

## Exploring the Possibility of Replacing Date Powder with Sugar in Pistachio Butter Formulation

Ahmad Shakerardakani (PhD)<sup>1\*</sup>, Roya Shayegh (MSc)<sup>2,3</sup>

<sup>1</sup> Pistachio Research Center, Horticultural Sciences Research Institute, Agricultural Research, Education and Extension Organization (AREEO), Rafsanjan, Iran

<sup>2</sup> Master of Science in Food Science & Technology, Department of Agriculture Kar Higher Education Institute, Rafsanjan, Iran

<sup>3</sup> Responsible for Quality Control of Mihan Food Industries Complex, Tehran, Iran

Information	Abstract
<p><b>Article Type:</b> Original Article</p>	<p><b>Introduction:</b> The delicacy, easy digestion, and nutritional value (e.g., high calories, vitamins, and minerals) are some characteristics that distinguish pistachios from other tree nuts. This research explores the replacement of the date powder of Ghasab cultivar with sugar in the formula of pistachio butter.</p> <p><b>Materials and Methods:</b> The date powder was substituted by 0, 25, 50, 75, and 100% sugar in the formulation of pistachio butter. In this field, a factorial experiment was used in a completely randomized design. Also, the time of mixing pistachio paste and sugar or date powder (3, 5, 7, and 9 h) in a ball mill was investigated. The pistachio butter formulas were stored at 20°C for 6 months. During storage, physicochemical tests (oil separation, peroxide value, and free fatty acid content) and sensory evaluation (in terms of taste, texture, and color) were carried out.</p> <p><b>Results:</b> The more the mixing time, the better the product was obtained. However, no significant difference (<math>P \leq 0.05</math>) was observed between mixing times of the raw materials (3, 5, 7, and 9 h). The free fatty acid amount and peroxide value were in the range of 0.4-0.8% and 4.7 - 4.9 mEq.kg, respectively. The pistachio butter with 100% date powder showed a lower percentage of separated oil than that with 25% date powder or without.</p> <p><b>Conclusion:</b> The final formula of pistachio butter containing 10% of the date powder of the Ghasab cultivar was selected as the best treatment.</p>
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<p><b>Corresponding Author:</b> <b>Ahmad Shakerardakani</b> <b>Email:</b> shaker@pri.ir <b>Tel:</b> +98 3434225204</p>	

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## 1. Introduction

Iran is among the most important pistachio producers in the world. Pistachio is one of the tree nuts with high nutritional value and utility. Therefore, the production of processed products from pistachio kernels increase value-added. Split pistachios are mostly used for direct consumption, while closed mouth and tiny pistachio are applied more in the food industry to produce pistachio butter, breakfast cream, halva, chocolate, and milk [1-4]. Pistachio butter is produced using pistachio paste and sugar [5, 6]. Despite all the benefits of sucrose as a natural sweetener with excellent functional properties, it is associated with some health problems, such as high blood pressure, heart disease, tooth decay, obesity, as well as increased blood glucose and insulin levels, especially in diabetes. Given its adverse health problems, besides economic and technological issues, a growing body of studies is being performed on the replacement of sugar with other sweeteners; the date is one of such alternatives.

Iran is one of the major countries in producing dates. Dates are rich in carbohydrates, dietary fibers, vitamins, and minerals, which are processed in addition to direct consumption [7]. One of such processes is using dates in the production of date paste and syrup. Producing and

marketing date processing industry products have increased dramatically in recent years. Date and its products, when used in the formulation of other products, serve as sweetening and flavoring factors, increasing the nutritional quality. Date paste can be used in a variety of products, including jams, jellies, and nutrition bars [7, 8].

Sanchez-Zapata, Fernandez-Lopez, Penaranda, Fuentes-Zaragoza, Sendra, Sayas, and Perez-Alvarez [9] have reported that during date harvesting, storing, and processing, some dates are lost, which can be turned into date paste. Using chemical and physicochemical analysis of the waste, they examine its applicability to meat products. Date paste contains high sugar (53%), especially reducing sugars (glucose and fructose), total and insoluble dietary fiber (7% and 4%), and natural antioxidants (including polyphenols, e.g., gallic acid 225 mg/100 g). The emulsion capacity of date paste is 57%, and its emulsion stability is as high as 98.6%. Adding 15% or more of date paste to Bologna sausage results in increased nutritional value (less fat and higher dietary fiber than the control sample), higher quality (redder color, less hardness, more texture coherence than the control sample), and better sensory characteristics in the product.

