KSÜ Mühendislik Bilimleri Dergisi, 28(1), 2025
Araştırma Makalesi

KSU J Eng Sci, 28(1), 2025
Research Article

Kahramanmaras Sutcu Imam University
Journal of Engineering Sciences

Geliş Tarihi : 01.10.2024
Kabul Tarihi :23.10.2024

Received Date : 01.10.2024
Accepted Date : 23.10.2024

THE EFFECT OF PEANUT TAHINI UTILIZATION ON THE MINERAL CONTENT OF HALVA

YER FISTIĞI TAHİNİ KULLANIMININ HELVANIN MİNERAL İÇERİĞİ ÜZERİNE ETKİSİ

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ABSTRACT

Halva is a traditional Turkish dessert with origins in the Seljuk and Ottoman periods. Made from tahini, sugar, soapwort extract, and various additives, it is widely consumed in the Middle East and Mediterranean, particularly in Turkiye. Often enjoyed for breakfast and special occasions, tahini halva can be enriched with ingredients like cocoa, pistachios, and hazelnuts. This study produced halva using different ratios of peanut tahini (50% and 100%), with sesame tahini as the control and analyzed the mineral content of the samples. The halvas were prepared by mixing tahini with other components and kneading until the desired consistency was achieved. Mineral content was analyzed using atomic absorption spectrometry to measure macro-minerals (Ca, K, Na, Mg, P) and micro-minerals (Fe, Zn, Mn). Results indicated that halva made with sesame tahini had higher levels of calcium, sodium, magnesium, phosphor, and zinc. In contrast, halva made with peanut tahini contained higher levels of potassium, iron, and manganese. Thus, the study concluded that the ratio of peanut tahini significantly affects the mineral content of halva.

Keywords: Halva, sesame, peanut, tahini, mineral content

ÖZET

Helva, Selçuklu ve Osmanlı dönemlerine dayanan geleneksel bir Türk tatlısıdır. Tahin, şeker, çöven otu ekstresi ve çeşitli katkı maddelerinden yapılır ve özellikle Türkiye'de Orta Doğu ve Akdeniz ülkelerinde yaygın olarak tüketilmektedir. Genellikle kahvaltılarda ve özel günlerde tercih edilen tahin helvası, kakao, fıstık ve fındık gibi malzemelerle zenginleştirilebilir. Bu çalışmada, %50 ve %100 oranlarında yer fıstığı tahini kullanılarak helva üretilmiş, kontrol olarak susam tahini kullanılmış ve örneklerin mineral içeriği analiz edilmiştir. Helvalar, tahini diğer bileşenlerle karıştırarak ve istenen kıvama gelene kadar yoğurarak hazırlanmıştır. Mineral içeriği, makro mineraller (Ca, K, Na, Mg, P) ve mikro mineraller (Fe, Zn, Mn) ölçmek için atomik absorpsiyon spektrometresi kullanılarak analiz edilmiştir. Sonuçlar, susam tahini ile yapılan helvanın daha yüksek kalsiyum, sodyum, magnezyum, fosfor ve çinko seviyelerine sahip olduğunu göstermiştir. Buna karşılık, yer fıstığı tahini ile yapılan helvanın daha yüksek potasyum, demir ve manganez seviyeleri içerdiği belirlenmiştir. Böylece, çalışmada yer fıstığı tahininin oranının helvanın mineral içeriğini önemli ölçüde etkilediği sonucuna varmıştır.

Anahtar Kelimeler: Helva, susam, yer fıstığı, tahin, mineral içeriği

ToCite: KARAKUŞ, V., & YAŞAR, K., (2025). YER FISTIĞI KULLANIMININ HELVANIN MİNERAL İÇERİĞİ ÜZERİNE ETKİSİ. *Kahramanmaraş Sütçü İmam Üniversitesi Mühendislik Bilimleri Dergisi*, 28(1), 285-291.

