

Investigation on the Effect of Fennel Essence on Sensorial, Textural and Microbial Properties of Baguette Bread

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Received: October 29, 2014

Accepted: December 31, 2014

ABSTRACT

Today, using natural preservatives as an alternative to synthetic preservative is very common due to decreased side effects on human health. Hence, the purpose of this study was using fennel essence (0.025% and 0.05 % levels on flour weight basis) compared with potassium sorbate (0.1% and 0.2% on weight of flour basis) on moisture, texture firmness, crust color components, microbial load and overall acceptance in sensory test of baguette bread. In this study, image processing technique and Image J software were used to evaluate crust color as a rapid and non-destructive method. The results showed that the use of both types of preservatives (except 0.025% level of fennel essence) decreased moisture and increased texture firmness of bread in comparison with control sample, but negative effect of potassium sorbate was more than that of fennel essence. Also the results clearly showed that by addition of potassium sorbate to baguette bread formulation, b^* and L^* crust color decreased. However, both preservatives (potassium sorbate and fennel essence) were effective in decreasing microbial load of bread during one week. Finally, panelists approved only the sample containing 0.05 % fennel essence in terms of having same sensory characteristics of control sample. Therefore, it seems that fennel essence as a natural preservative, while maintaining technological and sensory properties of baking products such as baguette bread, can be supplied to this industry.

Keywords: Fennel essence, Ultrasound, Baguette bread, Texture

INTRODUCTION

Today, bread has economic, political and technical sensitivities. According to current statistics, annually 30% of this product is removed from the food basket in waste. Therefore, economic value of bread waste in the country is high and if it could be partly decreased, it will be a substantial contribution to the economy (1). A part of the waste is due to microbial contaminations resulted from growth of mold and yeast that by using preservatives can be overcome. But today, using chemical preservatives is endangered regarding safety and adverse effects on human health. That is why dietetics researchers are looking for a natural and herbal anti-mold to replace it with a variety of chemicals in food industry. Fennel plant is the one that has anti-microbial and anti-oxidant properties due to the presence of a group of small terpenoids and phenolic compounds (thymol, carvacrol and eugenol) (2) and if penetrating smell of its essence and extract does not cause any problem for the product, it can be used as a natural preservative in food. In this regard, Synq et al (2006) during their study found that fennel essence has an anti-fungal effect on a number of fungi infecting the food, such as *Aspergillus*, *Penicillium* and *Fusarium* (3). Also Ranjbarian et al (2004) using disk diffusion method showed that fennel essence has an inhibitory effect on *Helicobacter pylori* (4). Therefore, regarding fennel proven role in preventing the growth of microorganisms and using it as a safe preservative, the purpose of this study was using fennel essence compared with potassium sorbate in baguette bread formulation and examining its effect on technological, sensory and microbiological characteristics of the end-product.

MATERIALS AND METHODS

Materials

Sweet fennel seeds were purchased from the local market. Its preparation includes cleaning and then grinding the seeds. Wheat flour was also prepared from Kalaleh flour factory (Mashhad, Iran) and kept in cold storage to perform experiments. The yeast used was *Saccharomyces cerevisia*, in active dry yeast powder form in vacuum packaging, that was purchased from Razavi leaven company (Mashhad) and a promoter and other needed materials (sugar and salt) were purchased from great companies. Also the medium and potassium sorbate were obtained from Merck Company, Germany.

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Methods

• Ultrasound-assisted extraction

An ultrasonic waves producer device (HUP200) manufactured in Germany was used to apply ultrasonic waves. It produced longitudinal mechanical fluctuations at a frequency of 24,000 cycles per second (24 KHZ). Finally, in order to perform extraction procedure, ultrasound time was 5 min, pulse amplitude factor was 100% and considered device cycle was 1.

