



ISSN 2790 – 5985  
eISSN 2790 – 5993

Agriculture College – Wasit University

Dijlah Journal of  
Agricultural Sciences

Dijlah J. Agric. Sci., 4(2):106-116, 2025

## Effect of Adding Peanut (*Arachis hypogaea* L.) Powder to Ice Cream on Its Sensory and Physical Properties

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### Abstract

In order to improve the qualitative and sensory characteristics of the ice cream product, the percentages of the main chemical components of the product were determined, which included moisture, protein, fat, carbohydrates and total solids, which amounted to 65, 5, 16, 20 and 40%, respectively. Different concentrations of pistachios (0, 10, 20, 30, 40 and 50%) were added to the main ingredients of the ice cream. Adding peanuts to ice cream at a rate of T4 (30%) showed a high rating in Color and texture and flavor were 6, 7.5 and 7.5 point respectively compared to other treatments. The viscosity of the product decreased with increasing peanuts. The best sample was the one with 30% pistachio added to it. However, in the 40% and 50% treatments, the product was very dense and resembled dough. 30% Peanut ratio: This ratio emerged as the best, balancing both physical and sensory properties effectively. In conclusion, the study highlights that a 30% Peanut addition provides the optimal balance for ice cream, maintaining desirable sensory characteristics while offering potential health benefits.

**Keywords:** Ice cream, Peanut powder, sensory properties, physical properties.

Received:22/12/2024

Accepted:13/1/2025

Published:1/8/2025

تأثير إضافة مسحوق الفول السوداني (*Arachis hypogaea* L.) إلى الآيس كريم في خصائصه الحسية والفيزيائية

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## الخلاصة

من أجل تحسين الخصائص النوعية والحسية لمنتج الأيس كريم، تم تحديد نسب المكونات الكيميائية الأساسية للمنتج، والتي شملت الرطوبة، البروتين، الدهون، الكربوهيدرات، والمواد الصلبة الكلية، حيث بلغت على التوالي 65%، 5%، 16%، 20%، و40%. تمت إضافة تراكيز مختلفة من الفول السوداني (0، 10، 20، 30، 40، و50%) إلى المكونات الأساسية للأيس كريم. وأظهرت معاملة الإضافة بنسبة 30 (T4) % من الفول السوداني تقيماً عاليًا من حيث اللون والملس والنكهة، إذ بلغت القيم 6، 7.5، و7.5 نقطة على التوالي مقارنةً بالمعاملات الأخرى. لوحظ انخفاض في لزوجة المنتج مع زيادة نسبة الفول السوداني. وقد كانت أفضل عينة هي تلك التي أضيف إليها 30% من الفول السوداني. ومع ذلك، فقد كان المنتج في المعاملتين 40% و50% كثيفًا جدًا وأشبه بالعجينة. وتعد نسبة 30% من الفول السوداني النسبة المثلى، حيث توازن بين الخصائص الفيزيائية والحسية بشكل فعال. وخلصت الدراسة إلى أن إضافة 30% من الفول السوداني توفر توازنًا مثاليًا في منتج الأيس كريم، مع الحفاظ على الصفات الحسية المرغوبة وتقديم فوائد صحية محتملة.

**الكلمات المفتاحية:** الأيس كريم، مسحوق الفول السوداني، الخصائص الحسية، الخصائص الفيزيائية.

## Introduction

Northern Iraq, known for its **Peanut** production, benefits from **Peanut** rich nutritional profile and versatile use in food products, including ice cream and sweets. These nuts are not only delicious but are also packed with nutrients, containing 45% fat, 27% carbohydrates, and 20% protein. They are an excellent source of essential vitamins and minerals like phosphorus, potassium, magnesium, calcium, iron, zinc, copper, and fiber. Furthermore, pistachios provide a variety of essential amino acids (such as tryptophan, leucine, lysine, methionine, and phenylalanine) and both essential and non-essential fatty acids. (19). Beyond their macronutrient content, **Peanut** offer significant health benefits, such as their prebiotic properties. They help increase the number of beneficial bacteria in the gut, promoting better digestive health. Additionally, the folic acid, calcium, and fiber in **Peanut** may play a role in reducing cancer risks (6).

