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The influence of lipoxygenase on flour obtained from Durum wheat (*Triticum durum L.)* used for manufacturing of pasta products

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Abstract

This study presents the enzyme activity of lipoxygenase on flour obtained from *Triticum durum* wheat used for manufacturing of pasta products. The determination of the rheological characteristics of the flour and dough is obtained by alveographic method. The tests results show that the addition of lipoxygenase decreases the time of kneading the dough. On the dough sample from flour obtained from *Triticum durum* wheat it can be seen that the enzyme preparation based on lipoxygenase is used to obtain pasta products with improved color and gloss and is also used to reduce the drying time of noodles, improves surface appearance and mechanical stability of noodles and pasta, and reduces raw material costs. The dough sample show also an improvement by increasing of the time at which it reaches the maximum pressure and also in the tolerance and stability of the dough.

Keywords: lipoxygenase, wheat, flour, pasta, alveograph method

1. Introduction

Pasta products are foods prepared from different types of flour and water, with or without the addition of other food materials such as enzymes. They are high food value farinaceous products based not only on their energy intake, given the increased content of carbohydrates and fats, but also the value of all components, representing shapes that are easily assimilated by the human body and high content of vegetable protein and nutrients.

Technological characteristics of flour and nutritional value of pasta are the following variables: flexibility, water retention capacity, maximum strength, extensibility, nutritional value and energy value. In order to improve these variables, the various additives and are placed in the technology of manufacturing of pastas.

Enzymes applications have grown to be a common practice in manufacturing of pasta products with advantage of being considered as natural additives. The enzyme activity of lipoxygenase is being used in pasta products to improve the flour and dough-handling properties. Flour obtained from Triticum durum wheat has the best characteristics due to high content of gluten.

Lipoxygenase oxidizes polyunsaturated fatty acids during kneading dough. Hydroperoxides formed can oxidize sulfhydryl groups of gluten proteins and thus may be beneficial in forming gluten network of the

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dough. [1] This addition of lipoxygenase also decreases the time of kneading the dough. Enzyme preparation based on lipoxygenase is used to obtain pasta products with improved color and gloss and is also used to reduce the drying time of noodles, improves surface appearance and mechanical stability of noodles and pasta, and reduces raw material costs. It positively influences the quality of final products by increasing tolerance to prolonged cooking, cooked pasta firmness and helps reduce oil uptake of fried instant pasta.

2. Materials and methods

2.1. Samples preparation. Materials used for the preparation of the samples are flour type 550 from *Triticum durum* wheat, salt, water, yeast and lipoxygenase enzymes.

The enzyme preparation used is:

EMCEdur – enzyme preparation which contains lipoxygenase enzyme; doze: 200-500g/100kg flour; description: enzyme complex to enhance boiling and chewing properties; properties: creates a firmer structure, reduces loss through boiling and lightens the colour.

Each sample of 250g of flour is mixed with a solution of salt, yeast and enzyme preparation in a laboratory mixer 15 min to form dough. The amount of water was adjusted according to the water absorption capacity of flour. The water absorption process starts and the formation of the dough takes places by the transfer of the proteic content characteristics into the gluten chain. The fermentation represents a complex enzymatic process, specially of amylolitic hydrolysis of the carbon hydrates and of gluten proteolysis. [2]

The first dough sample MARTOR contained 95% flour, 1.7% salt, 1.7% yeast and does not have any lipoxigenase.

The second dough sample F1 contained 95% flour, 1.7% salt, 1.7% yeast and 100g/100kg lipoxigenase.

The third dough sample F2 contained 95% flour, 1.7% salt, 1.7% yeast and 300g/100kg lipoxigenase.

The fourth dough sample F3 contained 95% flour, 1.7% salt, 1.7% yeast and 600g/100kg lipoxigenase

Each dough sample is divided in five circular consecutive dough patties which are rested 20 min in the alveograph in a temperature-regulated compartment at 25 °C. Each dough patty is tested individually and the result is the average of the five dough patties.

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The third dough sample F2 contained 95% flour, 1.7% salt, 1.7% yeast and 300g/100kg lipoxigenase.

The fourth dough sample F3 contained 95% flour, 1.7% salt, 1.7% yeast and 600g/100kg lipoxigenase

Each dough sample is divided in five circular consecutive dough patties which are rested 20 min in the alveograph in a temperature-regulated compartment at 25 °C. Each dough patty is tested individually and the result is the average of the five dough patties.[3]

3. Results and Discussions

The dough samples alevogrames are represented in Figure 1, Figure 2, Figure 3 and Figure 4. Each dough sample alveorgam show the five dough patties tested (marked with different colors) and the parameters registered at the testing moment. The results of the samples are represented by the average value obtained from the values of the dough patties tests for each dough sample.

In figure 1 the dough samples MARTOR alveograme represent the dough sample prepared from flour obtained from *Triticum durum* wheat that does not contain any enzyme preparation.

The alveograme's characteristics for flour used in pasta products have the following values: P = [63 – 70mm], L = [100 – 130mm], G = [19 – 20], P/L = [0,65 – 0,70] and W =[180 - 200x10^{-4}J].