• Production of bread

To prepare bread dough, 6 kg of flour, 3,300 ml of water, 90 g salt, 80 g yeast, 30 g of sugar and 12 grams of promoter with fennel essence (0.025 and 0.05 % based on flour weight) and / or potassium sorbate (0.1 and 0.2 % on flour weight basis) were mixed in the mixing tank (spiral model, made in Thailand) (It should be noted that control sample was free of any preservatives) and the dough was stirred at 150 rpm for 10 min. After preparing the dough, primary fermentation was done for 30 min at room temperature (25 ° C), then the dough was divided into pieces of 250 g and after that mid fermentation was done for 8-10 min at room temperature to pass the time. After completion the stage and forming the dough, final fermentation was done in hothouse for 45 min at 45 ° C in saturated steam. Then baking was done in rotating oven with hot air at 260 ° C for 13 min. After cooling, each sample was packed in polyethylene bags in order to assess the quantitative and qualitative characteristics and kept at ambient temperature (1).

• Moisture measurement

The standard AACC, No.2000 44-16 was used to perform this test (5).

• Evaluation of bread texture

Baguette bread texture was evaluated within two hours after baking using a texture measuring device based on the method of Pourfarzad *et al* (2009). The maximum force required for penetrating a probe with a cylindrical bottom (2 cm diameter and 2.3 cm height) with a speed of 30 mm per minute from the center of the bread was calculated as firmness index. Trigger point and target value were 0.05N and 30 mm, respectively (6).

• Crust Color Evaluation

Baguette bread crust color analysis at intervals of 2 hours after baking was done by setting three indices L *, a * and b * using Image J software (7).

• Microbial Evaluation

Microbial test including total yeast and mold count was done according to the national standard No. 2-10899 (8).

• Sensory Evaluation

The obtained results of this study were reported based on the total acceptance that is the average of parameters such as texture, bread color, crust color, taste and smell.

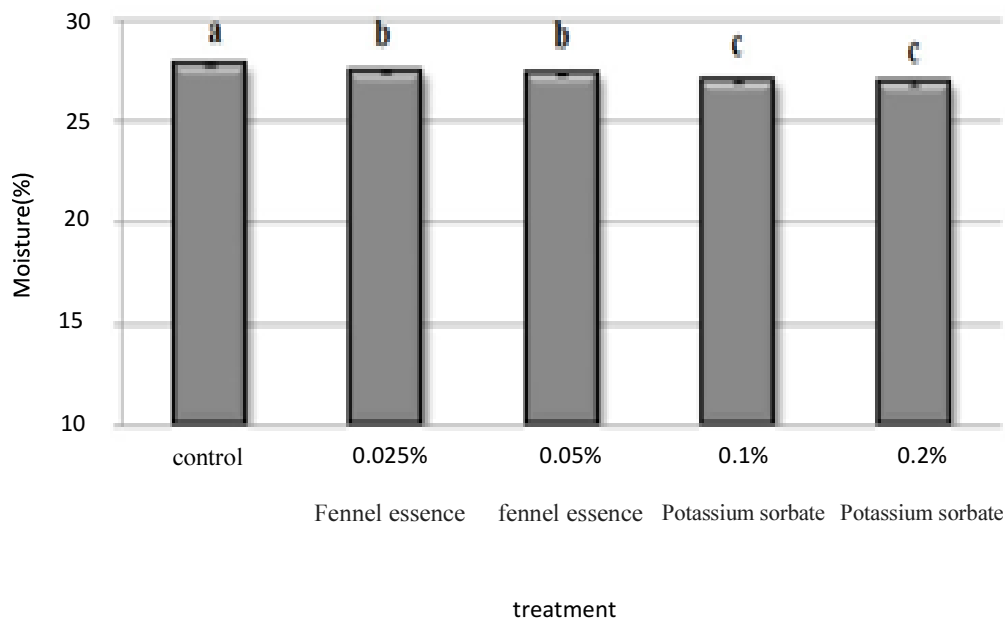
• Statistical Analysis

The obtained results of this study were evaluated using Mstat-c software version 1/42 based on a completely randomized design. Each sample was prepared in three replications. Means were compared by Duncan's test at a 5% significant level and Excel software was used to plot graphs.