This study aims to incorporate **Peanut** into the basic formulation of ice cream, enhancing both the nutritional value and flavor profile of the product. By doing so, it seeks to offer consumers a healthier alternative to traditional ice cream, while also providing prebiotic benefits, improving digestive health, and delivering a unique taste and aroma.

## Materials and Methods

### Ice Cream Preparation

Ice cream preparation The ice creams were prepared based on the formulation proposed by (13), with modifications. The ideal formulation was designed with 20% fat content, total solids ranging from 45%, and a yield of 30%. Increasing fat and solids in the ice cream mix is crucial for reducing the need for emulsifiers and stabilizers, improving the overall texture and consistency.(13), The first sample is made without Peanut (control), and then pistachio is added at five different levels (10%, 20%, 30%, 40%, and 50%) to replace some of the total solids in the formulation(19). This step-by-step approach allows for a systematic comparison of the sensory and physical properties of the ice cream based on varying Peanut content, assessing its impact on taste, texture, and overall quality.

## **Peanut Preparation**

The study used whole Peanut with shells, which were purchased and processed for use in the ice cream formulation. The Peanut were first separated from their shells, and the kernels (the edible part) were then ground to a fine consistency before being added to the ice cream mixture. This process ensures that the Peanut kernels are ready for incorporation, allowing their flavors, texture, and nutrients to blend seamlessly into the ice cream, enhancing both its sensory and nutritional qualities.

## **Chemical and physical analysis**

Moisture, Protein, Fat , Carbohydrate and total Solid compounds carried out to (21).

## **Sensory Evaluation**

In this study, ten evaluators of varying ages were assigned to perform sensory tests on the ice cream samples with different **Peanut** ratios. The evaluation focused on several key factors that contribute to the overall quality of the ice cream, including appearance, color, taste, and texture. To assess both sensory and physical properties, the following tests and measurements were conducted: Density (18) Viscosity (7) , Melting Resistance (12,22), yield (18), Product Appearance and Color: Sensory attributes such as the visual appeal and color consistency of the ice cream were assessed (21).

## **Statistical analysis**

The statistical analysis for the obtained data were done according to the SAS Version Statistical Analysis System (20)., Differences were considered significant at  $P \leq 0.05$ . Significant variations were determined by Duncan's multiple range test Duncan (1955).

## **Results and Discussion**

### **Chemical composition of ice cream**

Table1. shows key ratios such as moisture, fat, Protein, Carbohydrate and total solid compound, Moisture Content was 65%, It represents water in ice cream, making it the highest component. It is essential for maintaining the icy texture and distributing the other ingredients evenly. Protein content was 5%, Proteins are important for emulsion stability and contribute to good texture. This value is considered high because the milk used is whole milk. Fat content was 16%, Fat is a major source of flavor and creamy texture. This ratio is considered moderate, providing a balance between taste and nutritional value. Carbohydrate content was 20%, Carbohydrates contribute to the sweet taste, improved texture and freezing properties. This value is considered normal and important for reducing the freezing of free water. Total solid Content was 35% , Total solids include fat, protein, carbohydrates, and minerals. A high percentage indicates a rich and dense product.

Table 1. Chemical composition Content of ice cream

component	Approximate percentage %
Moisture	65
protein	5
fat	16
carbohydrates	20
Total solids	40

**The effect of adding pistachio nut on the chemical and physical properties of ice cream products**

**Table 2.** The moisture content gradually decreases when pistachios are added It ranged between (65-52%) because parts of the ice cream base that contain water are replaced by dry matter, thus reducing the moisture content. Also, increasing solids such as fat and protein leads to a reduction in the water content of the product (El-Sayed *et al*, 2020). The percentage of total protein in ice cream increases, especially at high concentrations 50% was 12% compared with Control sample was 5%, as it helps stabilize the foam and increases viscosity, which improves the structure of the product (Sofi *et al*, 2017). The table shows a significant increase in the fat content of ice cream, as the percentage increased with the increase in the concentration of field pistachio powder in the product it ranged between (16 -18.9)%, This is due to the fact that field pistachios are a plant rich in unsaturated fats, Oleic and Linolec ) it is contain approximately 50-55% fat, These results were consistent with what was found by (Guler *et al*, 2007).Carbohydrates are relatively low because fats and proteins replace part of the carbohydrates it ranged between ( 20-15)%, The carbohydrates in the final product are reduced due to the increased total weight of fat and protein. Mortazavi, 2017). Solids gradually increase with increasing pistachio concentrations, which improves the texture of the product because it reduces the ability of water to completely freeze, giving a smoother texture (Alboulfazli *et al*,2014).

