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The Effect of Ascorbic Acid and Glycerol on Quality of Frozen Barbari Bread

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ABSTRACT: To improve the quality and obtain a long shelf life of bread, in this study the effect of part baked technology and freezing storage and glycerol and ascorbic acid in Barbari bread were investigated. Glycerol and ascorbic acid were added to the Barbari bread formulation at different levels (0, 0.5, 1% for glycerol and 0, 75, 100 ppm for ascorbic acid) and their effects on the rheological and quality of breads were evaluated. Adding 0.5% glycerol and 150 ppm ascorbic acid to Barbari bread decreased the firmness of breads and increased the specific volume, porosity and sensory properties during part baked and freezing storage.

Key words: Ascorbic acid, Barbari bread, Glycerol, Freezing storage, Part baked.

INTRODUCTION

In recent years, many researches have been done to improve the quality and variety of bread formulations, and the results are due to achieve various formulas and techniques in the preparation and processing of dough and bread. The aim of this research was to improve the quality of bread and obtain a new method for optimizing the baking technology, shelf life and is the nutritional value of bread. Considering to increased demand and need for fresh bread and high quality production, new methods such as freezing, optimal packaging application and types of additives (hydrocolloids, emulsifiers and enzymes in bread formula was suggested (Barcenas and Rosell, 2007; Ribotta *et al.*, 2008).

The part baked technology is a method of bread production so that formed gluten network, without reaching the coloring reactions of the crust and frozen for to retard staling and to extend shelf life of bread then in the point of consume full baked (Vulicevic *et al.*, 2004; Barcenas and Rosell, 2006, 2007). The major factors that affect on storage life of frozen bread was include: product formulation, processing, packaging and storage conditions (Vulicevic *et al.*, 2004).

Ascorbic acid used in bakery products due to oxidation properties which oxidation SH of gluten protein to S-S bonds as results strengthening the gluten network to kept gas cells, softening crumb and increasing the bread volume (Waserman, 2000; Cauvain and Yong, 2005). Another additives that been used in frozen bread is Glycerol, because has an important role in the formation of ice crystals during freezing and frozen storage mode, thus preserving the quality of the bread (Asghar, 2012). In this study the effect of different formulation on part baked frozen bread were investigated and other parameters were kept constant. The aim was studying the effect of ascorbic acid and glycerol on quality of frozen Barbari bread.

MATERIAL AND METHODS

A. Materials

This research done at Agricultural and natural resources Research Centre, Mashhad, Iran. Commercial wheat flour with 10.52% moisture, 10.8% protein, 1.76% lipid, 0.79% ash, 26.7% wet gluten and 412 s falling number was procured from Razavi Mill Factory Mashhad, Iran. Glycerol and ascorbic acid were obtained from Pars Behbood Asia Co, Mashhad, Iran., and Merck Co. respectively. All of the bread recipes also contained active dry yeast (Razavi Co., Mashhad, Iran), vegetable oil (Ladan Co., Tehran, Iran), salt and sugar (Local market).

B. Methods

Flour analysis: Moisture (44-16 A), ash (08-07), fat (30-10), wet gluten (38-11) and falling number (56-81) were determined according to AACC-approved methods (AACC, 2000). Flour protein was tested using a Kjeltec auto protein tester (model 1030, Tecator Co., Hoeganaes, Sweden).

Part baked frozen Barbari bread preparation: All ingredients (100% flours, 1% sugars, 1% salt, 1% active dry yeast and 1% vegetable oil), glycerol and ascorbic acid were added to the flour at three levels (0%, 0.5% and 1%) and (0, 75 ppm and 150 ppm) w/w flour basis respectively, were mixed in a spiral mixer (Escher, Italy), for 8 min, and after resting for 30 min; it was divided into 250 g pieces and rounded mechanically moulded. The bread was part baked in an electric oven with an incorporated proofing chamber (Zucchelli forni, Italy) at 210°C for 7 min to obtained texture structure before starting colouring reaction. Part baked frozen (PBF) Barbari bread sample were packaged in polyethylene bags and frozen in a blast freezer. After storage at -18°C for 15 day, PBF bread was thawed at room temperature for 10 min and baked at 260°C for 8 min (Bárcenas and Rosell, 2006).