Majzoobi et al. (2016) have studied the effects of sucrose replacement with date syrup and date liquid sugar on the physicochemical properties of biscuits [10]. According to their results, the addition of both results in biscuits with harder texture and darker color. Sucrose replacement with less than 40% date syrup or 60% date liquid sugar results in biscuits with sensory characteristics similar to the control, as well as higher antioxidant and mineral contents.

Shinde *et al.* (2019) have reported that fortification by date paste improves bread nutrient composition, storage stability, besides physical and sensory properties [11]. Date syrup has also been used to make date milk and ice cream [12, 13]. Haneen (2019) has studied the physicochemical, microbiological, and sensory properties of yogurt prepared with date paste [14]. According to his research, the sensory properties of yogurt prepared by adding 15% date paste has the highest score. When date juice is used to make other products, its long-term storage with high soluble solids ( $^{\circ}$ Brix) is associated with the problems of crystallized sugar and microbial spoilage at low Brix [15]. It seems that these problems are reduced by replacing sucrose with date powder, mostly containing monosaccharide sugar. Therefore, in this study, different amounts of date powder of Ghasab, as one of the important Iranian date cultivars, are used

as a substitute for sugar used in pistachio butter formulation.

## 2. Materials and methods

### Sample preparation

Date powder was obtained by grinding Ghasab dates after removing kernels. Shaker Ardakani's method was used to prepare pistachio butter by grinding roasted pistachio kernels and mixing them with sugar (or date powder) [5]. The amount of sugar in pistachio butter was 10% (by weight). Each pistachio butter was prepared in 500 grams. The mixture of pistachio dough and date powder or sugar is called pistachio butter. A laboratory ball mill (3, 5, 7, and 9 h) was used to mix pistachio dough and sugar or date powder, containing 0, 25%, 50%, 75%, and 100% sugar.

The treatments were performed using a factorial experiment in a completely randomized design and three replications. Date powder was added to the mill over time to reduce the possibility of its conglomeration. The samples were then stored at  $20 \pm 2^{\circ}\text{C}$  for 6 months, and quality factors (peroxide and free fatty acids), oil extraction percentage, and sensory properties (taste, texture, and color) were measured.

### Measurement of qualitative factors

#### 1. Measurement of free fatty acids

Free fatty acids were measured using the method proposed by Wrolstad et al.

(2001) [16]. The oil sample ( $28.3 \pm 0.1$ ) was weighed in a 250 ml Erlenmeyer flask, and 50 ml of neutralized ethanol and 1 ml of phenolphthalein solution were added. The mixture was stirred and titrated with a 0.01 sodium hydroxide solution to

ensure a permanent pink color. The amount of sodium hydroxide consumed was recorded. The amount of free fatty acid was achieved by the following equation:

$$\text{FFA as \% oleic acid} = \frac{\text{ml NaOH} \times \text{NaOH normality} \times 28.2}{\text{weight of sample (g)}}$$

## 2. Determination of the peroxide value

The peroxide number was measured by the American Oil Chemists' Society (AOCS No. 8b-90). The oil sample ( $1.0\text{-}2.0 \pm 0.01$  g) was weighed in a 250 ml Erlenmeyer flask, and 30 ml of glacial acetic acid and chloroform (with a ratio of 3:2 by volume) were added. Then, 0.5 ml of saturated potassium iodide was added. The flask was placed in a dark place for one minute, and then 30 ml of the ionized water was added. The mixture was titrated with 0.01 N sodium thiosulfate solution to be yellow. Next, 0.5 ml of 1% starch solution was added, and the titration was continued until a blue color appeared. The peroxide value was calculated by the following formula:

$$\text{PV} = [(S - B) \times N \times 1000] / W$$

where S is the volume (ml) of sodium thiosulfate required to titrate the sample, B indicates the volume (ml) of sodium thiosulfate required for the blank, N is the

calculated normality of the standardized sodium thiosulfate solution, and W represents the weight of the sample (g).

## 3. Determination of the percentage of oil extracted from the product

To determine the percentage of oil extracted from the product, the method proposed by Shakerardakani et al. [3] was used. First, 100 grams of fresh pistachio butter were taken in a cup (150 g capacity). The cup was then covered with aluminum foil. It was inverted and placed on a Petri dish (weight A) containing three filter papers to absorb the oil passing through the perforations in the aluminum foil. The Petri dish with absorbed oil by filter paper was weighted to determine the amount of oil separation after 4 months of storage (weight B). Oil separation from the product was measured using the following equation:

$$\text{Oil separation (\%)} = [(B - A) / (\text{Sample weight})] \times 100$$

#### 4. Sensory evaluation of different samples of pistachio butter

Sensory evaluation was performed by 10 trained sensory panelists familiar with the taste of pistachio butter. A 15 cm scale (a 15 cm line marked at the beginning, middle, and end) was used to assess the tastes, textures, and colors of the samples.