Table 2. Chemical composition Content of ice cream after adding Peanut (Arachis hypogaea L.)

component	Approximate percentage %					
	T1 (%0)	T2 (%10)	T3 (%20)	T4 (%30)	T5 (%40)	T6 (%50)
Moisture	65.4 ± 1.49 A	65.05 ± 1.28 A	59.45 ± 1.28 B	57.65 ± 0.76 C	55.25 ± 1.28 D	52.24 ± 1.25 E
protein	5.4 ± 1.49 A	5.45 ± 1.28 A	6.95 ± 1.38 A	8.95 ± 0.73 B	11.25 ± 1.19 C	12.25 ± 0.96 D
fat	16.4 ± 1.42 A	16.65 ± 1.48 A	16.75 ± 1.29 A	17.65 ± 1.28 A	18.25 ± 0.78 A	19.15 ± 0.94 B
carbohydrates	20.4 ± 1.18 A	20.05 ± 1.03 A	19.85 ± 1.29 A	19.65 ± 0.84 A	16.25 ± 0.89 B	15.25 ± 1.19 C
Total solids	40.27 ± 1.09 A	40.43 ± 1.02 A	41.13 ± 0.94 A	43.61 ± 0.73 A	45.33 ± 1.07 B	46.33 ± 0.83

Different letters refer to a significant (p≤0.05) differences between treatments

### Sensory Evaluation of Ice Cream

#### Taste and Flavor

Table 3 and Figure 1. appeared the Sensory evaluation of the studied samples showed that the sample with 30% pistachio added gave the best evaluation for taste and flavor compared to the other samples. The analysis of variance further highlighted that increasing the peanut content in the ice cream formulation enhanced the intensity of the peanut flavor. Adding pistachios to ice cream enhances the flavor and texture and gives a distinctive taste to the final product, whether added in ground form or whole pieces (4).

Table 3. Sensory evaluation of Ice Cream different concentration of pistachios

Sensory Attributes	Treatments (Mean, S.D.)					
	T1 (%0)	T2 (%10)	T3 (%20)	T4 (%30)	T5 (%40)	T6 (%50)
Appearance and color	5.04 ± 0.11 A	5.22 ± 0.08 A	5.22 ± 0.11 A	5.36 ± 0.11 B	4.28 ± 0.08 C	3.32 ± 0.08 D
Texture	5.12 ± 0.08 A	5.24 ± 0.08 A	7.54 ± 0.08 B	5.86 ± 0.08 C	4.84 ± 0.08 D	5.72 ± 0.99 E
Test and flavor	5.25 ± 0.93 A	4.25 ± 0.93 A	6.05 ± 0.93 A	7.75 ± 0.93 B	6.15 ± 0.93 C	4.35 ± 0.91 A
Total points	15.35 ± 0.93 A	14.55 ± 0.91 A	17.15 ± 0.73 B	21.25 ± 0.93 C	16.25 ± 0.93 A	12.35 ± 0.93 D

