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The Impact of Ascorbic Acid and Some Additives in the Rheological Properties of Doughs in Pasta from Agimi, Apache and Anchor Wheat

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Abstract

This study is a report about the latest researches in dough technology. Results are valid for Balkan countries. In recent years, a high temperature drying system has been established in high quality pasta production. Continuous increase in pasta production has brought an increase in demand for processed materials such as flour from wheat processing. The production with only flour is not enough to recover the major part of pasta consumption. For this reason new methods to improve the quality of pasta production with *Tricitum aestivum* flour are being investigated. We have been studying the usage of L-Ascorbic acid in the industrial level experimented in 2 types of pasta where in the first type is used only the wheat with high "glassness" and in the second type is used the flour by soft wheats with extra additives. Before the experiment in the industrial level, prior researches were made in the laboratory of "Miell Tirana" Company in Albania. Here a mixture of flour by soft wheats with extra ascorbic acid and wheats only with high "glassness" are used for the pasta production. These systems facilitate the use of processing techniques using high temperature drying systems. Pasta quality depends on too many factors like water temperature, dough, product itself, added methods of LAA, the first material and working conditions.

Keywords: dough, pasta, high, glassness, extra additive

INTRODUCTION

The purpose of our researches is to determine the ascorbic acid impact in the pasta quality, produced in the industries,which use semola and different semolats by high "glassness" and soft wheats with different drying systems, generally the method with high temperature [7,15].

In cereal chemistry and technology, ascorbic acid is used for many years as an addition to improve physical properties and technological mixture of different flour products. In this study,was used the ascorbic acid in different quantities in semola and semolats with wheat flour. In some countries like Italy, Germany, France, Switzerland etc, ascorbic acid is the only additive that helps the drying process in rototherm. Its added quantity varies from 150-180 ppm. In our study the used quantity varies from 75-200 ppm. Pasta quality has had changes and adding ascorbic acid in this technology is carefully studied. This study, which is a result of an experimental work and analysis, opens new fields of ascorbic acid applications in the actual pasta production. All experiments are done in factory. From this experiment clearly results that adding mixture of different quantities of ascorbic acid has improved the quality of cooking pasta which requires the high temperature drying system technology.

MATERIALS AND METHODS

For the production of pasta, there are used flours produced by Russian, French and Albanian wheats in a certain percentage by each cultivar.

The first major material for industrial production of pasta is exclusively the wheat with high "glassness" or its flours, semola and semolats.

The usage of ascorbic acid and its high temperatures have been object of this study. As a result, production of pasta is different in comparison with traditional technologies. The usage of high temperatures in the end of pre-drying phase, makes the pasta incur a special hydrothermic treatment in ambiental environment with temperature 73-85 grade Celsius and relative moisture around 82-83 %. The dough for long pasta with an extra 200 ppm goes into rototherm with no more than 19% of moisture and in this way the freezing of starch is avoided, before the proteinic mesh, that covers amidon particles.

Also, during staying in rototherm for 10 minutes, the long pasta, especially the softer formats of pasta (diameter 1.7-1.8 mm), incured a thermic deactivation of enzyme. In this thermic level some oxidases and beta amylases are active in temperature 60 degree Celsius and above: like alpha-amylase, lipoxygenase, peroxidase. In our case, the usage of high temperature heating pasta in rototherm, in 65 grade Celsius and above, deactivated especially the complex enzyme of phenol-oxidase. If it is not deactivated, this enzyme has negative influences. In temperatures lower than 60 degree Celsius, it is transformed between effluent reactions without enzymatic catalyst.

In this point, it can be highlighted that kinons are reput in phenols, adding reductive substances such as L-Ascorbic acid. These reductive substances exert an antioxidant synergistic action that does not allow the formation of melanin. L-Ascorbic acid also prevents the lipids oxidation, a very important result in the production of pasta with eggs [17].

So the application of high and very high temperatures and adding ascorbic acid have fundamentally changed pasta technology, making sure that SH links are oxygenated in very powerful SS links. So we have not only "pastification" of the flour of soft wheat, but also of the other flours [7].

For this study we have taken cultivars from French, Russian and Albanian wheat. After the production and evaluation of the acquired flour, there are made pasta. First it is done the production from semola to granulometric 320 to 420 with and without extras. The physical-chemical and rheological analysis are done in accordance with standard methods ICC (impurity ICC stand, 102/1, moisture ICC stand. 110/1, ash ICC stand. 104/1, wet gluten ICC stand. 106/2). The determination of rheological qualities, is made with Farinograph and Extensograph Brabender, Alveography "Chopin" and organoleptics qualities of pasta are made in accordance with the physical-chemical methods rule for the cereals, products of grinding and furnace, pasta and frozen doughs (ICC-Standard No102/1, Revised 1972) [8.9].

