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

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| **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, & 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.

1. **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

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

**2.3. TPA of oil cake samples**

Textureanalysis for cake samples was performed by TEXTURE ANALYZER model Brook field-CT310K. TPA is a time-force curve used to quantify textureproperties 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 Fisherʼs Least Significant Differences (LSD) test at the 0.05 probability. Quantitative data were reported as mean ± standard deviation.

1. **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

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

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

Modifying the formulation of cake samples can change the textureproperties 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

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

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

1. **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.

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