

EVALUATING THE EFFECTS OF DIFFERENT LEVELS OF LIPASE ENZYME ON THE QUALITY OF BAGUETTE BREAD

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ABSTRACT

Utilizing lipase enzyme in formulation of baguette bread has led to production of a product with better nutritional properties and longer durability. The present study aimed at investigating the effect of lipase enzyme in four levels of 0, 50, 100, and 200 ppm on properties like special volume, moisture content, color, texture, and sensory characteristics of baguette bread. The results of the current study indicated that lipase enzyme has a positive effect on increased scores of properties like inner texture, shell characteristics, improvement in chewiness, and appropriateness of the cavities compared to the control subject (without enzyme). It was also concluded that among the different levels of lipase enzyme utilized, utilizing the concentration of 50 ppm received the highest score on general acceptance of the sensory properties of baguette bread. In general, utilizing lipase enzyme with concentrations of 50 and 100 ppm is better in terms of texture analysis, color analysis, and decreased toughness. Moreover, when lipase enzyme with concentration of 100 ppm was used in bread making, the produced bread had the maximum volume compared to other levels of the enzyme. In addition to this, utilizing lipase enzyme with concentration of 50 ppm resulted in creation of better color of the bread inside, and utilizing lipase enzyme with concentration of 100 ppm could lead to the best color of the shell compared to other subjects.

Key words: lipase enzyme, baguette bread.

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Introduction

Bread is one of the most consumed products produced from wheat, which is made in different types depending on people's taste, conditions, and facilities. Types of bread in the world are divided into three groups: bread with high volume (pan), average volume (baguette), and low volume (flat). First, bread used to be made in a flat form. Afterwards, types with higher volume were produced, such that nowadays in most countries, bread is baked in its complete volume⁽¹⁾. Baguette bread is unique to France, which is classified as thick bread types and is baked several times in bakeries. Since dough fermentation time takes long, its baking needs a regular and exact planning^(2,3,4).

In Iran, especially in recent years, baguette bread has been one of the most consumed thick types of bread. Baking thick bread depends on the baking capability of the flour and other different factors. Baking capacity is mostly dependent on

the flour properties, industrial factors and procedures, production method, and preparation procedures⁽⁵⁾. Bread staling is the toughening process of the product nucleus, which cannot be halted in normal conditions even if the food product are produced from the best materials and using the best methods. After the bread was taken out of the oven, it will staled gradually and loses its initial and natural taste, color, and texture⁽⁶⁾. Since staling process causes a remarkable reduction in the quality and popularity of baking final products, numerous studies have been conducted in order to reduce the pace of this process and delay it, and different suggestions have been made in this regard including: improving the quality of baking, packing the bread, storing the bread at a certain temperature, and using additives like gluten, protein and swelling materials such as gelatinized and dried starch, amylose, pentose, fats, emulsifiers, and hydrocolloids to keep the bread fresh^(7,8).

In recent decade, there has been an emphasis on using phospholipases and lipases instead of emulsifiers like DATEM and SSL in bakery industry⁽⁹⁾. Since lipase enzyme is removed due to being denatured and does not exist in the final product and also it is a natural compound of wheat, it causes no harm or risk to human⁽¹⁰⁾. Using this enzyme in bread formulation leads to an increase in dough durability and gas storage capacity, formation of a uniform structure in the bread nucleus, an improvement in its softness, and a rise in the volume of the bread loaf^(11, 12).

Studies conducted by Castello et al (1998) indicated that lipase has anti-stale effects because it causes triglycerides to convert into unsaturated polar fatty acids and mono-glycerides and free fatty acids⁽¹³⁾. Bread type containing lipase enzyme have a lower staling speed compared to the control ones, and when lipase enzyme was used solely, the bread softness was 1.73 times more than that of the control bread⁽¹⁴⁾.

Adili et al (2013) investigated the effect of lipase enzyme on baguette bread in four levels of 0, 10, 30, and 50 ppm relative to the flour weight⁽¹⁵⁾. In order to achieve better results and choose the best concentration of lipase in this study, four other levels were investigated in the control group (without lipase enzyme).

Materials and methods

The materials utilized in the present study included lipase enzyme (LP6) retrieved from Germany Sigma Company (produced by DFM, Netherlands), *Saccharomyces cerevisiae* active dry baker's yeast produced at Iran Mellas Baker's Yeast Company⁽¹⁶⁾, Setareh Flour for baguette bread with extraction degree of 72% produced at Golmakan Flour Factory, Khorasan⁽³⁾, and non-iodized salt produced at Ivanaki Salt Factory⁽¹⁷⁾. Other necessary chemicals were retrieved from Merck KGaA, Germany. Chemical tests on Setareh Flour were carried out based on AACC 2000 standard, there results are presented in Table 1, below^(18, 19, 20).

