L-CYSTEINE INFLUENCE ON THE PHYSICAL PROPERTIES OF BREAD OBTAINED FROM SHORT GLUTEN FLOURS

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Abstract

L-cysteine, by its ability to reduce the intermolecular disulfide bonds, may be a solution to improve the quality of bread made from strong flours.

The paper's aims is to demonstrate the positive impact that it has the addition of L-cysteine on some physical properties of bread (volume, porosity, elasticity) obtained from "short" gluten flours, with a protein network which is characterized by a high elasticity and resistance.

Keywords: L-cysteine, gluten network, bread, flour.

INTRODUCTION

Romanian flours are characterized by a very good protein content which frequently exceedes 13% and presents a deformation index of gluten which is predominantly situated on the left of interval 5-15 mm (*Catalogs with annual data on the quality of wheat, the areas of culture, varieties of wheat grown in Romania - yields 2001 - 2005, Bucharest IBA*) in which flours are very good/good for bread production. Given the low deformation index which most often (and especially if procedures for obtaining the bread are with short duration of fermentation) not allow to doughs to develop the optimum capacity to retain the fermentation gas, we need additives which may decrease the high resistance of gluten. For this purpose, currently in the breadmaking it is used a series of agents, mainly L-cysteine (*Bordei et al., 2000; Brümmer et al., 1980*) which, through the reduction of gluten proteins disulfide bonds, decrease the dough tenacity and elasticity.

MATERIALS AND METHODS OF ANALYSIS

Materials.

Flours. To conduct experiments we use a white strong flour, with "short" gluten from SC COMPAN S.A. Targoviste (FA3). The flour's determined characteristics are summarized in Table 1. The flour's quality indices refer to the protein content (expressed by wet gluten content), moisture, the elastico-plastic characteristics of dough, purity and content of non-starch polysaccharides (judged by the ash content) and α-amylase activity.

L-cysteine (trade name Cisto'Pan - company Beldem Food Ingredients). The preparation is presented in the form of white powder with taste and flavor of sulfur, with a content of L-cysteine - 10% and ash - maximum 1%.

Compressed yeast. In baking tests it has been used the compressed baking yeast from Pakmaya (SC Rompak Paşcani LLC).

Salt (sodium chloride) - having the characteristics from STAS 1465-72.

Methods of analysis.

Determination of flour moisture using drying method (ICC Method No 110/1). The setting of humidity was done by the indirect method, by drying. Analyzed flour was maintained at a certain temperature (in the classical method - at 105^0C for 4 hours; in the rapid method - at 130 ± 2^0C for one hour) until all the free water evaporates and other secondary effects that alter the chemical components not take place.

Determination of flour ash content using the burning method at 900-920^{0}C. Ash is defined (ICC Standard No. 104/1) as the quantity of mineral materials wich remains, after applying the burning methods, as incombustible residue of the analyzed sample. The result is expressed as a percentage by reporting the mass of the residue at the dry matter of the analyzed sample.

Determination of the flour wet gluten content. Wet gluten is a highly swelled colloidal gel containing 60-70% water, dry matter beeing made up of 75-90% gluten proteins (gliadins and glutenins). The method is based on separation of gluten by washing a dough made from flour with a solution of NaCl, concentration of 2%. The result is expressed as a percentage gain by reporting the weight of the wet gluten at the weight of meal flour taken into consideration.

Determination of deformation gluten index. The method involves the maintain of a wet gluten sphere (5g) for one hour at a temperature of 30^{0}C and determination of the deformation by measuring two medium horizontally diameters (in mm) - before and after the rest - and calculating the difference between them .

Determination of α-amylase activity in flours by the "Falling Number" (ICC Method 106/1, AACC 56-81B). The method, developed by Hagberg-Perten, is based on a rapid gelification of an aqueous suspensions of flour in boiling water and measurement of liquefaction produced by α-amylase to starch gel obtained from sample of flour. The Falling Number is defined as the time (expressed in seconds) needed to an agitator to fall into a gel flour heated, in a viscosimeter.

Alveographical method for determining the rheological properties of dough (ICC Method No.121, AACC 54-30A, ISO No 5530/4). Produced by Chopin, the Alveograph is an instrument that gives valuable information about the rheological dough sample by measuring the pressures attained during the inflation of a sample dough into a bubble. Because the test sample expands the dough in a biaxial plane, similar to the way dough cells expand in the current bread dough, this test is highly regarded. W - also known as "the deformation energy, the W represents the force required to inflation until the dough bubble rupture. P - also known as the overpressure, the P is the maximum height (h) in mm. on the alveogram multiplied by a factor of 1.1. This figure represents the viscosity, tenacity, or even strength of the sample. L is commonly used as a measure of dough extensibility. P/L - this ratio is generally thought to indicate gluten performance.