Specific volume: Specific volume was determined an hour after baking based on rapeseed displacement method (Bárcenas and Rosell, 2006).

Texture determination: The change in the texture of Barbari flat bread due to staling was measured by using the penetration test. A QTS texture analyser (CNS Farnell, Hertfordshire, UK) was used to measure the force required for penetration of a round-bottom (2.5 cm diameter × 1.8 cm height) probe at a velocity of 30 mm/min and descended 30 mm (a sufficient distance to pass through the slice of 10×10 cm of bread) into the bread. Trigger value 0.05 N. Three replicates from three different sets of baking were analysed (Pourfarzad *et al.*, 2009).

Porosity: The porosity of bread determined by prepared the 25 mml slices from the middle of crumb bread, get picture by scanner and saved in computer, using image j software and measurement porosity by activation 8 byte options and created grey scale images, activated the binary option, the binary images were created, and using the ratio of bright and dark spots as an indicator for estimated bread porosity (Wilderjans *et al.*, 2008).

Sensory assessment: Sensory evaluation was conducted on the breads to the study possible effects of treatments on the sensory profile of each type of bread. The sensory bread attributes were evaluated using the flat bread evaluation method described by Rajabzadeh (1991). Sensory evaluation was performed by 10 trained panellists and the overall quality of bread was evaluated using a ranking scale with scores ranging from 1 (least pleasure) to 5 (best pleasure). In this study, some sensory properties including odour, taste and flavour, upper surface properties and overall quality (total acceptance) of Barbari bread were evaluated. In this study, some sensory properties including taste, flavour, texture and overall quality (total acceptance) of PBF Barbari bread were evaluated.

C. Statistical analysis

Results of the study analysed with factorial design of triplicate analyses. In order to assess significant differences among samples, a factorial design of triplicate analyses was performed using the SPSS program (version 19). Duncan's new multiple range tests were used to study the statistical differences of the means with 95% confidence (Gacula *et al.*, 1984).

RESULT AND DISCUSSION

A. Specific volume

Bread volume is the most important factor that affected by freezing storage. Specific volume analysis of PBF Barbari bread is summarized in Fig.1. The Results indicated adding glycerol at 0.5% and ascorbic acid at 150ppm increased the specific volume of PBF Barbari bread, but the effect of combination of glycerol and ascorbic acid on specific volume were more significant, the same trend was observed, that the highest specific volume of PBF Barbari bread was related to sample with 0.5 glycerol and 150pmm ascorbic acid and the control had minimized it.

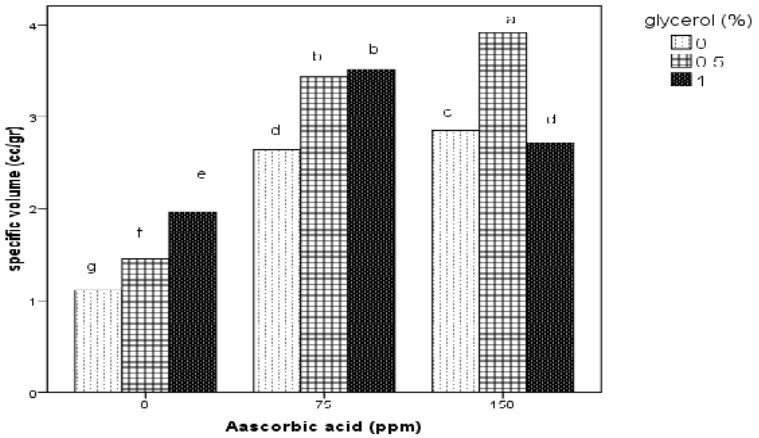

Fig. 1. Effect of ascorbic acid and glycerol on specific volume of PBF Barbari bread, different letters show the statistical significant differences ($p<0.05$).

