

Effect of Different Amounts of Pistachio Powder and Paste on the Sensory, Physicochemical and Microbial Characteristics of Oily Cake

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Information	Abstract
<p>Article Type: Original Article</p>	<p>Introduction: Pistachio cake is a product in which paste and powder of pistachios are used as its main ingredient. The use of paste and pistachio powder in the production of oily cake can improve the nutritional value and flavor of the product.</p> <p>Materials and Methods: The attributes of the oily cake include moisture, pH, color, texture; microbial evaluation (colony count, mold, yeast, Enterobacteriaceae) and sensory evaluation (by 6-point Hedonic method) was evaluated.</p> <p>Results: There are significant differences in pH, moisture, color attributes (L^*, a^* and b^*), stiffness, microbial evaluation and sensory evaluation in different treatments ($P \leq 0.01$). In all treatments, pH is decreased significantly compared to control ($P \leq 0.05$). Adding pistachio paste and powder in all quantities significantly increased the moisture content of cake ($P \leq 0.05$). Adding pistachio powder in all treatments caused texture hardness as compared with control ($P \leq 0.05$). For microbial evaluation, samples had less than 10 molds, yeast and enterobacteriaceae in different treatments, indicating there was no contamination of the cake containing different amounts of pistachio powder and pistachio paste.</p> <p>Conclusion: The cake containing 5% pistachio paste and 2.5% pistachio powder was the most favorable cake in terms of overall acceptability.</p>
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1. Introduction

Pistachio is one of the most important nuts rich in various nutritional components as well as vitamins and minerals. Its oil is cholesterol-free and mostly consists of essential unsaturated fatty acids. Hence consuming pistachio kernels have a significantly positive effect on human health and in the prevention of cardiovascular diseases and cancer diseases [1]. In recent years, pistachio processing industries has been a pressing and fundamental issue due to the limited use of pistachios as a snack and growing cultivation of pistachios [2]. Regarding the pistachio processing industries and providing products with good quality and durability in addition to having more added values, the product can be consumed by large groups of people. In production of pistachios dough-like foodstuff, roasting and milling are two main stages [3, 4]. The cake is a special texture and sweetness that is made up of flour, oil, sugar and eggs, and has a huge following because of its nutrient content as a snack. Since changing raw materials to improve the quality and increase the shelf-life of the product is a powerful tool for manufacturers, therefore, many studies on the modification and alteration of compounds have been made to enhance the quality and nutritional properties of oily cakes. Adding food grade fiber to these types of products can increase their nutritional value. Recently, plants have been identified as a natural source of bioactive materials, containing antioxidants and anti-carcinogens; have received a great deal of attention [5]. There have been a lot of studies focusing on

bakery products enrichment using mango fruit fiber [6], pumpkin fiber [7], date syrup [8], spirulina platensis [9] etc. In this research, the effect of different amounts of paste and pistachio powder on the sensory, physicochemical and microbial attributes of oily cake have been assessed.

2. Materials and Methods

2.1. Preparation of oily cake

The main ingredients of the oily cake prepared in this study are presented in Table 1. Confectionary wheat flour with a moisture content of 11.2%, 0.50% ash, 9.5% protein and 32.7% wet gluten were used. The cake paste was prepared from Shahd Riz Company, Rafsanjan, and then Pistachio powder and paste were added at three levels of 0, 2.5 and 5 percent of the weight of the cake dough. About 25 grams of dough was poured inside each mold and cooked at a temperature of 340°C for 10 minutes.

Table 1- Main ingredients of the oily cake prepared in this study

Ingredient	Percentage
Wheat flour	45.0
Sugar	8.7
Whole egg	8.1
Oil	10.0
Glucose syrup	5.0
Mono- & Diglyceride	1.2
Invert Syrup	5.0
Skimmed milk powder	0.6
Baking powder	1.2
Salt	0.2
Water	15.0

Cooked oily cakes were cooled and then put in polyethylene terephthalate packages insulated to moisture and oxygen, packed by a packaging machine and stored at $20 \pm 2^\circ\text{C}$.

