J. Appl. Environ. Biol. Sci., 4(11S)240-244, 2015

ISSN: 2090-4274
Journal of Applied Environmental and Biological Sciences
www.textroad.com

The Effect of Ultrasonic Waves on the Qualitative Properties of Cupcake Containing Triticale Flour and Tragacanth Gum

Hokmabadi, F.[1], Arianfar A.[2*], Sheikholeslami, Z.[3]

[1]Student of M.Sc. of Department of Food Science & Technology, Quchan Branch, Islamic Azad University, Quchan, Iran
2Department of Food Science & Technology, Quchan Branch, Islamic Azad University, Quchan, Iran
3Assistant of Agriculture and Natural Resources Research Center of Khorasan Razavi

Received: October 29, 2014
Accepted: December 31, 2014

ABSTRACT

Regarding the harmful effects of chemical additives such as benzoile peroxide, a decolorizer in flour industries, scientists are searching for safer alternatives. The effect of ultrasonic waves on the intensification of oxidation processes through aeration has been proven and these waves can be a good alternative to chemical decolorizers. In this research, the effect of ultrasonic waves was investigated on the specific volume, solidity, texture, porosity, sensory properties, and L* index of a sample containing 20% triticale flour and 0.6% gum. The findings clearly showed that ultrasonic waves result in better oxidation and better aeration. Therefore, the parameters such as specific volume, porosity, and sensory properties improved, the cake texture softened, and the color of the bark and the cake core brightened ($p<0.05$).

KEY WORDS: ultrasonic waves, triticale flour, tragacanth gum, oxidation, aeration

1. INTRODUCTION

Cake is a bakery product with a high status among consumers thanks to its popularity among different classes and covering a wide range of age groups. In the opinion of consumers, it is a delicious product with special organoleptic properties [3].

Ultrasonic is known as an emerging technology in food industries. This technology has many advantages including flavor reduction, increasing homogeneity, energy saving, more production, enhanced quality, decreased physiochemical hazards, and being environmentally friendly. Application of ultrasonic waves is highly effective as a catalyzer and as a facilitator in the oxidation of different products especially in foodstuffs. One of the chemical effects of low-frequency ultrasonic waves is the acceleration of oxidation reactions [4].

Sheikholeslami et al (2009) investigated the effect of ultrasonic waves on rheological features of dough and on the quality of the bread obtained from age-stricken wheat. Their results demonstrated that ultrasonic waves, with an intensity of 70% and a duration of 5 minutes, have the best effect on the preservation of rheological features of the dough. The employment of sound improved the absorption of the flour water, dough stability, texture, and dough texture resistance. The color of the bread made from age-stricken wheat flour treated by ultrasonic waves whitened and the physical properties and texture of the bread improved. The specific volume of the bread made by this flour increased significantly compared to the control bread.

Tan et al (2011) used ultrasonic waves in the mixing operation of sponge cake at the intervals of 3, 6, and 9 minutes with intensities of 1.1, 2.5, and 5 KW. They observed that these waves, within 6 minutes, improve the texture properties, porosity, sustainability, solidity of the sponge cake, and the rheological properties of the dough. They believe that the frequency of ultrasound and time dedicated to stir the cake dough have significant impacts on the properties of dough and the cake. They further state that the duration of sounding is more effective than the sound frequency in generating these changes.

2. MARTIALS AND METHODS

2.1. Materials

Wheat flour (Star) was supplied from the flour factory of Mashhad, Khorasan with an extraction degree of 27%. The genotype triticale flour ET-86-12 (at 0, 10, 20, and 30% levels) was provided from the research center of agriculture and natural resources in Razavi Khorasan. To this end, the flour required for conducting the experiments was supplied once and kept away from light and heat. Similarly, other consumer products (based on the flour content) involved in cake production were bought from the confectionery raw materials supply store. These products included Ladan sugar powder (50%), the Golden Ladan liquid oil (30%), Mahsa baking powder (2%), vanilla (0.2%) and eggs (36%). The fresh egg was provided one day before the daily production of cakes and kept in refrigerator. The required tragacanth gum was also purchased from the market under the name of white or cotton tragacanth.