Different letters refer to a significant (p≤0.05) differences between treatments

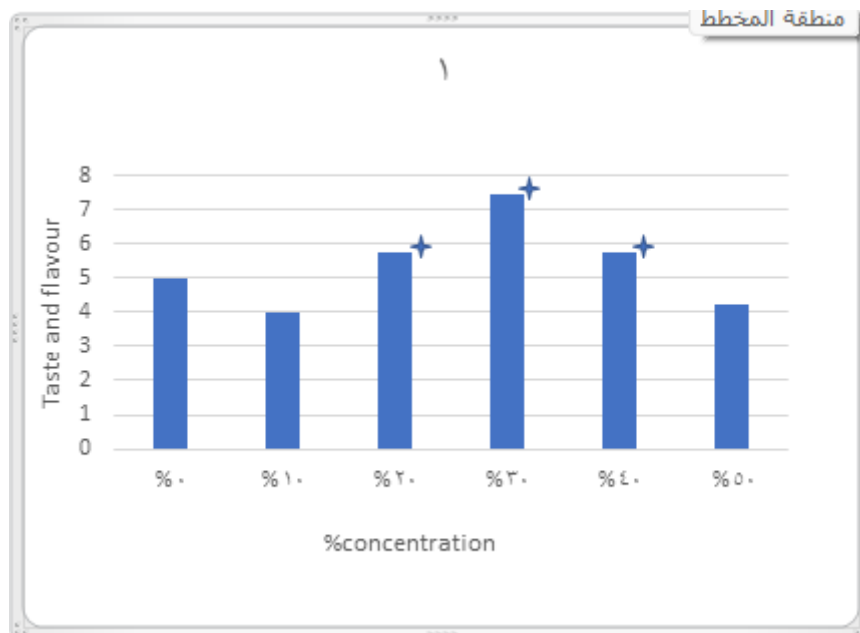


Figure 1. Ice cream sensory Evaluation at different concentration of pistachios

#### Appearance and Color

Table 3. and Figure (2) showed the statistical analysis of the treatments related to the appearance and color of the ice cream samples revealed that there were no significant differences between the control sample (without peanut) and the samples containing peanut up to the 30%

level. This indicates that the addition of peanut up to this point did not significantly affect the visual appeal or color of the ice cream. However, as the peanut content increased beyond 30%, the color of the ice cream became slightly darker. This change in color was more pronounced in the 50% peanut treatment, which also corresponded to a decrease in overall acceptance. The darker color at higher peanut levels might have affected consumer perception and acceptance, potentially making the ice cream less visually appealing.

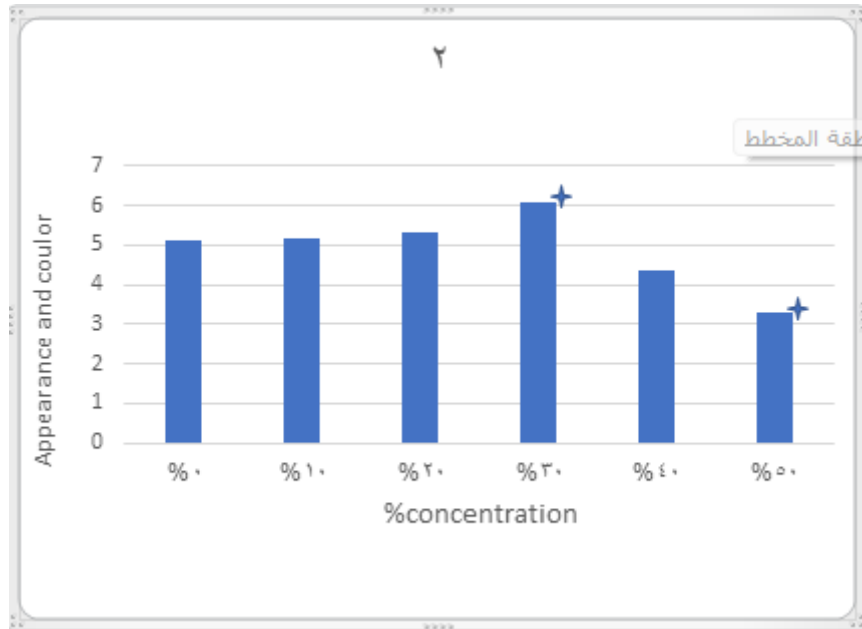


Figure 2. Ice cream Appearance and color at different concentration of pistachios

### Texture

Table 3. and figure 3. Appears The statistical analysis of the texture of the ice cream samples revealed a significant difference between the control sample and the samples with 30% peanut. As shown in Figure (3), the best consistency and overall texture quality were associated with the 30% peanut level. This suggests that the moderate addition of peanut enhances the texture of the ice cream, making it more desirable in terms of smoothness and creaminess. The analysis further indicates that peanut had no significant effect on the texture of the ice cream at lower levels (up to 30%). However, when peanut was added at this moderate level (30%), it resulted in greater acceptance and an improvement in texture, likely due to the balance it created in the formulation, On the other hand, at the highest 50% peanut level, the texture quality was somewhat reduced. This could be due to the high peanut content affecting the structural integrity of the ice cream, leading to a less desirable texture compared to the more moderate peanut levels.