2.2. Measuring the cake components

The moisture content was measured using an oven at 105°C for 4 hours. The oil content was measured using n-hexane solvent and a rotary evaporator device according to National Iranian Standard No. 2553.

2.3. Colorimetry

The Minolta chroma meter (Model CR-400, Japan) was used. The results were reported as three components of $L^* a^* b^*$ [10].

2.4. Texture analysis

Food texture plays an important role in overall acceptability as it is one of the most important qualities of the product by consumers. Texture properties of pistachio cakes were measured on the first and tenth day by stiffness (Model Lutron FG5020 made in Taiwan). Cakes were cut in 4×4 cm for further tests. The stiffness of the specimens was measured with a cylindrical probe 8 mm in diameter [11].

2.5. Microbial evaluation

a sample of 10 g was mixed in 90 ml of Ringer solution and diluted to 0.1. Then the initial suspension was added to specific culture medium. Yeast Extract Glucose Cholranphenicol Agar for mold identification and counting of yeast and molds and MacConkey agar for identification and enumeration of Enterobacteriaceae was used.

2.6. Sensory evaluation:

30 untrained panelists were used to evaluate the organoleptic characteristics of pistachio cakes. 6 point Hedonic method was used for sensory evaluation of cakes. taste, color, appearance, texture and overall acceptability were assessed by the panelists [3].

2.7. Statistical analysis

SPSS software (version 22) was used to analyze the variance of data (ANOVA). The Duncan test was used to compare the means.

3. Results

3.1. Effect of treatments on pH

In all oily cake treatments, pH was significantly decreased compared to the control ($P < 0.05$). The increase in pH was more pronounced with the addition of pistachio paste compared to pistachio powder (Table 2)

3.2. Moisture.

Addition of pistachio paste and powder at all values significantly increased moisture content in oil cake ($P < 0.05$). The results showed that pistachio paste was more effective in increasing the moisture content of the oil cake compared to pistachio powder (Table 3).

3.3. Color

The highest brightness factor L^* (40.98) was determined in the oily cakes used in formulation of 5% pistachio powder. Redness was significantly decreased in all treatments compared to control ($P < 0.05$). Except for treatments containing 2.5% dough +2.5% powder and 5% paste +5% powder with b^* color factor values of 15.44 and 15.84, other

treatments showed no significant differences with the control treatment (18.35) (Table 5).

3.4. Texture

Addition of pistachio powder in all treatments increased the firmness of the texture compared to the control treatment ($P < 0.05$). Generally, in the treatments containing only pistachio paste (2.5% and 5%), the texture of the cake was softer than the control treatment (Table 4).

3.5. Microbial assessment

The number of mold, yeast and Enterobacteriaceae in different treatments as well as on day 0 and day 10 was less than 10. It indicates that there was no contamination of oil cakes containing different amounts of pistachio powder and pistachio paste.

3.6. Sensory evaluation

The results showed that in all sensory traits, the treatments were significantly different from the control ($P \leq 0.01$). The highest taste

score was for the sample containing 2.5% pistachio paste +2.5% pistachio powder (5.33 points) and the lowest score was for the sample containing 5% pistachio paste (4.27 points). The control earned 4.47 ($P < 0.05$) (Table 6).

The most favorable color for the cakes was observed in cakes containing 2.5% pistachio powder +5% pistachio paste achieving a score of 5.40. Appearance of the cake containing pistachio powder became more favorable according to the panelists evaluation. As the percentage of pistachio paste increased, the oil cake gained less point. The most favorable appearance of the oily cake was 5.57 with 2.5% pistachio paste +5% pistachio powder. Oily cakes containing 2.5% pistachio paste +5% pistachio powder had the best texture with 5.57 points ($P < 0.05$). According to panelist's evaluation, the addition of high amounts of pistachio paste and powder reduced the overall acceptability of the oily cakes.