Moisture content	Protein	Ash	Crude Fiber	Fat	Gluten
12.10%	9.30%	0.90%	0.67%	1.20%	25.50%

Table 1: Chemical properties of Setareh Flour

Method of preparation of baguette bread

The initial dough, the flour, and the emulsifier are poured in a trough, then the mixture is slowly stirred (the dough temperature should be low). Based on the dough mixing system, the dough should be kneaded for 30 minutes in order for the gluten gain necessary extension. After the dough is kneaded for 10 minutes, the yeast is well mixed and added to the dough and the blender will be turned on again, and after a total of 20 minutes, the non-iodized table salt is spread over the dough. After the dough rests and dough balls are made, with full delicacy, some dough is rolled to make a pipe of about 80 cm and is covered with a piece of cloth. After about 90 minutes of final fermentation, the formed dough balls should be scratched longitudinal 5-6 times using a special sharp knife. First, the bread is baked without steam and after 1 minute and when a thin layer forms in the oven, steam will be puffed in slowly. Meanwhile the oven door need to be left ajar because the dough balls do not need unnecessary pressure. The baking time lasts about 30 minutes. The oven door can be opened completely during the last 5 minutes so that the bread will become crispy and roasted. Baguette bread should be placed in special baskets and kept cool^(2, 3, 4). In the present study, the basis was like this that the ingredients of the baked baguette breads were 100 units flour, 1 unit non-ionized salt [17, 2 units *Saccharomyces cerevisiae* active dry baker's yeast⁽¹⁶⁾, and 50 units water, which were equally used. Afterwards, lipase enzyme (with mold origin and without heat resistance) in liquid form and at four levels of 0, 50, 100, and 200 ppm relative to the flour weight were utilized⁽¹⁵⁾.

In so doing, the control treatment (without enzyme), the second treatment (with 50 ppm enzyme), the third treatment (with 100 ppm), and the fourth treatment (with 200 ppm) were prepared. The procedure of the study included the initial rest (20-25 min), dough ball making and middle rest (10 min), rolling and the final rest (30-45 min), and baking at 220-270° C (12-15 min). After the breads cooled, they were packed and stored in polypropylene packages. In order to evaluate the effect of lipase enzyme on baguette bread, the specific volume, texture, moisture content, the color of the nucleus, and the bread shell were evaluated. Moreover, tests related to sensory and observational evaluation (stale, taste, smell, etc.) were conducted by selective trained judges using a 5-point Hedonic scoring method, and each of the factors was given a score

from 1 to 5. Data analysis was conducted using a totally randomized factorial design for each treatment. To analyze the variance and compare the means at a significance level of 95%, Duncan's multiple range test was employed using SAS Software^(21, 22).

Discussion

Texture evaluation test

The toughness level of the bread nucleus was measured using QTS-25 texture analyzer made by CNS Furnell and using Plunger 2 with a diameter of 25 mm. Treatments with volume of 25 mm were carefully cut from the bread nucleus and the Plunger 2 that was working at a pace of 1 mm per second was allowed to penetrate inside the breads about 80%, i.e. 20 mm. At this time, the force (in terms of N) recorded by the device was considered as the toughness index of the bread treatments⁽²³⁾.

Table 2 indicates the results of texture analysis of the treatments in 2 hours, 2 days, and 4 days after their production. According to the results of texture analysis, treatments with 50 and 100 ppm had a remarkable increase compared to the control treatment. The treatment with 200 ppm lipase enzyme; however, indicated more toughness compared to the control treatment. An increase in consumed concentration has caused an increase in the toughness of the treatments. Lipases cause fats to break down as a result of which free fatty acids increase in the dough and the product will have a soft texture.

		T1	T2	T3	T4
Texture (g/force)	2 hours	670	467	620	689
	2 days	980	731	845	10003
	4 days	1102	893	1004	1205
Moisture (%)		25	27	29	24
Volume (ml/g)		1.7	1.95	2.2	2.3
Color	Shell	34	38.2	38.0	37.5
	Nucleus	29	34.5	34.3	33.7

Table 2: Comparison between the means of the measured properties of the baguette breads.

Moreover, the bread toughness will drop as a result of hydrolysis of lipids existing in flour and production of mono-glycerides due to lipase enzyme because the saturated mono-glycerides place in the center of the circular chain amylose and create a water-insoluble complex. While bread is produced or baked; therefore, neither does amylose exit the granule nor does crystallization of

starch occur, whereby bread staling will be delayed, its inside texture softness increases, and the produced bread will maintain its freshness for a longer time. In high levels of this enzyme; however, amylose is released due to decomposition of mono-glyceride into fatty acids and other lipid compounds; therefore, retrogradation occurs and the bread toughness will increase⁽²⁴⁾.