Tragacanth preparation: First, tragacanth scales were powdered by an electrical mill. The tragacanth powder and other powder ingredients in the cake formula were then passed through a sieve with a mesh of 40 to separate coarse materials and impurities.

Triticale flour was brought by agricultural and natural resource center of Razavi Khorasan. Invert syrup that was needed as much as 12% in the cake formulation was also used according to the instructions available in the Iranian national standard, number 8025 issued in 2005.

*** Corresponding Author:** Arianfar A., Department of Food Science & Technology, Quchan Branch, Islamic Azad University, Quchan, Iran

2.2. Methods

2.2.1. The oil cake preparation method

In order to prepare the cake dough, the ingredients were weighed by a digital balance (AND EK-200i, Japan) according to the desired formulation. Next, based on the creaming method, oil, sugar powder, and egg were mixed with an electric mixer (Moulinex, 272, 150 W, France) at 128 rpm within 3 minutes so that a cream containing air bubbles form. The invert syrup was then added to this cream, while stirring was further continued for 3 minutes. In the next stage, the baking powder, vanilla, tragacanth gum (at 0, 0.4, 0.6, and 0.8% levels), and triticale flour (at 0, 10, 20, and 30%) were added and the resulting mixture was gradually added on to the cream. Thereafter, 40 g of the prepared dough was poured into specific cake papers, which were placed in molds using a cloth funnel (Lebensmittelecht, Germany).

Baking was done in a hot-air revolving experimental oven (Zuccihelli Forni, Italy) at 170 □C for 20 minutes. After cooling down, each of the samples were packed and kept in polyethylene bags at ambient temperature (25 □C) in order to evaluate the qualitative and quantitative properties.

2.2.2. Method of applying ultrasonic waves on the optimal sample

The prepared dough mixture was homogenized by ultrasonic waves and an ultrasound instrument made in Germany. In this system, ultrasounds were transmitted directly from the tip of exchanger to the ambient liquid. The Sonotrode tip (two-thirds) was placed down the emulsion and the device started at an amplitude of 70% and a constant rotation of Grade 1. During homogenization, the span of sound application was set at 4 minutes. Since the sound energy was applied to a small volume of liquid surrounding the exchanger tip, the sample had to be shaken slowly to ensure the effectiveness of homogenization. The emulsion temperature increased during the ultrasound process, thus a cold water bath was used to cool down the sample. The prepared emulsion was used in the formulation of a specific cupcake dough [9].

2.3. Statistical analysis

To investigate the results and to conduct research analysis, SPSS Software was used in a fully random format based on factorial for analysis of variance and mean comparisons. The means were compared in 5 levels and the resulting curve was drawn by Excell 2007. Finally, the optimal treatment was chosen for the stage of exploring the effect of ultrasound. All of the experiments were repeated twice.

3. RESULTS AND DISCUSSION

According to the conclusion drawn from the experiments on the samples, the sample containing 20% triticale flour and 0.6% tragacanth gum was selected as the optimal sample for ultrasound investigations, to which ultrasonic waves were applied. T-test was done on the optimal sample and on the employed ultrasound.

3.1. The effect of ultrasonic waves on the specific volume

According to Fig. 1, the specific volume of the cake increased by applying ultrasound. Applying ultrasonic waves improves the dough aeration which in turn increases the number of air bubbles in the dough and enlarges the volume [2].

Tan et al (2011),investigated the effect of ultrasound with various intensities of 1.1, 2.5, and 5 KW and durations of 3, 6, and 9 minutes on the mixture of sponge cake dough. The results showed that ultrasonic waves reduced the density and the flow behavior index, while increased the amount of stabilized air in the dough and viscosity of the cake dough, which in turn led to cake enlargement, decreased texture solidity, and the formation of a cake with high flexibility and adhesion abilities.