The baking test. In experiments, we have been used baking bread Moulinex machines which carry out all the process operations - mixing-kneading, re-kneading, fermentation, final proof, baking - in the same room in which operations parameters (temperature, time) are strictly controlled based on program, offering the possibility to compare corectly the obtained results.

Determination of bread volume by the method with the apparatus Fornet. The principle of this method is measuring the bread volume using the rape seeds and the apparatus Fornet, the result beeing exprimated at 100g product.

Determination of bread porosity - method STAS 91-83. The method consists in determining the total volume of pores of a known volume of crumb, knowing its mass and density. To obtain an average of porosity, bread was transverse sectioned, removing the crust and cut from crumb three cylinders, from three different areas, which were subjected to measurement method.

Determination of bread elasticity - method STAS 91-83. The method consists of pressing a piece of crumb cylinder from one minute and measure the return to the original position, after removing the force and after a rest for one minute. To achieve the analysis it were used the crumb cylinders from the porosity determination.

Table 1.

Characteristics of flour used in experiments.

Flour code	Humidity (%)	Ash (% dry weight basis)	Wet gluten (%)	Gluten deformation index (mm)	Glutenic index	Alveogram parameters	Falling Number (sec.)
FA3	13,53	0,64	27,60	4	48,02	P =184mmH_2O	251
						L = 21mm	
						P/L = 8,76	
						W = 174×10e^{-4}J	

RESULTS AND DISCUSSIONS

From fig. 1. that describes the changes in the volume of bread obtained from FA3 flour depending on the dosage of L-cysteine added, is evidence that, once with increase the dose of amino acid to a specific value, occurs the corresponding increase in the volume of bread. This is due to decrease of dough resistance, consequence of disappearance of part of disulfide bridges between gluten proteins, which gives dough tenacity, and the gradual installation of a balance between flexibility and extensibility. To this effect competes the fact that L-cysteine is an inhibitor of endogenous peroxidase.

By increasing the addition of L-cysteine over the optimal dose, for the specific conditions of making the test baking, bread volume declines as a result of diminishing the ability of the dough to retain gas fermentation.

A similar trend with the variation of volume - increased by a certain amount of decline followed - records the other physical characteristics of bread - porosity and elasticity, issues presented in Fig. 2.

The low volume of witness sample (and, accordingly, low elasticity and porosity) is caused by a high resistance of gluten network that make the dough to oppose an appreciable resistance to increasing pressure gas derived from the fermentation.

From Table 2 it is found that supplementing FA3 flour with L-cysteine it may provide a maximum increase of the volume of bread around 20%, of porozității around 7,5% and of elasticity around 8,5%, these values indicating a good potential improvement of this amino acid for bread obtained from flours which have a gluten with high resistance and low deformability.

CONCLUSIONS

L-cysteine minimize the resistance and tenacity of the dough, thus creating the premises to reduce the energy required for dough kneading and the time of the technological flour processing, with positive economy repercussions.

The involvement of L-cysteine in the breadmaking processes which need regimes with the reduced technological times, lead to significant increases in volume (up to 20%), porosity and elasticity of the results bread.

L-cysteine can be successfully used in processing of flours with strong gluten, particularly in processes that use the reduced duration of fermentation.

