THE EFFECT OF ADDING CINNAMON EXTRACT ON THE TEXTURE PROFILE ANALYSIS OF OIL CAKE

Fatemeh GHANNADIASL [1,*], ***Banafshe BORDBAR LOMER*** [2]

[1] *Faculty of Agriculture and Natural Resources, Department of Food Sciences and Technology, University of Mohaghegh Ardabili, Ardabil, Iran*

0000-0001-8257-8559

[2] *Faculty of Agriculture, Department of Food Science and Technology, Urmia University, Urmia, Iran*

0000-0002-9457-5483

Abstract

Bakery products, especially oil cakes, are among the most widely consumed food products. The production of functional bakery products with physiological effectiveness and consumer acceptance requires careful consideration of their appearance, taste, and texture. The quality of these products mainly depends on the ingredients used in the recipe, the dough mixing conditions, and the baking conditions. Determining the optimal formulation to have healthy properties, maintain tissue properties, and improve the flavor of these products is very important. Cinnamon is a spice that has been shown to have antioxidant, anti-inflammatory, and antidiabetic effects, as well as enhance the sensory attributes of bakery products. This study aimed to evaluate the impact of different concentrations of cinnamon extract (0%, 0.1% and 0.2%) on the hardness, adhesiveness, cohesiveness, and resilience of oil cake. We hypothesized that adding cinnamon extract would improve the texture characteristics of oil cake. Texture profile analysis (TPA) was performed using the TEXTURE ANALYZER model Brook field-CT310K. The results showed that adding cinnamon extract reduced the hardness of the cake samples, while the adhesiveness increased compared to the control sample. The cohesiveness and resilience of the cake samples also decreased with increasing extract levels. Results suggest that using cinnamon extract can enhance the texture and stability of oil cakes.

Keywords: *Oil cake, Cinnamon extract, Texture profile analysis.*

1. Introduction

Bakery products, especially oil cakes, are among the most widely consumed food products globally due to their favorable texture and taste (Rios, Garzón, Lannes, & Rosell, 2018). Researchers are always looking to optimize the technology for preparing these products, to improve the variety, quality, and taste (Dhillon & Amarjeet, 2013). The production of functional bakery products with physiological effectiveness and consumer acceptance is essential (Siró, Kápolna, Kápolna, & Lugasi, 2008). The quality of these products mainly depends on the ingredients used in the recipe, the dough mixing conditions, and the baking conditions (Doweidar, Amer, &

* *E-mail address:* ghannadiasl@uma.ac.ir

Tawfek, 2016). Therefore, determining the effective formulation to have healthy properties, maintain tissue properties, and improve the flavor of these products is very important (Škrbić & Cvejanov, 2011).

Cinnamon (C. Verum or C. Zeylanicum) belongs to the Lauraceous family. This brown substance has a pleasant aroma and sweet taste (Sharma, Mandal, Kant, Jachak, & Jagzape, 2020). Cinnamon is considered as an widespread spices in the world. It is used in traditional and modern medicine (Dhillon & Amarjeet, 2013). In medicine, cinnamon is mentioned as a traditional herbal medicine with different biological properties (Sadeghi et al., 2019) that has been shown to have antioxidant, anti-inflammatory, and antidiabetic effects (Muhammad & Dewettinck, 2017), as well as enhancing the sensory attributes of bakery products (Ghannadiasl & Bordbar Lomer, 2023). For a long time, researchers have been doing much research on cinnamon as a suitable flavoring for various foods and medicinal agents (Stevens & Allred, 2022). Due to the significant increase in the use of extract (Haddi, Faroni, & Oliveira, 2017), the present study aimed to prepare a cake formulation using cinnamon extract and to evaluate its texture characteristics.

2. Materials and Methods

2.1. Preparation of cinnamon extract

In order to extract, samples of Cinnamon bark (Golestan brand, Kian Badas Company of Tehran) were purchased and pulverized in suitable conditions and away from the sun with an electric grinder (France Moulinex Company, A320R1). The resulting powder was soaked in distilled water for 48 hours to prepare an aqueous extract (for every 100 g of powder, 300 ml of distilled water as solvent). Then, the soaked powder was transferred to the Buchner funnel machine and filtered using Whatman 42 filter paper. The aqueous cinnamon suspension was centrifuged for 15 minutes at 5000 rpm to separate the solids from the aqueous cinnamon solution. The resulting extract was concentrated using a rotary evaporator (EV400-Labtech-Italy) at a temperature of 75℃ and a speed of 200 rpm in a vacuum to 15 Brix. Brix measurements were performed with a refractometer (Onderoglu, Sozer, Erbil, Ortac, & Lermioglu, 1999).