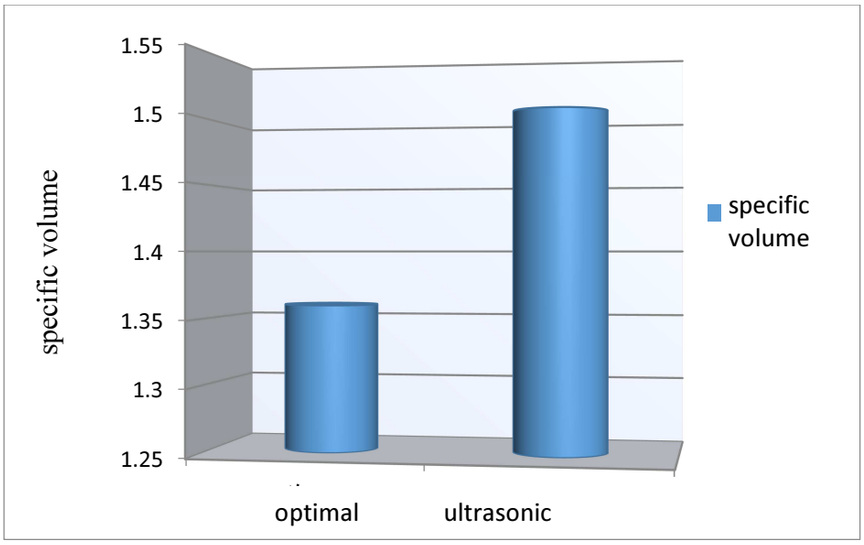

Fig. 1. The comparison of the effect of ultrasonic waves on the specific volume of the optimal sample

3.2. The effect of ultrasonic waves on solidity

According to Fig. 2, by applying ultrasound, the cake texture solidity diminished. The reason of this reduction is the growth of porosity and the number of pores as a result of better dough aeration by the sound. Sheikholeslami (2012) ,also reported that sound utilization reduces the bread solidity[8].

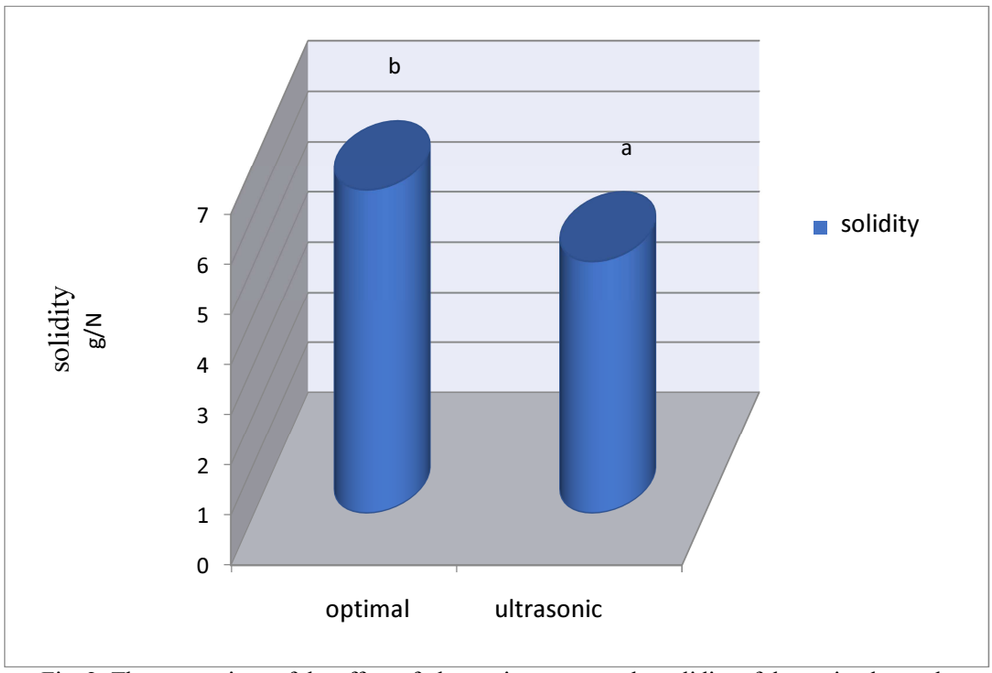

Fig. 2. The comparison of the effect of ultrasonic waves on the solidity of the optimal sample

3.3. The effect of ultrasonic waves on the texture

According to Fig. 3, the texture of the cake was enhanced by ultrasound application. The results of this research have been in concordance with those of Shahsavan et al (2012), in a study on the application of ultrasonic waves to molded bread, Shahsavan stated that as the sounding time lengthens the amount of bread texture increases [6].