The glycerol acts as a polyols and can increase gas retention by improving dough viscosity (Pourfarzad *et al.,* 2008). Ascorbic acid by oxidation SH of gluten protein to S-S bonds improving and maintaining the gas cells in gluten network (Cauvain and Yong, 2005,). Oxidizing agents like ascorbic acid, are required to be added to frozen dough formulas to strengthen their gluten network and to improve the final product's volume as well. The combination of ascorbic acid and potassium bromate are often added into a frozen dough formula.

B. Bread porosity

Crumb porosity is an important characteristic for bakery products. Similar results that obtained from porosity test followed the similar pattern like specific volume, because porosity and volume refer to number and attribute of the gas cells in crumb. As reported in Fig 2, the porosity of samples increased when compared to the control. Results showed adding glycerol at 0.5% and ascorbic acid at 150ppm together enhanced the porosity and prevented from lost the cell gas during frozen storage. Increasing glycerol concentrate to 1% decreased porosity; due to polyols in high concentrates caused dough was viscous and sticky. Similar results were obtained from Pourfarzad *et al.* (2008).

C. Crumb firmness

Significant difference in firmness were detected between treated samples and control ($p<0.05$) (Fig. 3). Bread firmness significantly decreased with addition of glycerol at 0.5% and ascorbic acid at 150 ppm and control samples had the highest firmness. Glycerol has hydrophilic groups such as hydroxyl and carboxyl groups, which allow more water interactions through hydrogen bonding and increase the ability to retain water (Izawa *et al.*, 2004).

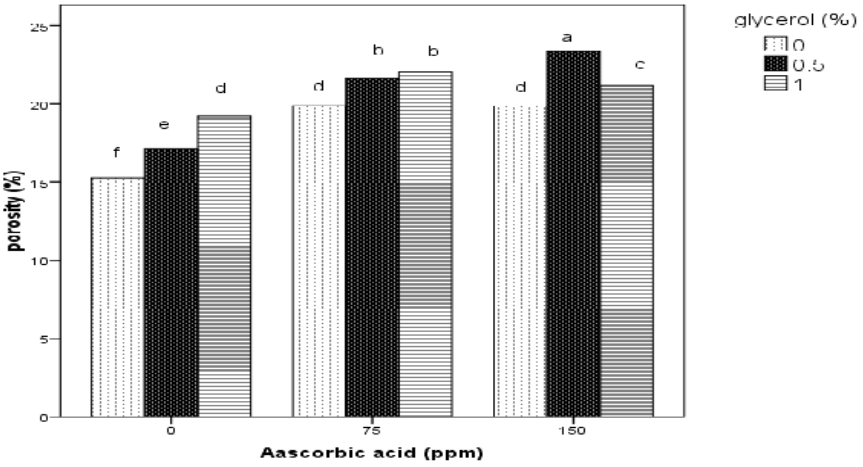

Fig. 2. Effect of ascorbic acid and glycerol on porosity of PBF Barbari bread, different letters show the statistical significant differences ($p<0.05$).