RESULTS AND ANALYSIS

Characteristics of wheat

In order to investigate the effect of ascorbic acid in the flour, the wheats originally from France (Apache), Russia (Anchor), and Albania (Agimi) was taken in the study.

Table 1. The qualitative indicators for studying of wheat [8]

Cultivar of wheat	Wheat qualities						
	Hectolitre Weight *(kg/hL)*	Humidity (%)	Protein (%)	F.N (sek) Amilase AU		Gluten (%)	W (P/L)
Apache	78.3	12.6	11.8	310	600	26	200
Anchor	78	13.1	12.5	290	400	29	240
Agimi	79.2	13.2	12.8	320	700	30	245

According to Table 1 the highest content of protein and the highest W is in Agimi wheat.

From every cultivar there are taken 20 tons each for grinding and are conditioned for 18-24 hours to achieve moisture 16.5% for grinding, where we have won 2 semola fractions with granulometrics 420 micron and 530 micron [5,6].

Table 2. The quantity of produced semolas from wheat cultivars grinding

Cultivar of wheat	Semola 420 µ
Anchor	67 %
Apache	65 %
Agimi	64 %

From the data of table 2 it is observed that Anchor cultivar gives higher semola quantity than other wheats.

Table 3. The physical-chemicals and rheological qualities of acquired flours, by each cultivar after grinding.

Wheat qualities	Cultivar of wheat					
	Anchor		Apache		Agimi	
	Semola µ		Semola µ		Semola µ	
	420	530	430	520	440	530
Humidity (%)	13.8	13.5	14.1	13.8	13.7	13.8
Ash (%)	0.67	0.76	0.68	0.81	0.69	0.74
Sedimentation	58	49	40	33	51	41
Wet Gluten (%)	30	30	27.5	28	31	31
Protein (%)	13.1	12.9	12.3	12.2	13.1	13
Carbohydrate (%)	56.5	-	56.7	-	55.4	-
Water absorbtion (%)	64	65	62	63	65	66

In this table there are presented the acquired results for the physical-chemical and rheological qualities of acquired flours by each cultivar after grinding.

There are given all physical-chemical qualities of above listed cultivar semolas in table 3 [13]. The moisture of all cultivars is in normal values and it varies from 13.5% to 14.1%.

Table 4. The granulometric values of wheat semolas given for pasta production.

Sieves standards	Diameter (µ) Anchor	Diameter (µ) Apache	Diameter (µ) Agimi
About 35-40	450	470	440
About 45	410	380	340
About 60	280	240	320

The produced pasta with finely semolas (between 315 and 225 micron) has got a beautiful yellow color, without white points. The yellow color is noted more if pasta is dryed with the very high temperature technology [13].

Table 5. Semolas Characteristics

Designation	Humidity (%)	Ash (%)		Cellulose		Nitrogenated substances
		Min.	Max.	Min.	Max.	
SEMOLO	14,2	0,65	0,80	0,20	0,45	12,50
SEMOLATI	14,3	0,90	0,95	–	0,85	12,90

The first most finely materials are easier to be transformed in homogenious dough, which is an optimal base for homogenious products. They require shorter time for dough cooking and on going, they require smaller tubs for dough, since they are easier to be cleaned [4].

Rheological analysis of cultivars taken for study

The evaluation of rheological qualities of wheat cultivars is really important for the determination of the improvement of quantities in flours and in doughs that produce pasta.

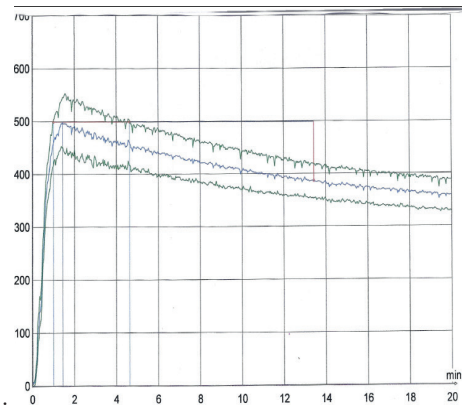
Analysis in Farinograph

Farinograph measures the dough consistency, mixing it with a constant speed and absorbs water, which enables the achievement of this consistence [8].