(10)

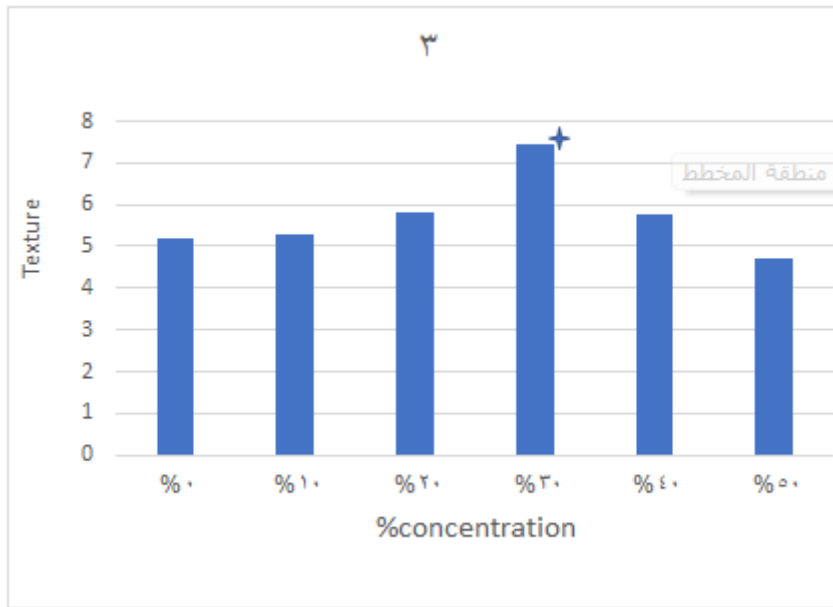


Figure 3. The ice cream Texture at different concentration of pistachios

### Physical Properties of Ice Cream

#### Viscosity

Statistical analysis of the viscosity-related treatments showed a significant difference among the test samples at levels above 10%. As illustrated in table 4. and Figure (4), the viscosity of the mixture decreases with the increase in peanut (after the aging phase). There is no significant difference between the control sample and the sample with 10% peanut. However, at higher levels, there is a significant difference due to various factors, including the type of liquid, its chemical composition, temperature, concentration, molecular weight, and the type and amount of suspended materials—all of which affect the viscosity of fluids (12). Additionally, the amount of solid fat in the mixture has a direct relationship with the viscosity of the emulsions (14). Other researchers have reached similar conclusions, noting that when using vegetable oils to make ice cream, viscosity decreased compared to ice cream made from milk fat, due to the differences in the size of fat globules (10).

Table 4. Physical Properties of Ice-cream at different concentration of pistachios

Physical Properties	treatments					
	T1 (%0)	T2 (%10)	T3 (%20)	T4 (%30)	T5 (%40)	T6 (%50)
Viscosity	6.61 ± 1.2 A	5.71 ± 1.3 A	5.86 ± 1.5 A	5.35 ± 1.4 A	3.83 ± 1.3 B	3.25 ± 1.7 C
Melting Resistance %	95.01 ± 1.24 A	93.36 ± 1.33 A	93.06 ± 1.57 A	89.25 ± 1.45 A	87.53 ± 1.35 B	86.75 ± 1.37 C
Density g/cm <sup>3</sup>	1.068 ± 1.42 A	1.072 ± 1.48 A	1.078 ± 1.2 A	1.082 ± 1.28 A	1.088 ± 1.33 A	1.13 ± 1.29 B
Yield %	49 ± 3 A	45 ± 2 A	39 ± 4 B	34 ± 3 C	31 ± 2 D	29 ± 5 E

Different letters refer to a significant ( $p \leq 0.05$ ) differences between treatments