#### 5. Statistical analysis

Factor testing was performed in a completely randomized design to prepare the samples. The analysis of variance (ANOVA) and Tukey's test were both used to compare the mean scores of the variables using the Minitab software (version 17).

### 3. Results

#### 1. Measurement of free fatty acids

The results showed that the mixing time did not significantly affect the amount of free fatty acids. Besides, as given in Table 1, the percentage of date powder did not have a significant effect on the amount of free fatty acids.

#### 2. Determination of the peroxide value

Table 1 shows the effect of the mixing time and date powder percentage in the pistachio butter formulation on the amount of peroxide:

As can be seen, the mixing time did not significantly affect the peroxide value. Further, different percentages of date powder did not have a significant effect on the peroxide value ( $P \leq 0.05$ ).

#### 3. Determination of the percentage of oil separated from the product

This study showed that the mixing time did not have a significant effect on the amount of oil extracted from the product. Further, as shown in Table 1, the date powder percentage significantly affected the amount of oil extracted from the product texture. The samples with 100% date powder showed a lower percentage of separated oil than those with 25% date powder or without.

#### 4. Sensory evaluation of different samples of pistachio butter

The research results suggested that the mixing time did not significantly affect product taste, texture, and color. Also, as presented in Table 2, the date powder percentage significantly affected product taste and texture; however, it did not have a significant effect on its color.

##### 4.1 Taste

The highest score was assigned to the samples containing 100% date powder and the lowest score to those without any date powder.

##### 4.2 Texture

The highest score was assigned to the samples containing 100% date powder, and the lowest score was related to those without date powder (especially those with a mixing time of 3 h).

##### 4.3 Color

The sensory evaluators did not show a significant difference between samples containing up to 10% of date powder and others.

**Table 1-** Effect of mixing time and date powder percentage in pistachio butter formula on the free fatty acid content

Mixing time (hr)	Date powder (%)	FFA (%)	PV (meq/kg)	Oil separation (%)
3	0	0.40 ± 0.00 a*	4.73 ± 0.60 a	7.60 ± 0.60 a
5	0	0.40 ± 0.01 a	4.80 ± 0.00 a	7.75 ± 0.65 a
7	0	0.40 ± 0.01 a	4.87 ± 0.60 a	5.60 ± 0.50 bc
9	0	0.40 ± 0.01 a	4.90 ± 0.00 a	6.15 ± 0.30 b
3	25	0.50 ± 0.01 a	4.77 ± 0.60 a	4.75 ± 0.45 cd
5	25	0.50 ± 0.01 a	4.70 ± 0.00 a	4.70 ± 0.50 cd
7	25	0.60 ± 0.02 a	4.83 ± 0.11 a	4.20 ± 0.20 de
9	25	0.60 ± 0.02 a	4.90 ± 0.00 a	4.15 ± 0.50 de
3	50	0.60 ± 0.02 a	4.87 ± 0.60 a	4.15 ± 0.30 de
5	50	0.60 ± 0.01 a	4.80 ± 0.00 a	4.10 ± 0.30 de
7	50	0.70 ± 0.02 a	4.77 ± 0.60 a	3.75 ± 0.30 def
9	50	0.70 ± 0.02 a	4.77 ± 0.60 a	3.65 ± 0.30 def
3	75	0.70 ± 0.01 a	4.70 ± 0.10 a	3.75 ± 0.30 def
5	75	0.80 ± 0.02 a	4.70 ± 0.10 a	3.80 ± 0.20 def
7	75	0.80 ± 0.02 a	4.80 ± 0.11 a	3.65 ± 0.35 def
9	75	0.80 ± 0.01 a	4.80 ± 0.10 a	3.55 ± 0.20 def
3	100	0.80 ± 0.02 a	4.90 ± 0.00 a	3.25 ± 0.25 ef
5	100	0.76 ± 0.05 a	4.80 ± 0.11 a	3.10 ± 0.20 ef
7	100	0.73 ± 0.05 a	4.83 ± 0.12 a	2.85 ± 0.25 f
9	100	0.73 ± 0.05 a	4.85 ± 0.12 a	2.75 ± 0.10 f

\*Means that do not share a letter are significantly different ( $P \leq 0.05$ )

