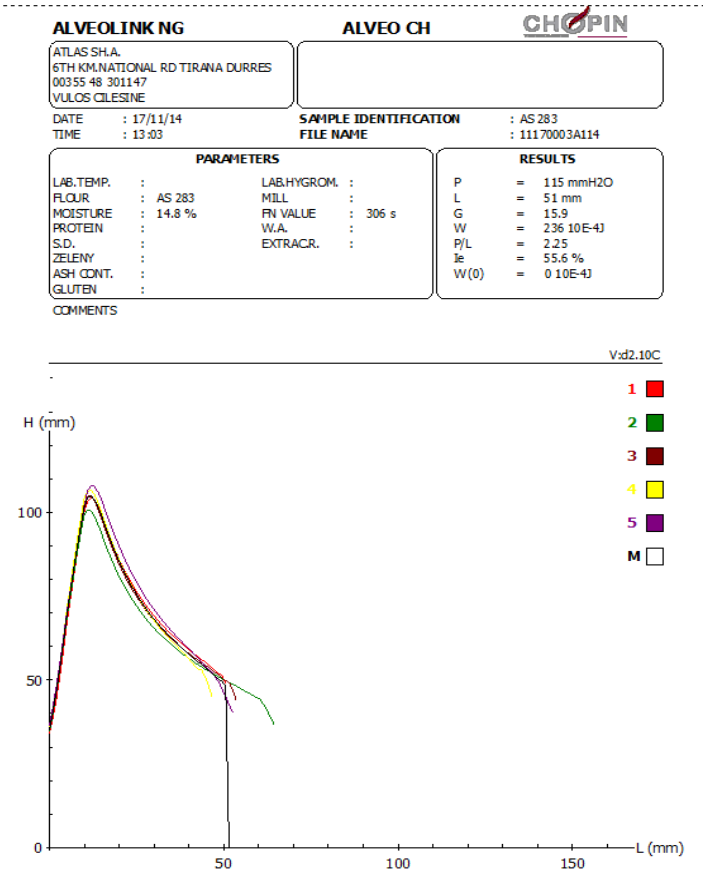
where: P - height (75 mm); L-length (49 mm); G - unit of energy measurement in dough 15.6; W-energy (132 J); P / L height / length 1.53; Le - surface air (42.3%).

From data analysis in Falling Number - FN 308 s - were taken the bread (Schedule 9).

Figure 4 - Samples of bread from F1 C985 Hungarian.

Bread produced from FN 308s grain (Fig. 4) has intermediate amylasitic activity. From the analysis in Alveograph seen that there is not much strength (P 102 mm H_2O) and elasticity L 51 mm; as a result, its harmonization is needed.

Analysis data from harmonizated flour in Alveograph – *30 % F1-985* Russian, *30 % F1-986* Hungarian, *20 % F1-983* Serbian, *dhe 20 % F1-984* Macedonian – are as follow:



Schedule 10 - Type of flour FN 306.

where: P - height (115 mm); L-length (51 mm); G - unit of energy measurement in dough 15.9; W-energy (236 J); P / L height / length 2.25; Le - surface air (55.6%).

From data analysis in Falling Number - FN 306 s - were taken the bread (Schedule 10).

Figure 5 - Samples of bread from FN 306.

Bread produced by harmonizing of grain FN 306 (Fig. 5) has vlolum normal, pulp regular structure, very good porosity, average crust thickness and candy colored crust.

4. Conclusions

1. Using wheat by germinate 6-7% F1-984 Macedonian and by normal content of α-amylase produced bread with sticky pulp and crumbed, while harmonized flours were produced bread with optimal indicator: good volume, structure, regular pulp, with very good porosity, average crust thickness and color of caramel crust.

2. By the study showed that the milling reduces levels of α-amylase and the distribution of α-amylase is uneven in the various factions of the sieve diagrame.

3. Wheat starch damaged F1-984 Macedonian results that absorbs more than 300 x its weight in water.

4. F1-984 Macedonian flour contains a much higher level of damaged starch, increases water absorption, has obvious effects on increasing range of bread (sticky pulp, small volume, and disconnect the crumb from the crust) that reaches 7-10%.

5.To reduce levels of α-amylase in flour, during this study are done several harmonization of wheat and flours, and according to analysis indicators were reached optimum: 30 % F1-985 Russian, 30 % F1-986 Hungarian, 20 % F1-983 Serbian, dhe 20 % F1-984 Macedonian.

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