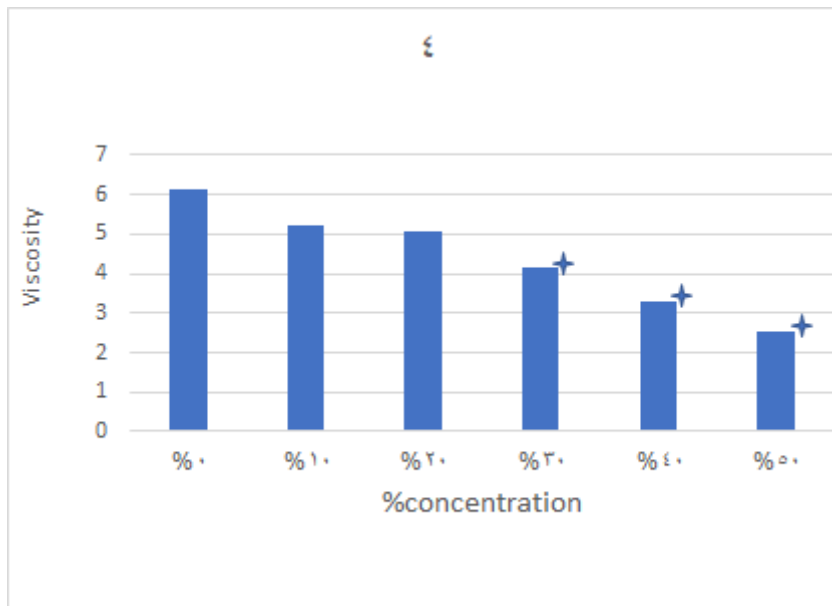


Figure (4) The ice cream Viscosity at different concentration of pistachios

**Melting Resistance**

Statistical analysis of the treatments related to this property, as shown in table 3. And Figure( 5) , indicates that there is no significant difference in melting resistance among the test samples up to the 30% level. The best solubility percentage is between 40 and 60% at room temperature was in T4, T5 and T6 were 88, 88.6 and 86 % respectively. One of the most important physical properties is the slow melting of good ice cream (8) . As the addition of peanut increases, the melting resistance decreases, which can be attributed to the increase in unsaturated fats in the ice cream formulation. Other researchers have found similar results, indicating that ice cream with a high percentage of unsaturated fatty acids in its composition had a lower melting point. Consequently, with the reduction in melting resistance, the overall melting rate is higher(15) .

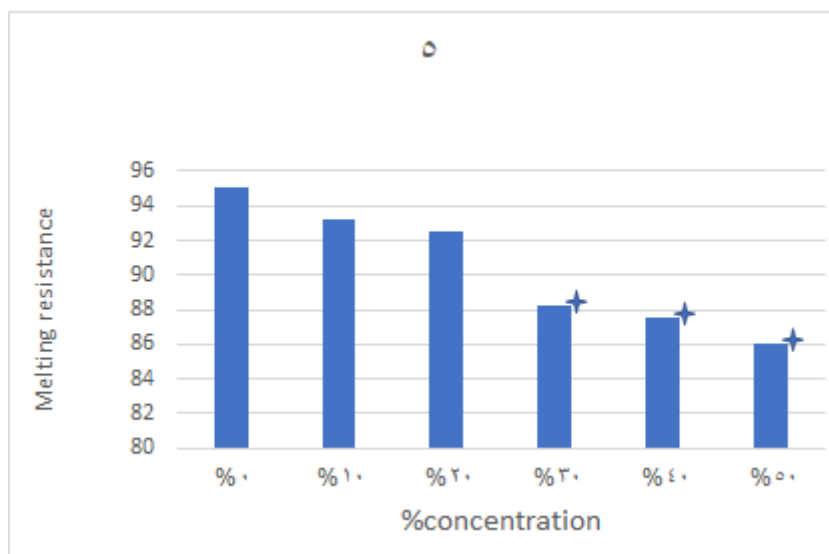


Figure 5. The ice cream Melting resistance at different concentration of pistachios

## Density

As shown in table 4. And Figure (6), the statistical analysis of the treatments related to this property reveals no significant differences between the samples at 0%, 10%, 20%, and 30% in terms of density. This indicates that even at the 30% addition level, there was no substantial change in density. However, at the 40% and 50% addition levels, a significant effect on the final product's density was observed. It is clear that the density is high at the 40% and 50% concentrations, where the mixture has a paste-like consistency due to the presence of very weak air cells. As a result, with the increase in addition, the volume of the ice cream decreases (yield decreases), leading to an increase in density(9).