The values for dough sample MARTOR (no enzyme) Figure 1, regarding the resistance of the deforming dough (P_{martor}) and the balance between dough strength and extensibility (P/L_{martor} ratio) are higher than the normal values. The values regarding the dough extensibility (L_{martor}) are lower with 40mm than the normal values. The expansion index (G_{martor}) is very low and the total quantity of absorbed energy during the dough deformation (W_{martor}) is high, therefore the dough is very resistant to stretch and does not easily brake.

In figure 2 it is shown the alveograme of the dough sample F1 – with 100g of lipoxigenase. Compared to sample MARTOR (no enzyme), the values of the resistance to deformation dough (P_1) is lower by 6mm H_2O and the dough extensibility (L_1) is with 29mm higher than (L_0). The P/L_1 ratio is lower with 0,58 and the expansion index ($G_{martor\ A}$) is higher by 4,2 than sample MARTOR (no enzyme). The total quantity of absorbed energy during the dough deformation (W_1) is higher. These parameters suggest a small improvement of the dough quality but they do not reach the standard values for pasta products.

Results
P_{martor} = 95 mmH_2O
L_{martor} = 60 mm
G_{martor} = 17.2
W_{martor} = 204x10E^{-4}J
P/L_{martor} = 1.58
Ie_{martor} = 49.4 %

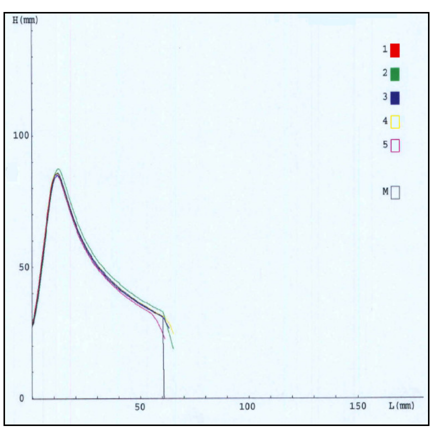

Figure 1. Sample MARTOR (no enzyme) alveograme

Results
P_1 = 89 mmH_2O
L_1 = 89 mm
G_1 = 21,0
W_1 = 249x10^{-4}J
P/L_1 = 1,0
Ie_1 = 51,7 %

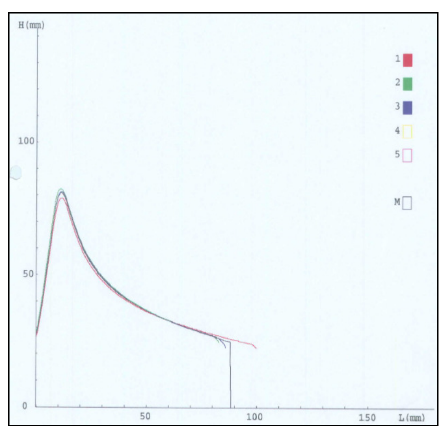

Figure 2. Sample F1 – with 100g/100kg flour of lipoxigenase alveograme

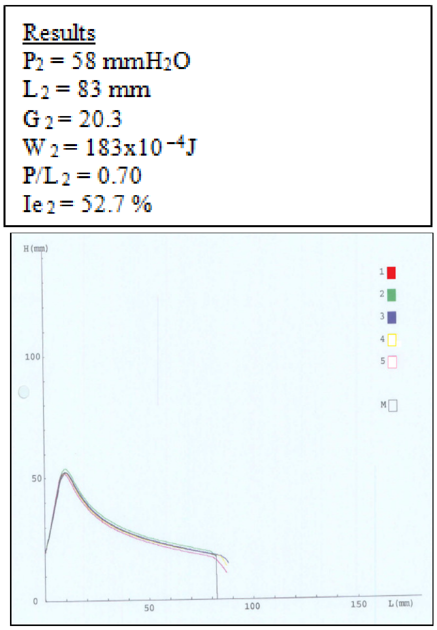

Figure 3. Sample F2 (contain 300g/100kg flour of lipoxygenase) alveograme

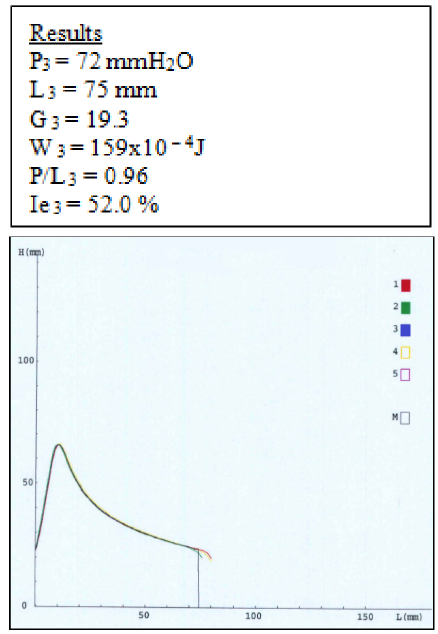

Figure 4. Sample F3 (contain 600g/100kg flour of lipoxygenase) alveograme

Table 1. Alveograph results of the dough samples: MARTOR (no enzyme); F1 – with 100g/100kg flour of lipoxigenase alveograme; F2 (contain 300g/100kg flour of lipoxygenase) alveograme; F3 (contain 600g/100kg flour of lipoxygenase) alveograme