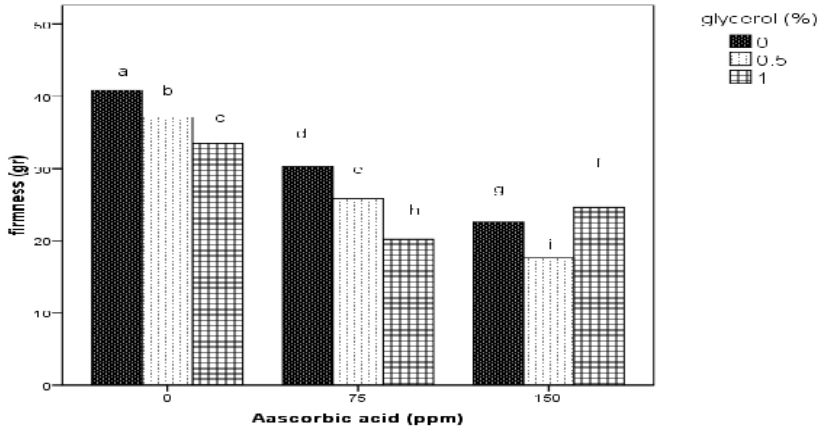

Fig. 3. Effect of ascorbic acid and glycerol on firmness of PBF Barbari bread, different letters show the statistical significant differences ($p<0.05$).

Ascorbic acid is a reducing agent (or sometimes called an anti-oxidant), it must first be oxidized to dehydro-L-ascorbic acid (DHA) in order to act as an oxidant". It may create -S-S- (disulphide) bonds reinforcing the gluten network, thus improving dough gas retention. Furthermore, ascorbic acid provides other benefits to bread making, such as providing resistance to dough deformation during mixing, increases oven spring, and finer crumb grain.There are many factor influences on staling and hardening of the bread crumb, such as retrogradation of amylopectin, recrystallization of amylose, emigration moisture from crumb to crust (Cauvain and Yong, 2005). The result showed using glycerol and ascorbic acid at part baked bread could retarded the staling and hardening of crumb during frozen storage at 15 day.

D. Sensory attributes of the part baked frozen Barbari bread

Data for the effects of ascorbic acid and glycerol on bread sensory properties are presented in Table 1. The quality of PBF bread deteriorates during frozen storage, whereas by adding ascorbic acid and glycerol the acceptance of sensory properties wasn't decreased. The most acceptable bread was the one with 0.5% glycerol and 150 ppm ascorbic acid which had a fine taste, brown color, good aroma and fresh appearance. Control sample received lower crumb texture, taste, and overall acceptability scores because of lost quality during freezing storage. Glycerol due to their polyols properties, made a soft and good texture and feel to the mouth. Results that obtained from sensory tests almost match with finding of Asghar *et al.* (2012).

Table 1: Effect of ascorbic acid and glycerol on sensory properties of PBF Barbari bread, different letters show the statistical significant differences ($p<0.05$).

Ascorbic acid (ppm)	Glycerol (%)	Texture	Aroma	Color	Taste	Overall acceptance
0	0	3.3^{a}	3.5^{d}	3.6^{c}	3.5^{e}	3.5^{e}
0	0.5	3.8^{e}	3.9^{c}	3.9^{b}	3.8^{d}	3.8^{d}
0	1	3.9^{e}	3.9^{c}	3.9^{b}	3.9^{d}	4^{c}
75	0	4^{d}	4^{c}	4^{b}	4^{c}	3.9^{c}
75	0.5	4.4^{b}	4^{c}	4.2^{a}	4.2^{b}	4^{c}
75	1	4.4^{b}	4.2^{b}	4.2^{a}	4.4^{a}	4.2^{b}
150	0	4^{d}	4^{c}	4^{b}	4.2^{b}	4^{c}
150	0.5	4.7^{a}	4.5^{a}	4.3^{a}	4.4^{a}	4.5^{a}
150	1	4.2^{c}	4^{c}	4.3^{a}	4.4^{a}	4.2^{b}

CONCLUSION

In this paper, the effects of ascorbic acid and glycerol on quality and rheology of part baked frozen Barbari bread were evaluated. The frozen storage has significant effects on the specific volume, porosity, crumb hardness and sensory properties. The presence of ascorbic acid at 150ppm interactive with glycerol at 0.5% increased the specific volume, porosity and sensory properties and decreased crumb hardness of the Barbari bread during frozen storage, removing the negative effects of that process conditions.

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