Similarly, investigating the interactive effects of intensification and duration of sounding on the bread texture, Sheikholeslami (2009) suggested that elevating the intensification and duration of sounding resulted in improved bread volume and texture [7].

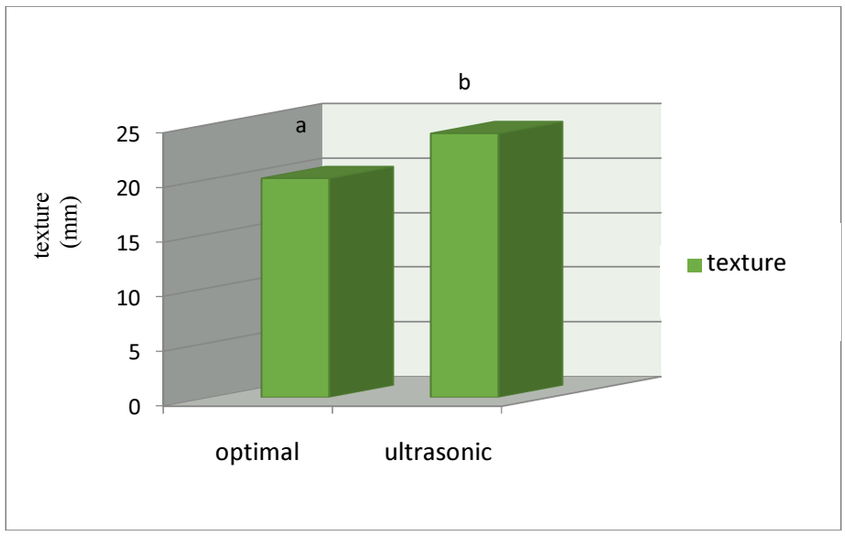

Fig. 3. The comparison of the effect of ultrasonic waves on the texture of the optimal sample

3.4. The effect of ultrasonic waves on porosity

According to Fig. 4, the cake porosity developed by applying ultrasonic waves. Among the advantages of ultrasonic aeration during the emulsion production is the formation of a texture with tiny, numerous, and uniform pores, i.e. a fully porous texture in the final product[1].

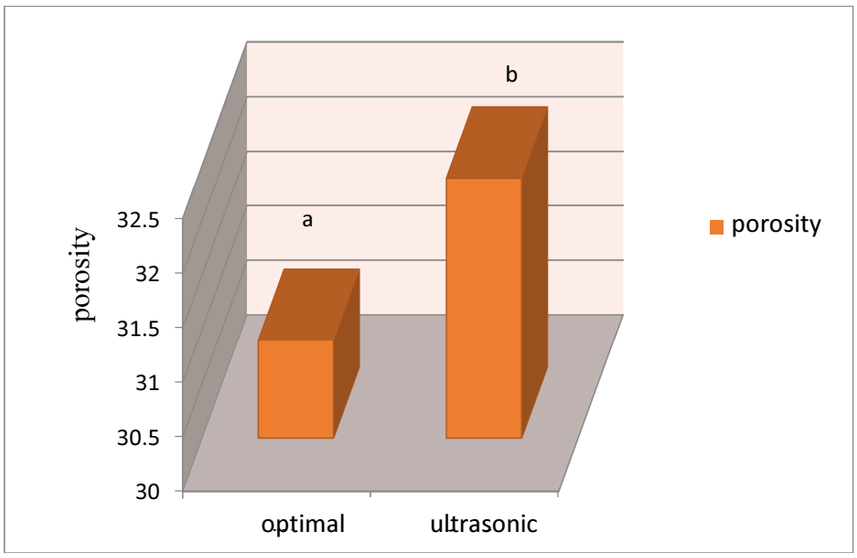

Fig. 4. The comparison of the effect of ultrasonic waves on the porosity of the optimal sample

3.5. The effect of ultrasonic waves on sensory properties

According to Fig. 5, two properties of the bark color and chew ability of the cake significantly improved after the application of ultrasounds. The reason of color improvement could be the ability of ultrasound waves in creating an emulsion with a high-humidity retention, which forms a more light-reflective cake with smooth, uniform, and brighter bark[5].