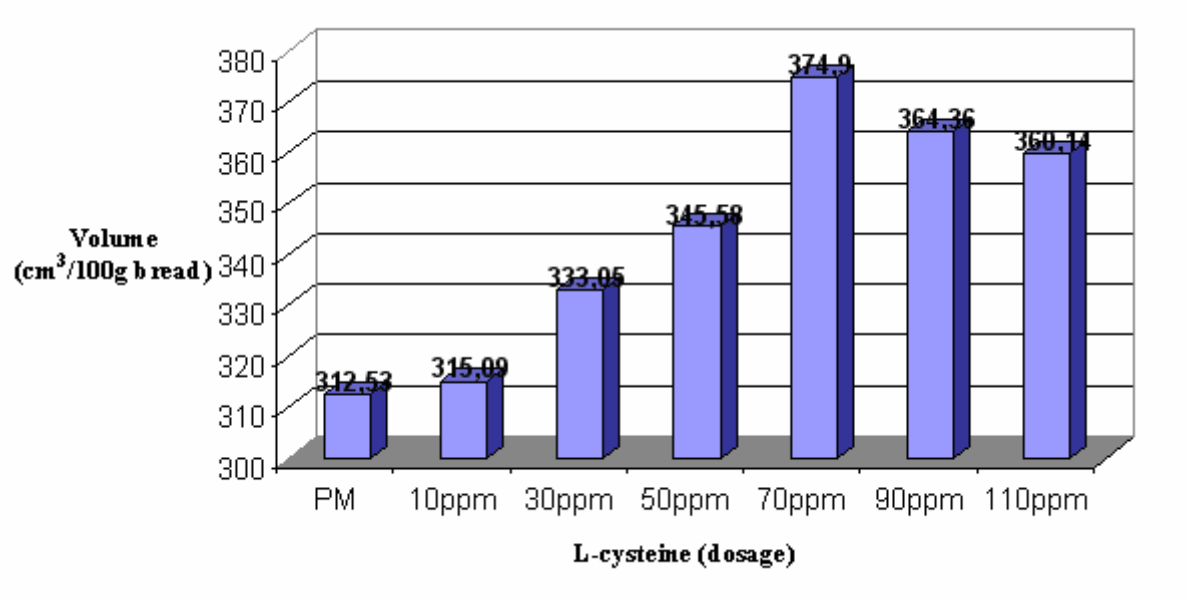
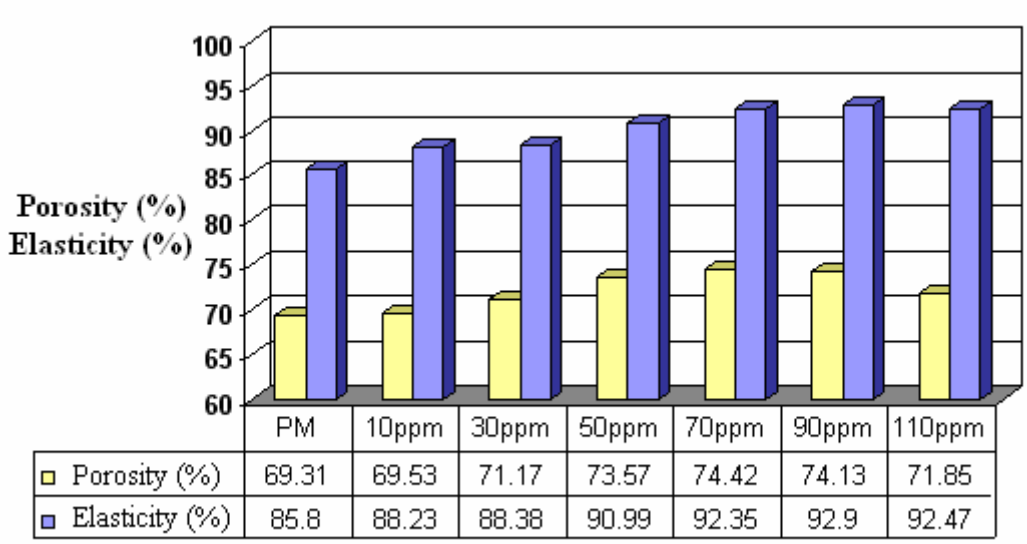


Figure 1. Variation of bread volume depending on the dose of L-cysteine added.



	PM	10ppm	30ppm	50ppm	70ppm	90ppm	110ppm
Porosity (%)	69.31	69.53	71.17	73.57	74.42	74.13	71.85
Elasticity (%)	85.8	88.23	88.38	90.99	92.35	92.9	92.47

Figure 2. Variation of bread porosity and elasticity depending on the dosage of L-cysteine added.

Table 2

The percentual variation of the bread volume, porosity and elasticity depending on the dosage of L-cysteine added.

PERCENTUAL VARIATION OF:	**FA3**	**L-CYSTEINE**					
	0 ppm(PM)	10 ppm	30 ppm	50 ppm	70 ppm	90 ppm	110 ppm
Volume	0	+0,81	+6,56	+10,57	**+19,95**	+16,58	+15,23
Porosity	0	+0,31	+2,68	+6,14	**+7,37**	+6,95	+3,66
Elasticity	0	+2,83	+3,00	+6,04	+7,63	**+8,27**	+7,77

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