Table 2- pH value of oily cake in different treatments and at different times after production

Treatment	Time after production	
	Day 0	Day10
C	6.74 ^{a*A**}	6.63 ^{bA}
pa2.5	6.65 ^{aB}	6.55 ^{bB}
po2.5	6.55 ^{aC}	6.45 ^{bC}
pa5	6.46 ^{aD}	6.33 ^{bD}
po5	6.43 ^{aD}	6.33 ^{bD}
pa2.5+po2.5	6.57 ^{aC}	6.46 ^{bC}
pa5+po5	6.42 ^{aD}	6.31 ^{bD}
pa5+po2.5	6.45 ^{aD}	6.35 ^{bD}
pa2.5+po5	6.45 ^{aD}	6.34 ^{bD}

*The lowercase letters in each row indicate the significant difference of the same treatments on different days ($P < 0.05$)

**The uppercase letters in each column indicate the significant difference between the different treatments at the same time ($P < 0.05$). C: control, pa: pistachio paste, po: pistachio powder

Table 3- Moisture content (%) of oily cake in different treatments and at different times after production

Treatment	Time after production	
	Day0	Day10
C	17.19 ^{a*H**}	16.17 ^{bF}
pa2.5	18.19 ^{aF}	17.17 ^{bD}
po2.5	17.68 ^{aG}	16.68 ^{bE}
pa5	18.86 ^{aC}	17.90 ^{bB}
po5	18.38 ^{aD}	17.36 ^{bC}
pa2.5+po2.5	18.19 ^{aF}	17.23 ^{bD}
pa5+po5	19.13 ^{aA}	18.09 ^{bA}
pa5+po2.5	18.97 ^{aB}	17.96 ^{bB}
pa2.5+po5	18.28 ^{aE}	17.26 ^{bD}

*The lowercase letters in each row indicate the significant difference of the same treatments on different days (P< 0.05).

**The uppercase letters in each column indicate the significant difference between the different treatments at the same time (P< 0.05). c: control, pa: pistachio paste, po: pistachio powder

Table 4- Oily cake texture (Kg/m²) in different treatments and at different times after production

Treatment	Time after production	
	Day0	Day10
C	0.213 ^{a*EF**}	0.233 ^{aCD}
pa2.5	0.137 ^{aF}	0.153 ^{aD}
po2.5	0.540 ^{aB}	0.543 ^{aB}
pa5	0.103 ^{aF}	0.120 ^{aD}
po5	0.793 ^{aA}	0.797 ^{aA}
pa2.5+po2.5	0.300 ^{aDE}	0.313 ^{aC}
pa5+po5	0.450 ^{aBC}	0.487 ^{aB}
pa5+po2.5	0.307 ^{aCDE}	0.313 ^{aC}
pa2.5+po5	0.423 ^{aBCD}	0.440 ^{aB}

*The lowercase letters in each row indicate the significant difference of the same treatments on different days (P<0.05).

**The uppercase letters in each column indicate the significant difference between the different treatments at the same time (P<0.05). c: control, pa: pistachio paste, po: pistachio powder

Table 5- L*, a* and b* color factors of oily cake in different treatments and at different times after production

Treatment	L*		a*		b*	
	Day0	Day10	Day0	Day10	Day0	Day10
C	34.40 ^{a*BCD**}	35.39 ^{aBC}	12.29 ^{aA}	12.12 ^{aA}	18.51 ^{aA}	18.19 ^{aAB}
pa2.5	39.33 ^{aAB}	39.37 ^{aAB}	7.79 ^{aC}	7.76 ^{aCD}	19.75 ^{aA}	19.75 ^{aA}
po2.5	39.58 ^{aAB}	39.23 ^{aAB}	6.87 ^{aC}	6.82 ^{aD}	19.47 ^{aA}	19.48 ^{aA}
pa5	27.66 ^{aABCD}	27.53 ^{aABC}	10.60 ^{aAB}	10.56 ^{aB}	19.75 ^{aA}	18.75 ^{aA}
po5	40.96 ^{aA}	40.99 ^{aA}	2.80 ^{aD}	2.14 ^{aE}	19.42 ^{aA}	19.40 ^{aA}
pa2.5+po2.5	32.52 ^{aD}	23.01 ^{aC}	10.27 ^{aAB}	10.44 ^{aB}	15.26 ^{aC}	15.64 ^{aC}
pa5+po5	33.57 ^{aCD}	33.63 ^{aC}	9.22 ^{aBC}	9.19 ^{aBC}	15.90 ^{aBC}	15.78 ^{aBC}
pa5+po2.5	39.25 ^{aAB}	39.38 ^{aAB}	6.86 ^{aC}	6.86 ^{aD}	18.98 ^{aA}	19.00 ^{aA}
pa2.5+po5	37.98 ^{aABC}	37.95 ^{aABC}	6.95 ^{aC}	6.98 ^{aD}	18.42 ^{aAB}	18.40 ^{aA}

*PThe lowercase letters in each row indicate the significant difference of the same treatments on different days (P<0.05).