Moisture content test

The baked and cooled treatments were cut into smaller pieces of 12-16 and dried at 105°C till they reached a constant weight in a hot air oven (Membert Model 1100-800). The difference between the weights of the treatments indicated the moisture content level of each treatment⁽²⁵⁾. According to these results, it can be concluded that presence of lipase enzyme in bread can have a remarkable effect on the bread moisture content such that its presence in bread enhances bread moisture content. Furthermore, the results indicate that with an increase in lipase concentration, moisture content in treatments with 50 and 100 ppm increases compared to the control group. However, a higher increase in the rate of this enzyme, i.e. more than 100 ppm, can have a reverse effect on bread moisture content. It was observed that the maximum level of moisture content was seen in lipase concentration of 100 ppm. However, when lipase concentration increases to 200 ppm, bread moisture content drops, which can be attributed to the fact that an increase in lipase in baguette bread formulation causes triglycerides to hydrolyze and the lipid level to rise. Moreover, the produced fats places around and the external surface of starch granules and prevents water available inside the network from exiting during baking. These issues cause the polymetallic molecules to be trapped and lose the least amount of water during the baking process. Therefore, exit of the least water leads to the highest level of moisture content, and this effect intensifies with an increase in the concentration of lipase enzyme to 100 ppm.

The results of the special volume of baguette breads

One of the quality factors of bread is its special volume. The more appropriate the volume of bread, the more popular it will be. In the present study, rapeseed displacement method was employed in order to measure the special volume of bread⁽²⁶⁾. Table 2 presents the results of baguette

bread volume test. According to these results, bread volume increases with an increase in the concentration of lipase enzyme. It was observed that all treatments experienced an increase in their volume. This is can be attributed to the fact that the triglycerides available in bread is hydrolyzed by lipase enzyme, and lipids form a thin layer around gluten proteins and starch granules, which results in stabilization and maintenance of gas in the dough and also blockage of the holes and cells available in gluten network and prevents carbon dioxide from exiting during the dough extension and other phases of bread production.

The results of the nucleus color of the baguette breads

Analyzing the color of the breads was conducted using three criteria of L, a, and b. This method is utilized to define the quality of bread. L criterion is the lighting of the treatment, which ranges from 0 (pure black) to 100 (pure white). Criterion a is the rate of closeness of the treatment color to green and red and criterion b is the rate of closeness of the treatment color to blue and yellow, which range from -120 (pure blue) to 120 (pure yellow). To conduct the color test, a piece of the bread surface was cut with a saw knife and was tested using colorflex4.510 Hunter color analyzer (made in the USA). In this test, the colors of the bread nucleus and that of its shell were separately analyzed. The color intensity was calculated using the total color variation index as follow⁽²⁷⁾.

$$\Delta E = [(L_{\text{Standard}} - L_{\text{Treatment}})^2 + (a_{\text{standard}} - a_{\text{treatment}})^2 + (b_{\text{standard}} - b_{\text{treatment}})^2]^{0.5}$$

The results of the color analysis indicated that all of the three experimental treatments, compared to the control treatment, had remarkable appropriateness in regard with the bread nucleus color; however, there was not much difference between the three experimental treatments in this regard. However, the minimum amount of the consumed enzyme had a better effect, which is indicated in Table 2. Lipase enzyme resulted in a change in the cellular structure of the breads followed by smaller and more uniform air cells that distribute in the texture uniformly, which reduces the bread darkness and gives it a brighter texture^(14, 28).

Evaluating the general properties of baguette breads

All of the quality properties of the breads were calculated and measured based on sensory test and the following formula:

$$Q = \frac{\sum(P.G)}{\sum G}$$

Where, Q = quality digit, P = the result of the tested properties, G = evaluation coefficient

The results of the sensory tests were reviewed by selective trained judges using a 5-point Hedonic scoring method, and the means are presented in Table 3. The results of the sensory tests indicated that there was no significant difference among the treatments in regard with their smell, taste, color, chewiness, cracks and tears, and the total appearance scores. According to these results, it can be stated that by adding lipase, the texture of the product will be better compared to the control treatment; however, it should be noted that the texture score drops with an increase in the concentration of this enzyme, such that lipase has the best sensory effects when its minimum amounts are used while an increase in the concentration of lipase enzyme can reduce the score of these properties. Even higher concentrations of lipase can cause lower scores in regard with the bread chewiness compared to the control treatment.

Conclusion

The present study as aimed at investigating the effect of lipase enzyme on quality and sensory properties of baguette bread.

	T1	T2	T3	T4
Smell	3.6	3.8	3.74	3.65
Taste	4	4.2	4.12	4.08
Color	4.2	4.5	4.3	4.2
Crack and Tear	4.4	4.7	4.6	4.5
Chewiness	4	4.4	4.3	4.1
Texture	3.3	3.9	3.7	3.4

Table 3: The results of Freedman test for evaluation of general sensory properties.

In so doing, the effects of four levels of 0, 50, 100, and 200 ppm lipase were investigated. The results indicated that adding lipase enzyme to

baguette bread leads to an increase in the bread volume and the dough product durability and a delay in bread staling. Utilizing the concentration of 100 ppm indicated the maximum moisture and better shell color compared to the whole treatments. And using the concentration of 50 ppm led to the maximum score in terms of the bread nucleus color, texture, chewiness, and the total properties of the inner texture.

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