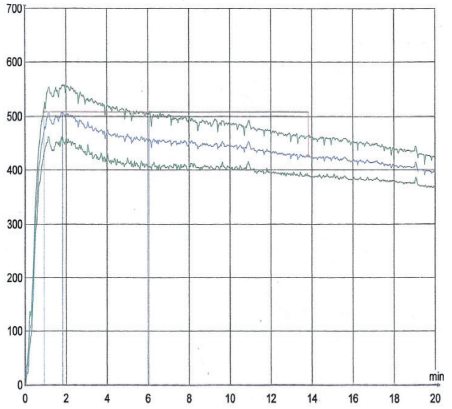
Table 6. Qualitative indicators with Farinograph

Cultivar of wheat	Farinographic characteristics			
	Water absorption (%)	Development time (min)	Stability (min)	Softness (PE)
Apache	59.0	1.7	7.2	54
Anchor	60	1.9	7.4	55
Agimi	58	2.6	6.9	77

From the data observed in table 6, clearly is seen that Anchor cultivar has a bigger absorption of water than Agim and Apache. The development time of Agim is the longest, while its stability is smaller than Anchor and Apache cultivar. Also the softening scale of Apache cultivar is smaller than that of the Anchor. So it's important using redox additives (ascorbic acid) in these kinds of wheats. [7].



Reference flour



Reference + 200 ppm ascorbic acid

Analysis in Extensograph

Extensograph measures dough opening and resistance during resting time.

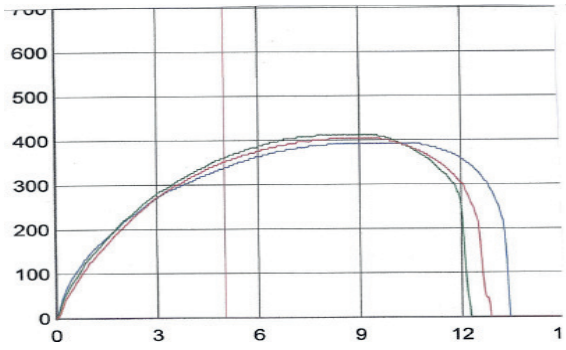
From analysis datum with extensograph we can see that it hasn't only prononuned changes in "opening" of dough,in its resistance impacted, or in self qualities of flours (that depend from cultivars we analyse, their radius), but also the ascorbic acid has got a pronounced impact upon them.

Table 7. Qualitative indicators in Extensograph

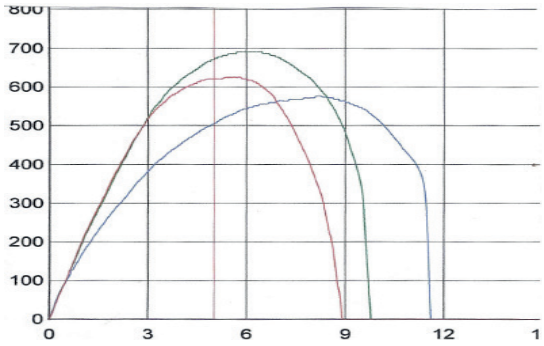
Flour Cultivars	Extensograph			
	Resistance in tow (EU)	Elasticity (mm)	R/E	Energy (cm^2)
Apache	275	159	1.69	78
Anchor	298	172	1.82	92
Agimi	289	168	1.67	89

Note: ascorbic acid 200 ppm

From the comparison of data with extensograph we can see, we have a pronounced increasement of dough resistance when we add 200 ppm ascorbic acid.



Flour free additives (Reference)



Reference + 200 ppm ascorbic acid

Addition of L-Ascorbic Acid

For this proofs are done: [13.15]

In the first one frizzy pasta reproduced with first materials in respective quantities:

-200 kg flour
-54 litres water
-200 ppm L-Ascorbic

Table 8 .Values of extensograph of Apache, Anchor, Agimi wheats flour used in the production of long pasta

After the break	Dough of resistance						Dough of extension (E) (mm)			R5:E			Surface(S) (cm^2)		
	5 min.			Max											
T	R5			R max											
45	550	520	540	580	570	580	102	103	102	5.4	5.3	5.2	78.6	78.5	78.8
90	460	430	470	525	530	535	123	125	126	3.6	3.5	3.7	79.1	78.4	78.6
135	360	370	360	400	390	395	136	137	138	2.6	2.7	2.6	79.4	78.6	78.9

The best value of extensograph is represented after 45 minutes of dough resting from the extensograph. The second proof is similar with the first one, with the only difference, that in this case, there are added 200 mg (200 ppm) melted L-Ascorbic Acid in a water part used for the dough. For all of these it is known, especially in the high and very high temperature drying systems (respectively around 74-76 degrees Celsius and 85-96 degrees Celsius), while in the traditional technologies case of drying (from 45 to 54 degrees Celsius), the necessities are lower.