Sample	**MARTOR** (no enzyme)	**F1 (contain 100g/100kg flour of lipoxygenase) alveograme**	**F2 (contain 300g/100kg flour of lipoxygenase) alveograme**	**F3 (contain 600g/100kg flour of lipoxygenase) alveograme**
P(mmH_2O)	95	89	58	72
L(mm)	60	89	83	75
G	17.2	21	20,3	19.3
W(10^{-4}J)	204	249	183	159
P/L	1.58	1,0	0,7	0.96
Ie(%)	49.4	51,7	52,7	52.0

In Figure 3 is represented the alveogram of dough sample F2 which contain 300g/100kg flour of lipoxygenase. Compared with the blank sample MARTOR there is a significant change regarding the dough strength (P_1) that decreased with 37 mmH_2O. Looking at the increase of the extensibility characteristics and the absorbed energy during the dough deformation we can see, obviously, the dough quality improvements. The P/L_1value is lower because of the decreased dough strength and increase of the dough extensibility. These results suggest that the flour obtained from *Triticum durum* wheat and also the dough can be considered for manufacturing of pasta products.

In Figure 4 is the alveograme for the dough sample F3 which contain 600g/100kg flour of lipoxygenase. Addition of 600g enzyme preparation which contains lipoxigenase in dough, reduces the dough strength (P_3) with 23 mmH_2O. The absorbed energy during the dough deformation (W_3) has been reduced under 180x 10^{-4J} as well as the $P/L_{F\ A}$ ratio which was reduce to 0.96 but not as the low as the sample F2 . There is a small increase of the extensibility characteristics and of the elasticity index (Ie_3) compared to the normal values. The overdose of lipoxygenase has negative effects especially on the physical attributes of the dough that can become wet and sticky. The cause for these effects are the large amount of dextrin produced and the unbound free water from the jellification process of the starch.

In Tabel 1. there are presented the characteristics of dough samples obtained by alveographic method.

The dough sample MARTOR (no enzyme) has the highest values for the resistance of the deforming dough (P_{martor}) and the balance between dough strength and extensibility (P/L_{martor} ratio) and the lowest values for the elasticity index (Ie_{martor}) and dough extensibility (L_{martor}) compared to the other samples. These indicators were slightly improved when adding a low dosage of lipoxygenase as it can be seen in sample F1- 100g/100kg flour of lipoxygenase which shows the dough resistance to deformation (P_1) and the P/L_1 ratio decreased.

Although the sample F1- 100g/100kg flour of lipoxygenase shows improvement we can see that the best characteristics are in sample F2- with 300g/100kg flour of lipoxygenase due to a significant decrease for the dough strength (P_2) and the absorbed energy during the dough deformation (W_2) which suggest that addition of lipoxygenase helps to enhance boiling and chewing properties, creates a firmer structure, reduces loss through boiling and lightens the colour.

4. Conclusions

Enzyme preparation based on lipoxygenase used to obtain products with improved color and gloss is also used to reduce the drying time of noodles, improved surface appearance and mechanical stability of noodles and pasta, and reduce raw material costs. It positively influences the quality of final products by increasing tolerance to prolonged cooking, cooked pasta firmness and helps reduce oil uptake of fried instant pasta. They do not modify the technological process of bread making and their utilization is not expensive.

Through the alveograph test we can notice is that the best characteristics are in sample in F2- with 300g/100kg flour of lipoxygenase which suggest that addition of lipoxygenase helps to enhance boiling and chewing properties, creates a firmer structure, reduces loss through boiling and lightens the colour.

Addition of the correct dosage of lipoxygenase in dough can improve the extension of freshness, increases of the quantity of fermentation sugars that can make finite products with a more pronounce color of crust.

A lower dosage of lipoxygenase does not have a big improvement effect on the quality of the dough and it is not relevant for the technological process.

The overdose of lipoxygenase leads to a wet and sticky content of the dough which affects the dough handling during the technological process and an abnormal volume and porosity.

Selecting a correct dosage of lipoxygenase will be made in conformity with the rheological characteristics of dough and the proportions from the dough will be added so that they would be maximal.

The enzyme preparations are used to obtain bakery products with "clean label", more natural, this products being the product that enjoys the greatest interest from consumers.

Compliance with Ethics Requirements: Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human and/or animal subjects (if exists) respect the specific regulations and standards.

References

1. Banu, C., *Biotechnologies in food industry*, Tehnical Publishers, Bucharest, 2000, pp. 622
2. Mencinicopschi, Gh., David, I., Brăgărea, Şt., Zarnea, G., *Food biotechnologies. Vol II*. Mirton Publisher, Timişoara, 2008, pp. 353-355
3. Roumanian Standards ISO 5530-4:2005. *Wheat flour. Phisical characteristics of the dough. Part 4: Determination of the rheological characteristics using the alveograph*