Sheikholeslami et al (2010) also reported that intensification of the ultrasound did not have a significant effect on the aroma of bread and its taste [8]. In the research by Shahsavan et al (2012), the bark color also became more acceptable by increasing the duration of sounding. They concluded that the application of ultrasonic waves resulted in the oxidation of pigments in the flour in an aquatic medium [6].

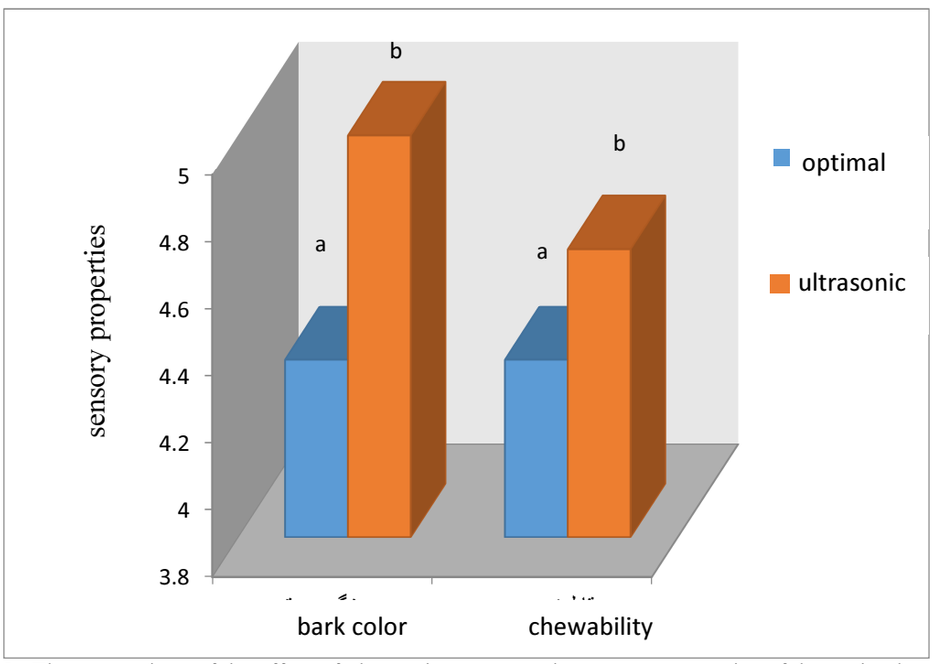

Fig. 5. The comparison of the effect of ultrasonic waves on the sensory properties of the optimal sample

3.6. The effect of ultrasonic waves on the L* index

Fig. 6 demonstrates that the effect of ultrasonic waves is significant on the L* index ($p<0.05$) and magnifies this index. It can be due to the homogenization and foam-generating effects of ultrasonic waves and there by the formation of larger pores, lower texture compression, and better center color. The results showed that the application of ultrasonic waves is more effective on the color of cake center and brightens it, while its effect on brightening the bark color was less substantial[5].