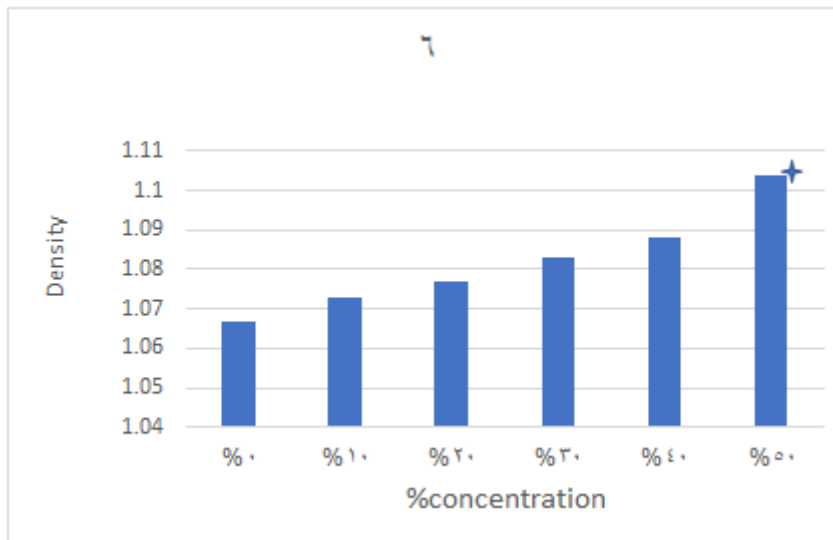


Figure 6. Ice cream Denisty at different concentration of pistachios

## Yield

As shown in table 4. And Figure (7), The data indicates that as the amount of peanut in the formulation increases, the yield decreases. The control sample, which had 16% fat, 20% sucrose, and 40% total solids, was able to achieve a yield between 25% and 50% (15). This yield range is typical for standard ice cream formulations. Yield is directly affected by the viscosity of the ice cream mixture. As the viscosity increases, the yield tends to improve because a thicker mixture is less prone to air loss during the freezing process (2).

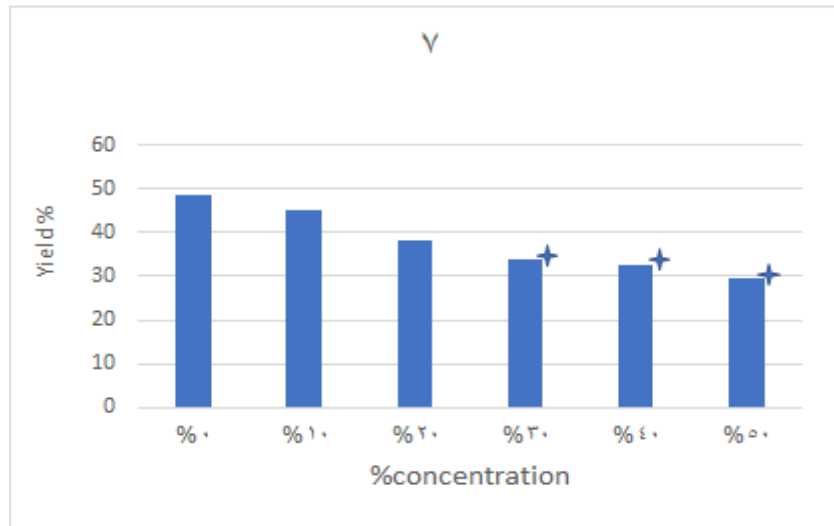


Figure 7. Ice cream Yield% at different concentration pistachios

### Conclusion

Adding pistachios to ice cream at different levels significantly improves the chemical and physical properties of the final product, as it leads to an increase in protein, fat, and total solids, and also improves the functional properties of ice cream, such as texture, density, and smoothness. It can be concluded that adding pistachios at a rate of 30% represents an ideal choice for improving the nutritional value and physical properties without negatively affecting the sensory perception of the product.

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