2.2. Preparation of cake formulations

Cake dough was prepared by the sugar-dough method according to the instructions in Table 1 (Peyghambardoust, 2010). The studied samples included the control sample (without extract) and cake samples in 2 different concentrations of cinnamon extract (0.1% and 0.2%), which were added during the preparation of cake dough. After preparing the cake batter, the batter was poured into a greased pan and baked in a preheated oven at 180 °C for 20-25 minutes. Then, the cakes place in a clean space to cool. After reaching ambient temperature, it was completely covered with cellophane and prepared for tissue analysis.

Table 1. Formulation of oil cake by the sugar-dough method

Material	Percentage based on flour weight	Weight (g)	Method
Oil	57	263	Step 1) Warm up until a light color is produced (about 10 minutes).
Sugar	72	330	
Egg	72	330	Step 2) will be added in 4-5 parts.
Flour	100	425.6	Step 3) All the powdered ingredients will be sifted and then added to make the dough semi-smooth.
Baking powder	1.34	7.5	
Milk powder	2	9.2	
Vanilla	0.5	2.3	
Whey powder	4	18.4	
Water	25 (Variable)	114	Step 4) is added and mixed to form the desired dough.

2.3. TPA of oil cake samples

Texture analysis for cake samples was performed by TEXTURE ANALYZER model Brook field-CT310K. TPA is a time-force curve used to quantify texture properties related to sensory evaluation results (Vácha, Stejskal, Vejsada, Kouřil, & Hlaváč, 2014).

TPA of oil cake samples (2×2×2 cm) were pressed twice from the middle of the cakes, using a 38.1 mm diameter cylindrical probe (Probe: TA4/1000). Test Target 50%, Trigger Load 7g, Return Speed 2 mm/s, Test Speed 2.00 mm/s, Pretest Speed 1 mm/s, Fixture: TA-RT-KI. Finally, the TPA was determined from the curves using Texture Expert 1.05 (Stable Microsystems) software. Tissue measurement parameters, includeding hardness, adhesiveness, cohesiveness, and resilience were performed with an average of 3 replications per sample.

2.4. Statistical Analysis

For statistical analysis of data from a completely randomized design, the data were subjected to one-way analysis of variance (ANOVA) at the significant level of 5%. If there was a significantly different, it will be continued by Fisher's Least Significant Differences (LSD) test at the 0.05 probability. Quantitative data were reported as mean ± standard deviation.

3. Results and Discussion

The dimensions of the analyzed cakes (length, width, and depth) are shown in Table 2. According to the results, the addition of aqueous cinnamon extract in most cases does not affect on the Length, Width and Depth of oil cakes.

Table 2. Dimensions of cake samples

Dimensions (mm)	Samples		
	Control sample	0.1% extract	0.20% extract
Length	22.49±3.52[a]	23.70±6.51[a]	22.80±5.94[a]
Width	20.83±5.21[a]	21.10±3.49[ab]	25.28±0.25[ab]
Depth	18.45±4.84[a]	21.90±3.03[a]	21.69±5.99[a]

Dissimilar letters in each line indicate a significant mean difference (P<0.05).