**PThe uppercase letters in each column indicate the significant difference between the different treatments at the same time (P<0.05). c: control, pa: pistachio paste, po: pistachio powder

Table 6- Results of Tukey test for evaluation of sensory traits of different oily cake treatments

Treatment	Flavor	Color	Appearance	Texture	Overall Acceptability
C	4.47 ^{bc*}	4.47 ^{bc}	5.17 ^{ab}	4.37 ^{bcd}	4.27 ^{abc}
pa2.5	4.67 ^{abc}	5.20 ^{ab}	4.60 ^{bc}	5.10 ^{ab}	5.17 ^{abc}
po2.5	5.20 ^{ab}	5.00 ^{ab}	5.27 ^{ab}	3.90 ^{de}	5.90 ^{ab}
pa5	4.27 ^c	4.33 ^c	3.90 ^c	4.77 ^{bc}	3.77 ^c
po5	4.63 ^{abc}	4.70 ^{ab}	4.77 ^b	3.50 ^e	5.53 ^{abc}
pa2.5+po2.5	4.43 ^{bc}	4.53 ^{bc}	4.73 ^b	4.30 ^{cd}	4.53 ^{abc}
pa5+po5	4.97 ^{abc}	4.57 ^{bc}	4.63 ^{bc}	4.30 ^{cd}	3.97 ^{bc}
pa5+po2.5	5.20 ^{ab}	5.40 ^a	4.83 ^{ab}	5.03 ^{abc}	6.20 ^a
pa2.5+po5	5.33 ^a	4.80 ^{ab}	5.57 ^a	5.57 ^a	5.67 ^{abc}

*The lowercase letters in each column indicate the significant difference of the same treatments on different days (P<0.05), c: control, pa: pistachio paste, po: pistachio powder

4. Discussion

4.1. The effect of treatment on pH

pH of a product such as cake is important from the point of view of product spoilage. According to National Iranian Standard No. 2553, the pH of the cake should be in the range of 6 to 7 in order to create conditions that are perishable [10]. In the present study, pH value was 6.69 in control treatment and in all oil cake treatments, pH was significantly decreased compared to control ($P < 0.05$). It was also observed that the pH increase was higher with the addition of pistachio paste compared to pistachio powder. In examining the effect of time on pH, test results showed a significant difference in pH of samples over time. According to National Iranian Standard No. 2553, the maximum acidity of an oily cake can be 0.4 but this is not currently mandatory [12]. Shakerardekani et al. (2015) investigated the production of pistachio wafer from pistachio paste and powder. The results showed that all samples were pH-compliant [13].

4.2. The effect of treatment on moisture content

Raei et al. (2016) investigated the effect of different amounts of date palm powder on shelf life and quantitative and qualitative characteristics of sponge cake. The results showed that the reason for increasing the moisture content can be found in the moisture-absorbing properties of this compound and the competitiveness of water-absorbing compounds in its formulation [8]. According to Iran's national standard, cake moisture should be in the range of 15 to 20 percent.

The results of this study showed that the addition of pistachio paste and powder significantly increased the moisture content in the oily cake ($P < 0.05$). It is more effective because of its water absorption and hygroscopic properties of pistachio powder and paste.