It's preferable for L-Ascorbic acid to be melted in water, for the most homogenious digestion. It is outputted a long

pasta with good quality, applying these drying methods immediately after the pre-drying phase, or when water content in pasta is around 11.5%. The usage of THT systems gave pasta a bigger plasticity, in comparison to traditional systems, guaranteeing a higher resistance towards phenomena like breakings or bursts. Pasta in 95 degree Celsius is covered with a very poor mixture of air and is rich with overheated steam in atmospheric pressure, which theoretically is unappropriate to accelerate the drying. The plant for the industrial production of pasta is made of an automatic continuous press that deals with different operations, dosage of different ingredients, dough formation, which is done in two phases, with a pre-mixture of components and the next phase of dough perpetration (compression and) for the acquisition of different formats desired by the manufacturer. The good functioning of press and ongoing, of compressor, are the major factors of producing a clean product, with good commercial and cooking characteristics. The dosages are interdependent and in some modern presses, there are pre-mixture mechanism that mix too fast (turbospray) the flours and water (or also other ingredients if they have been asked to, without causing any damage to semolo or flour) [14].

The formula calculated in 100 parts is this:

100 kg flour (with 14-14.5 % water);

30.1 l water, 5200 mg L-Ascorbic acid (200 ppm). It is obtained a long pasta with good quality applying these drying methods with a water percentage in pasta around 11.5%.

We made the evaluation of dryed and boiled pasta

The criterias in which the tests about the quality of pasta products are based, include control of organoleptical, biochemical, commercial and nutritional features. In commercial features a great importance is noted in the color and absence of fractures, crackings, white and black points in the pasta surface. Pasta are produced only with semolas of Agim, Russian and French.

They deal with a color yellow to gray. The quality of pasta boiling is absolutely the most imporant aspect to verify the control [1.2].

- water absorption;
- increasement of mass after boiling;
- residue in the mixture water.

Characteristics in boiling, are shown in table 9, referring to pasta samples, produced only with semolas of Agim, Anchor and Apache wheats.

Table 9. The quality of different formats boiling of pasta with wheat base Agim, Apache, Ankor

Formati	Time for cooking (min.)(1)			Water of absortion from pasta (%)(2)			Total weight After boiling (gr)(3)			Remaining in water boiling (%)(4)		
Strow like	10	9	11	155	150	140	63	62	59	8	9	8
Star	10	9	11	190	180	170	72	71	70	9	10	11
spaghetti (diam.1,8 mm)	12	12	12.3	180	180	160	72	71	68	4	5	6
Ribbon-like	9	9	10	167	162	160	69	68	67	6	7	8
with holes	10	10	11	173	170	160	69	68	67	5	6	7
Semolina noodles pasta	12	11	12	190	185	160	77	76	75	4	5	6

(1) The time is calculated from the moment of water boil;

(2) It is calculated in 100 g pasta after boiling;

(3) It is the final weight of 25 g pasta, after boiling;

(4) The loss of total solids in boiling water in the actual moisture content.

From data in table 9, it is seen that pasta produced by semolas of Agim wheat has the lowest residue of all, in the boiling water. This shows that SS links in proteins are stronger. Also the highest absorption is noted in Agim wheat semolas pasta.

CONCLUSIONS

The mixture for dough preparation has got a moisture of 29-31%. In these conditions of hydration also the LAA effect is visible. LAA quantity must be at least 200 ppm, especially when we use flour with above indicator. Water purity is very important and its temperature has got an impact in the LAA action. When LAA is digested, the water temperature must not pass 50-55 degree celsius, while the mixture temperature with egg adding and LAA must not be higher than 38-48 degree celsius. The addition of LAA is recommended for nutritional dough with flour or mixture. In the case of low quality flour, the moisture compound is lower than 24% and it is necessary to add 200-300 ppm of LAA and eggs knowing that albumina has got a positive impact in the compound characteristics. Usage of HT drying system in rototherm, the short drying time (around 10 hours). We must note that dough enters in rototherm having max 18.5% H_2O, and in opposite case the HT effect may be negative.

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