Table 2- Effect of mixing time and date powder percentage in pistachio butter formula on product sensory properties

Date powder (%)	Mixing time (hr)	Flavor	Texture	Color
0	3	7.50 ± 0.30 K*	8.00 ± 0.20 n	12.17 ± 0.29 a
0	5	7.70 ± 0.20 k	8.20 ± 0.20 mn	12.30 ± 0.30 a
0	7	7.90 ± 0.01 k	8.50 ± 0.30 mn	12.43 ± 0.35 a
0	9	8.00 ± 0.10 k	8.70 ± 0.20 m	12.33 ± 0.29 a
25	3	9.50 ± 0.30 j	10.50 ± 0.20 l	12.47 ± 0.35 a
25	5	9.70 ± 0.20 j	10.20 ± 0.20 kl	12.40 ± 0.30 a
25	7	9.90 ± 0.00 ij	10.40 ± 0.10 jkl	12.50 ± 0.40 a
25	9	10.1 ± 0.20 hij	10.60 ± 0.00 ijkl	12.30 ± 0.30 a
50	3	10.50 ± 0.30 ghi	10.70 ± 0.20 hijk	12.13 ± 0.32 a
50	5	10.80 ± 0.10 fgh	10.90 ± 0.20 ghij	12.47 ± 0.30 a
50	7	11.00 ± 0.10 fg	11.10 ± 0.10 ghi	12.60 ± 0.30 a
50	9	11.20 ± 0.20 efg	11.30 ± 0.30 fgh	12.47 ± 0.40 a
75	3	11.50 ± 0.40 def	11.50 ± 0.40 efg	12.30 ± 0.30 a
75	5	11.80 ± 0.30 dec	11.80 ± 0.30 def	12.20 ± 0.20 a
75	7	12.00 ± 0.20 bcd	12.00 ± 0.00 cde	12.33 ± 0.42 a
75	9	12.20 ± 0.20 bcd	12.20 ± 0.20 cd	12.47 ± 0.31 a
100	3	12.50 ± 0.30 abc	12.60 ± 0.20 bc	12.50 ± 0.30 a
100	5	12.60 ± 0.20 ab	12.90 ± 0.20 ab	12.50 ± 0.40 a
100	7	12.70 ± 0.20 ab	13.10 ± 0.10 ab	12.40 ± 0.40 a
100	9	13.00 ± 0.20 a	13.30 ± 0.30 a	12.53 ± 0.35 a

\*Means that do not share a letter are significantly different ( $P \leq 0.05$ ).

## 4. Discussion

The results of the study indicated that the date powder percentage did not significantly affect the amount of free fatty acids; this amount was in the range of 0.4% to 0.8%, following the Iranian National Standard No. 5691 [17]. Therefore, all samples can be considered appropriate. As presented in Table 1, the date powder percentage did not have a significant effect on the peroxide value; this value was in the range of 4.7 to 4.9 mEq.kg. Since the standard limit is 5 [17], all samples can be considered appropriate. Shakerardakani *et al.* (2019) reported that the peroxide value decreased from 10% to 7.4% when 1% pistachio hull and 1% pistachio testa were added to the pistachio butter [18].

According to the present research results, the date powder percentage had a significant effect on the amount of oil extracted from the product. Oil separation from the pistachio butter texture without date powder (after 6-month storage) was 5.6-7.75%, according to 3-5 h mixing time. While this amount decreased to 2.75% using date powder. The samples with 100% date powder showed a lower percentage of separated oil than those with 25% date powder or without. A total of 9 samples can be considered appropriate. Shakerardakani and Shahedi (2015) reported the oil separation from pistachio halva texture as

4.3% after 4-month storage [19]. The present research results are consistent with those of Shakerardakani *et al.* (2013) concerning the oil separation from pistachio spread [3].

Based on the results, 4 samples can be selected in terms of taste and texture. As to color, samples did not differ significantly and can be considered appropriate. Ahmadnia *et al.* (2008) reported that adding date powder to toffee did not affect the sensory characterization of chocolate toffee [20].

## 5. Conclusion

In general, given quality assessments, including the peroxide value, free fatty acids, the separated oil amount, and the sensory evaluation (taste, texture, and color), the samples in which 100% sugar was replaced with Ghasab date powder can be introduced as the best. It should be noted that in these conditions, the amount of dates used in pistachio butter is 10%. Accordingly, it is recommended to use 10% of Ghasab date powder for preparing the pistachio butter formulations.

## Conflict of Interest

The authors declare no conflict of interest.

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