4.3. The effect of treatment on color

The results of this study (Table 5) showed that there is a significant difference in the L^* , a^* and b^* color indices in different treatments ($P \leq 0.05$). L^* indicates the brightness of the sample. The highest L^* (40.98) was determined in the oily cakes formulation containing 5% pistachio powder, which could be due to the presence of pistachio nuts. The b^* factor is used to express the yellow-blue dimension (+b represents yellow and -b represents blue). The b^* values of oily cakes were positive (yellow color). Factor a^* indicates green to red color. Negative and positive values showing green and red color, respectively. Since the values of factor a^* in the samples are positive, so the color, changes in the red color spectrum. It was observed that the amount of redness was significantly decreased in all treatments compared to the control. Shakerardekani et al. (2011) reported that color attributes ('L' and 'b' values, yellowness index) of kernels and 'a' value of ground-state could be used to monitor the roasting quality of whole-kernels. Also during the roasting process the color of the kernel changes from green to red color [14]. Shakerardekani et al. (2013) reported that the color of pistachio spread depends to type of ingredients used in the formulation [15].

4.4. The effect of treatment on texture

The results of this study showed that there was a significant difference in the hardness of different treatments ($P \leq 0.05$). Addition of pistachio powder in all treatments increased the firmness of the texture compared to the control. Adding pistachio powder will increase the number of cavities in the cake and this microstructure will make these cavities uniform. This will prevent more air from expanding inside the cavities. The presence of these small cavities causes the cake structure to not be easily destroyed by the forceps applied by the tissue meter. The test results showed no significant difference in the hardness of the specimens over time ($P = 0.797$). On day zero, the stiffness was 0.363 kg and on the tenth day was 0.378 kg. Similarly, Shakerardakani et al. (2015) reported that if the percentage of pistachio powder increased in the pistachio wafer, the firmness of the product will increase [13].

4.5. Microbial evaluation

The results of the present study showed that the number of molds, yeast and Enterobacteriaceae was less than 10 cfu/g in different treatments as well as on day 0 and day 10 indicating no contamination of oily cakes containing different amounts of pistachio powder and pistachio paste [12]. Haghparast et al. (2016) reported that if the moisture content of sweet is low, the microbial contamination will be low. Also baking reduced the microbial contamination of different sweets [16].

4.6. Sensory evaluation

The results showed that in all sensory traits, the treatments had a significant difference with the control treatment. The score on taste evaluation ranged from 4.27 to 5.33. As the percentage of pistachio paste in oil cakes increased, the panelists gave less score to the most favorable color in cakes containing 2.5% pistachio powder +5% pistachio paste and scored 5.40. It was also observed that in the same amounts of pistachio powder and paste used in the formulation of the oil cake, the appearance of pistachio powder cake was more favorable to the panelists due to the effect of pistachio powder on texture and better consistency of the samples. As the percentage of pistachio paste cakes increased the cakes got less points. According to the panelist evaluation, the texture of the control cakes received a score of 4.37. Adding 5% pistachio powder reduced the texture score (3.50 points). Oily cakes containing 2.5% pistachio paste +5% pistachio powder had the best texture with 5.57 points ($P < 0.05$). In general acceptance, control cakes scored 4.27 points.

This evaluation also showed that adding high amounts of pistachio paste and powder reduced the overall acceptability of the oily cakes so that cakes containing 5% pistachio paste (3.77 points) and 5% pistachio paste +5% pistachio powder (3.97 points) gained the least points. Cakes containing 5% pistachio paste +2.5% pistachio powder with a score of 6.20 were identified as the most favorable ones due to the improvement in color and taste in general acceptability ($P < 0.05$) and these results indicate that pistachio paste treatments had lower scores in terms of sensory

characteristics, but pistachio paste treatment in combination with pistachio powder may be more desirable in general.

5. Conclusions

The results of this study showed that there was a significant difference in the hardness of different treatments as pistachio powder and paste increased. Addition of pistachio powder in all treatments increased the firmness of the cake compared to the control. Cakes containing 5% pistachio powder and 5% pistachio paste had the highest and lowest firmness, respectively. Cakes containing only pistachio paste (2.5% and 5%), the texture was

softer than the control cake. The cakes containing different amount of pistachio paste or pistachio powder showed more green color (less “a” value) than control cakes. Based on the results of the sensory evaluation, the cakes containing 5% pistachio paste +2.5% pistachio powder showed the most overall acceptability.

Conflict of Interest

The authors declare no conflict of interest.

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