Modifying the formulation of cake samples can change the texture properties related to physicochemical or structural phenomena (Soukoulis, Gaiani, & Hoffmann, 2018). Changes in the textural properties of the oil cake by adding aqueous cinnamon extract are shown in Table 3. TPA of the measured cake samples showed that by increasing the level of cinnamon extract in the oil cake, its hardness decreased, and the cake became softer. So, the cake hardness in the control sample decreased from 3816.33 to 2964.00 g in 0.20% sample. This result shows the improvement of the texture and hardness of the cake by adding the cinnamon extract to the oil cake. Our results were consistent with other findings (Majzoobi, Hedayati, Habibi, Ghiasi, & Farahnaky, 2014). In this study, the hardness of cakes decreased with increasing the percentage of resistant corn starch. Nakov et al. (2016), showed that the hardness of the measured cake samples becomes softer by increasing the level of button mushroom powder (Fakhreddin Salehi, Kashaninejad, Asadi, & Najafi, 2016). Different results have been reported in other studies. Adding different amounts of guar gum to carrot sponge cake is directly related to increasing the hardness of the cake (F Salehi & Kashaninejad, 2021). Also, increasing the amount of grape pomace powder increased the hardness of the cake (Nakov et al., 2020). Lu et al. (2010) found that the texture of sponge cake becomes harder by increasing the level of green tea powder (Lu, Lee, Mau, & Lin, 2010). The difference in the results was related to the type of added material. Adhesiveness is a surface property that depends on the combined effect of adhesive forces and other factors, including viscosity and viscoelasticity (Huang, Kennedy, Li, Xu, & Xie, 2007). The adhesiveness of the oil cake did not show a significant difference with increasing the percentage of cinnamon extract. However, all measured values for all concentrations were higher than the control sample. In the Slima et al. (2021) study, Lepidium sativum polysaccharide in cake formulation leads to increased cake adhesion (Slima et al., 2021). Cohesiveness indicates the internal strength of the food structure (F Salehi & Kashaninejad, 2021). One of the reasons for cake cohesion may be due to moisture or its circular cells (Slima et al., 2021). Thus, it can be inferred that cake samples with large amounts of small air cells show less dense structure than more cohesive cake samples (Moza & Gujral, 2017). In our study, the results of

TPA showed a decrease in cake cohesion by increasing the level of cinnamon extract. In addition, the resilience of cakes decreased with increasing the percentage of extract. The results of our study were consistent with the study of Lu et al. (2010) in reducing the cohesiveness and resilience values in sponge cake samples by increasing the level of green tea powder (Lu et al., 2010).

Table 3. Textural properties of oil cakes with different levels of cinnamon extract

Parameters of texture	Samples		
	Control sample	0.1% extract	0.2% extract
Hardness (g)	3816.33±8.89[a]	3042.00±0.95[ab]	2964.00±3.12[ab]
Adhesiveness (mj)	0.20±0.26[b]	0.86±0.49[a]	0.47±0.31[ab]
Cohesiveness	0.73±0.13[a]	0.62±0.06[a]	0.58±0.02[a]
Resilience	0.24±0.02[a]	0.21±0.15[ab]	0.19±0.02[b]

Dissimilar letters in each line indicate a significant mean difference ($P<0.05$).

4. Conclusion

Considering the importance of bakery products worldwide, in this study, we investigated the texture characteristics of oil cakes enriched with cinnamon extract. According to the results obtained in this research, with the increase in the level of cinnamon extract, the hardness, cohesiveness, and resilience decreased compared to the control sample. However, the amount of adhesiveness increased compared to the control sample. These results suggest that using cinnamon extract can enhance the texture and stability of oil cakes.

Acknowledgement

The authors express their gratitude to Iran High-Tech Laboratory Network, central laboratory of Mohaghegh Ardabili University and Gilan University for supporting and providing laboratory facilities and equipment.

References

Dhillon, G. K., & Amarjeet, K. (2013). Quality Evaluation Of Bread Incorporated With Different Levels Cinnamon Powder. *Int. J. Food Sci. Nutr. Diet*, 2, 70–74.

Doweidar, M. M., Amer, A. M., & Tawfek, A. (2016). Preparation and evaluation of healthy cinnamon cake. *Egyptian Journal of Nutrition*, 31(4), 157–195.

Ghannadiasl, F., & Bordbar Lomer, B. (2023). Physicochemical and sensory properties of oil cake enriched with cinnamon extract. *Journal of Food Research*, 33(2), 43–55.

Haddi, K., Faroni, L. R. A., & Oliveira, E. E. (2017). Cinnamon oil. In *Green pesticides handbook* (pp. 117–150). CRC Press.

Huang, M., Kennedy, J. F., Li, B., Xu, X., & Xie, B. J. (2007). Characters of rice starch gel modified by gellan, carrageenan, and glucomannan: A texture profile analysis study. *Carbohydrate Polymers*, 69(3), 411–418.