RESULTS AND DISCUSSION

Moisture

The results of baguette bread moisture evaluation are given in figure 1. Based on the results, it was clear that all the samples containing preservative (natural and chemical) at all levels had lower moisture than that of the control sample. While lowering effect of fennel essence on baguette bread moisture was less than potassium sorbate.



From left to right: control, fennel essence (0.025%), fennel essence (0.05%), potassium sorbate (0.1%), potassium sorbate (0.2%)

Figure 1. The effect of using fennel essence and potassium sorbate compared with the control sample on baguette bread moisture.

(Similar letters don't have statistically significant difference at $P < 0.05$)

Texture

The results of this section (figure 2) clearly show that only the sample containing 0/025% of fennel essence had a texture similar to that of the control sample, and the remaining samples had firm texture compared with control sample (without preservative). It should also be noted that negative effect of potassium sorbate on texture firmness increase was higher than that of fennel essence. This can be affected by moisture decrease with addition of fennel essence and potassium sorbate to baguette bread formulation. Because moisture is an effective factor on texture firmness of baking industry products, and plays an important role in waste rate in the period immediately after baking and after that (during maintenance period).

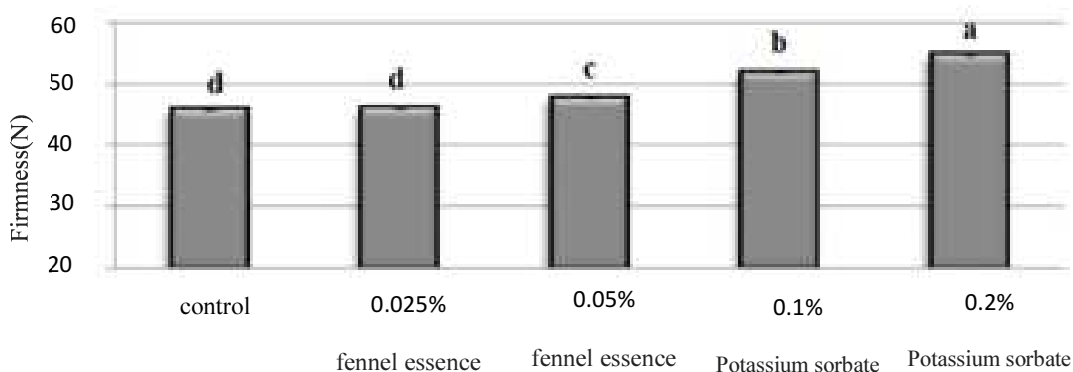


Figure 2. The effect of using fennel essence and potassium sorbate compared with control sample on baguette bread texture firmness.

(Similar letters don't have statistically significant difference at $P < 0.05$)

Crust color

The obtained results of color components evaluation are presented in table 1. As the results show, with addition of potassium sorbate b^* and L^* color components decreased. While fennel essence had no significant effect on these two color components and two samples containing fennel essence (at 0.025% and 0.05% levels) along with the control sample contain the highest amount of b^* and L^* color components. Also the results showed no

significant difference among the produced samples in terms of a^* color component. Here it seems sensible decrease of b^* and L^* color components was affected by moisture decrease caused by addition of potassium sorbate to the formulation of baguette bread that resulted in a rough and wrinkled product surface and due to this incident, light reflection and radiance decreased. In this regard, Purlys and Salvador (2009) reported similar results (9).

Table 1. The effect of using fennel essence and potassium sorbate compared with control sample on color components of baguette bread crust.