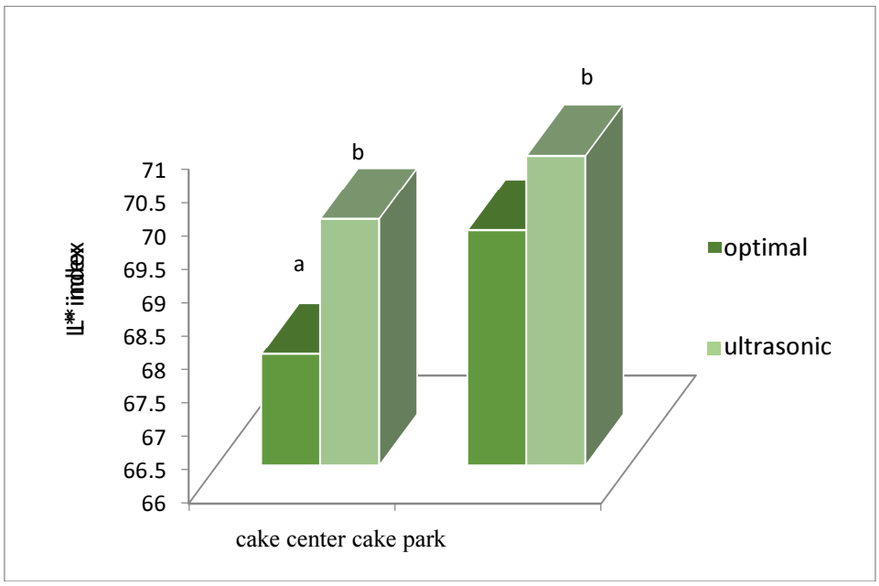

Fig. 6. The comparison of the effect of ultrasonic waves on the L* index of the optimal sample

4. CONCLUSION

One of the results obtained from this study is the high efficiency of ultrasonic waves in oxidation and aeration. The findings clearly revealed that ultrasonic waves improve the aeration and thus ameliorate parameters such as specific gravity and porosity. It also softens the cake texture and brightens the color of cake bark and the center.

5. Acknowledgements

The researchers wish to highly appreciate the endeavors of the venerable supervisor, Dr. Arianfar and the respected advisor, Dr. Sheikholeslami. Also, many gracious thanks go to the agricultural and natural resource center of Razavi Khorasan who supported us greatly in proceeding this research.

REFERENCES

1-Ashwini, A., R. Jyotsna and D.Indrani, 2009. Effect of hydrocolloids and emulsifiers on the rheological, microstructural and quality characteristics of eggless cake. Food Hydrocolloids., 23:700-707.

2-Every, D., J.A.K.Farrell and M.W. Stufken, 1983. Effect of Nysius huttoni on the protein and baking properties of two New Zealand wheat cultivars. Journal of Crop and Horticultural Science., 17: 55-60.

3-HajMohamadi, A., J.Keramat, M. Hojat Al-eslami, H. Molavi ,2014. Investigating the effect of tragacanth on the qualitative properties of sponge cake. Quarterly of Food Industries and Sciences., 11(42): 1-8.

4-Kidak, R., N.H. Ince, 2007. Catalysis of advanced oxidation reactions by ultrasound: A case study with phenol. Journal of Hazardous Materials., 146(3): 630–635.

5-Pakbaten ,S., A. H. Elhami Rad, M. Karimi and Z. Sheikholeslami, 2011. On the comparison of the effect of emulsion making through physical (ultrasonic waves) and chemical methods (E471) on the quality of oil cake. M.S.thesis, Islamic Azad University of Sabzevar.

6-Shahsavan Tabrizi, A., E. Ataye Salehi andZ. Sheikh Al-Eslami , 2012. A Study on the effect of ultrasonic waves and soy flour on the qualitative properties of molded bread. M.S.thesis, Islamic Azad University of Quchan.

7- Sheikholeslami,Z.,2009. The effect of ultrasonic waves on rheological features of dough and on the quality of bread made from age-stricken wheat. Ph.D.thesis. Ferdowsi University of Mashhad.

8-Sheikholeslami, Z., S. A. Mortazavi, H.Purrazrng and M.Nasiri Mohallati, 2010. The influence of ultrasonic waves on the rheological properties of dough and quality of bread wheat. Iranian Journal of Food Science and Technology., 7(2): 39-49.

9-Tan, M.C., N.L. Chin and Y.A.Yusof, 2011. Power ultrasound aided batter mixing for sponge cake batter. Journal of Food Engineering, 104: 430–437.

10- Verbeken, D., S.Dierckx and K. Dewettinck,2003. Exudate gums: Occurrence, production and applications. Applied Microbiology and Biotechnology., 63: 10-21.