Lu, T.-M., Lee, C.-C., Mau, J.-L., & Lin, S.-D. (2010). Quality and antioxidant property of green tea sponge cake. *Food Chemistry*, 119(3), 1090–1095.

Majzoobi, M., Hedayati, S., Habibi, M., Ghiasi, F., & Farahnaky, A. (2014). Effects of corn resistant starch on the physicochemical properties of cake. *Journal of Agricultural Science and Technology*, 16(3), 569–576.

Moza, J., & Gujral, H. S. (2017). Influence of barley non-starchy polysaccharides on selected quality attributes of sponge cakes. *LWT-Food Science and Technology*, 85, 252–261.

Muhammad, D. R. A., & Dewettinck, K. (2017). Cinnamon and its derivatives as potential ingredient in functional food—A review. *International Journal of Food Properties*, 20(sup2), 2237–2263.

Nakov, G., Brandolini, A., Hidalgo, A., Ivanova, N., Stamatovska, V., & Dimov, I. (2020). Effect of grape pomace powder addition on chemical, nutritional and technological properties of cakes. *Lwt*, 134, 109950.

Onderoglu, S., Sozer, S., Erbil, K. M., Ortac, R., & Lermioglu, F. (1999). The Evaluation of Long- term Effects of Cinnamon Bark and Olive Leaf on Toxicity Induced by Streptozotocin Administration to Rats. *Journal of Pharmacy and Pharmacology*, 51(11), 1305–1312.

Peyghambardoust, S. H. (2010). Cereal Products Yechnology. Volume 2. *Tabriz University of Medical Science*. 250p.

Rios, R. V, Garzón, R., Lannes, S. C. S., & Rosell, C. M. (2018). Use of succinyl chitosan as fat replacer on cake formulations. *LWT*, 96, 260–265.

Sadeghi, S., Davoodvandi, A., Pourhanifeh, M. H., Sharifi, N., ArefNezhad, R., Sahebnasagh, R., … Mirzaei, H. (2019). Anti-cancer effects of cinnamon: Insights into its apoptosis effects. *European Journal of Medicinal Chemistry*, 178, 131–140.

Salehi, F, & Kashaninejad, M. (2021). Influence of Guar Gum on Texture Profile Analysis and Stress Relaxation Characteristics of Carrot Sponge Cake. *Journal of Food Biosciences and Technology*, 11(1), 1–10.

Salehi, Fakhreddin, Kashaninejad, M., Asadi, F., & Najafi, A. (2016). Improvement of quality attributes of sponge cake using infrared dried button mushroom. *Journal of Food Science and Technology*, 53(3),

1418–1423.

Sharma, S., Mandal, A., Kant, R., Jachak, S., & Jagzape, M. (2020). Is Cinnamon Efficacious for Glycaemic Control in Type-2 Diabetes Mellitus? *JPMA. The Journal of the Pakistan Medical Association*, 70(11), 2065–2069.

Siró, I., Kápolna, E., Kápolna, B., & Lugasi, A. (2008). Functional food. Product development, marketing and consumer acceptance—A review. *Appetite*, 51(3), 456–467.

Škrbić, B., & Cvejanov, J. (2011). The enrichment of wheat cookies with high-oleic sunflower seed and hull-less barley flour: Impact on nutritional composition, content of heavy elements and physical properties. *Food Chemistry*, 124(4), 1416–1422.

Slima, S. Ben, Ktari, N., Trabelsi, I., Chouikhi, A., Hzami, A., Taktak, M. A., & Msaddak, L. (2021). Antioxidant Activities, Functional Properties, and Application of a Novel Lepidium Sativum Polysaccharide Cake Formulation.

Soukoulis, C., Gaiani, C., & Hoffmann, L. (2018). Plant seed mucilage as emerging biopolymer in food industry applications. *Current Opinion in Food Science*, 22, 28–42.

Stevens, N., & Allred, K. (2022). Antidiabetic Potential of Volatile Cinnamon Oil: A Review and Exploration of Mechanisms Using In Silico Molecular Docking Simulations. *Molecules*, 27(3), 853.

Vácha, F., Stejskal, V., Vejsada, P., Kouřil, J., & Hlaváč, D. (2014). Texture profile analyses in tench (Tinca tinca L., 1758) from extensive and intensive culture. *Acta Veterinaria Brno*, 82(4), 421–425.