Sample	concentration(%)	Crust color		
		L^*	a^*	b^*
Control	-	$^{a}70.94\pm0.61$	$^{b}44.75\pm0.13$	$^{a}23.25\pm0.33$
Fennel essence	0.025	$^{a}89.80\pm1.61$	$^{b}73.72\pm0.13$	$^{a}26.21\pm0.33$
	0.05	$^{a}70.92\pm0.61$	$^{b}43.51\pm0.13$	$^{a}23.23\pm0.33$
Potassium sorbate	0.1	$^{b}21.07\pm1.52$	$^{a}36.60\pm0.16$	$^{b}13.02\pm0.30$
	0/2	$^{b}93.67\pm0.51$	$^{a}27.33\pm0.17$	$^{b}09.93\pm0.29$

(Similar letters in each column don't have statistically significant difference at $P < 0.05$).

Microbial test

As it can be seen (table 2), both natural (fennel essence) and chemical additives (potassium sorbate) resulted in a significant decrease (at 5% level) in growth of mold and yeast of produced samples in comparison with control sample. In general, it can be said that essence and herbal essences have different mechanisms for destroying microorganisms. These compounds have anti-microbial properties, entering lipids in cell membranes and mitochondria, and this causes differences in cells structures and their more permeability and removal of ions and other cell contents. Although removal of specified amounts of bacteria interior materials can be tolerated for cell, but the removal of large quantities of cell contents and / or key molecules and ions resulted in cell death, and hence microorganisms growth inhibitory action occurred (10).

Table 2. The effect of using fennel essence and potassium sorbate compared with control sample on microbial load of baguette bread.

Sample	concentration(%)	$\mu\text{fu/g}$ (Microbial load)	
		2 days after baking	1 week after baking
Control	-	-	$^{a}89.737.4\pm11$
Fennel essence	0.025	-	$^{d}34.97\pm3.88$
	0.05	-	-
Potassium sorbate	0.1	-	$^{b}55.5\pm10.463$
	0.2	-	$^{c}03.7\pm10.283$

(Similar letters in each column don't have statistically significant difference at $P < 0.05$)

Sensory test

According to obtained results (Figure 3), it was clear that only the sample contained 0.025% of fennel essence was equal with control sample in terms of form score for tasting judges.

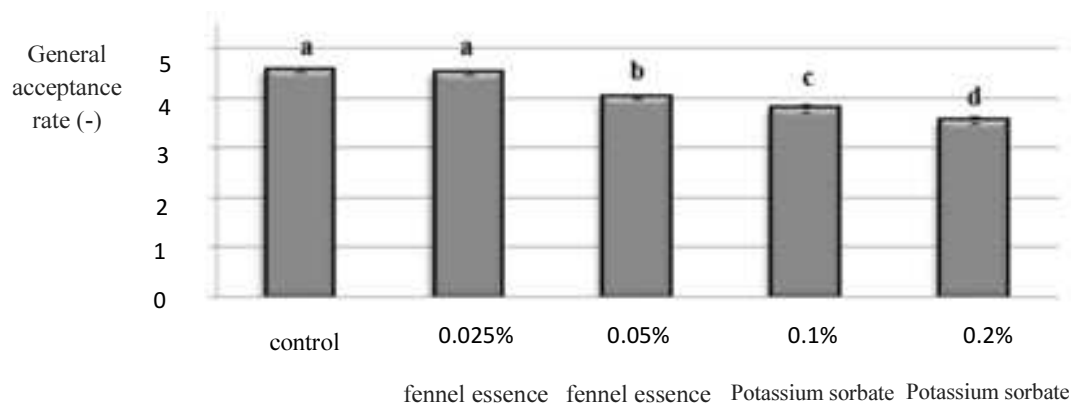


Figure 3. The effect of using fennel essence and potassium sorbate compared with control sample on the general acceptance rate of baguette bread.

(Similar letters don't have statistically significant difference at $P < 0.05$)

CONCLUSION

This study's findings suggest that fennel essence at 0.025% has usage in baking industry products especially baguette bread. Because while decreasing microbial load in comparison with control sample and high similarity in terms of efficiency in comparison with potassium sorbate, is a chemical and dangerous preservative to the health, maintained technological characteristics of the product in terms of texture, crust color components and sensory characteristics.

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