INTRODUCTION

Desserts hold a significant place in Turkish cuisine, which is a continuation of Seljuk and Ottoman culinary traditions, and various types of halva are prominent among these desserts. Today, numerous varieties of halva are produced both locally and on an industrial scale in many regions of Turkey (Badem, 2020). Tahini halva, one of the renowned traditional desserts of Turkish cuisine, is made by combining tahini (sesame paste) with sugar, water, citric acid, tartaric acid, an emulsifier, and soapwort (Saponaria officinalis) extract. Tahini halva and similar products are widely produced and consumed in Middle Eastern, Mediterranean, and Balkan countries (Öğütcü et al., 2017). Halva, which is generally consumed for breakfast, can have its flavors enhanced by adding sweeteners such as cocoa, pistachio, almond, and hazelnut, depending on consumer preferences (Var et al., 2007).

Sesame (Sesamum indicum L.), belonging to the Pedaliaceae family, is acknowledged as one of the four primary oilseed crops in China and is among the oldest oil crops cultivated for human consumption. Traces of sesame have been discovered in ancient settlements in Pakistan, and today it is widely cultivated in countries such as India, China, Malaysia, Sudan, Myanmar, and Tanzania. In recent years, sesame production has surged, particularly in Africa, with Tanzania surpassing India to become the leading global producer (Wei et al., 2022). Tahini, also known as tehina or tahina, is produced by roasting and grinding sesame seeds. It serves as a vital component in numerous food products, particularly bakery items, confections, and traditional dishes. For instance, tahini is the primary component of halva in the Middle East, Saudi Arabia, and Türkiye, where it is mixed with sweeteners to create spreadable desserts (Lokumcu et al., 2005; Torlak et al., 2013). Sesame seeds considered nutritionally valuable are used in numerous food products such as tahini, halva, hummus, crackers, cakes, cookies, donuts, chips, and margarine due to their high oil and protein content (Bakal, 2022).

Peanuts (Arachis hypogaea L.) rank among the most cultivated legumes worldwide cultivated agricultural crops globally, valued for their high nutritional content and distinct flavor. China leads global peanut production, contributing 37.9% of the world's supply, followed by major producers such as India, Nigeria, the USA, and Sudan. Türkiye is the largest producer of peanuts among European countries, and more than 80% of peanut cultivation is carried out in the provinces of Adana and Osmaniye (Sahin et al., 2022).

Peanuts are rich in essential nutrients and bioactive compounds, including proteins, lipids, carbohydrates, vitamins, minerals, stilbenoids, flavonoids, phenolic acids, phytosterols, triterpenes, and alkaloids. Among these, resveratrol is particularly notable for its extensive biological activities, which include anticancer effects, cardiovascular protection, anti-inflammatory properties, antibacterial effects, and its role in regulating intestinal microbiota (Mingrou et al., 2022). Peanuts are utilized across various industries, including oil production, peanut butter, confectionery, roasted peanuts, and snacks, making them the fourth most significant oilseed crop globally. Peanut protein is highly regarded for its nutritional value, offering a balanced amino acid profile that closely resembles animal proteins, making it a valuable source of plant-based nutrition (Boukid, 2022). Moreover, peanut shells which contain 47% fiber are increasingly recognized for their functional food potential due to their significant antioxidant and antimicrobial properties (Toomer, 2020).

Minerals are essential micronutrients that play key roles in maintaining bone structure, regulating muscle and nerve functions, and balancing fluids. They also act as cofactors for enzymes and hormones. Additionally, minerals support the immune system, influencing both innate and adaptive immune responses. Adequate mineral intake is crucial for infection resistance and reducing the risk of chronic diseases (Weyh et al., 2022).

Sesame production in Türkiye is limited and heavily reliant on imports, resulting in increased costs for sesame-based products like halva. Conversely, peanuts are primarily consumed as a snack and contain more protein than sesame, which is available at a lower price. Taking these factors into account, peanuts seem to be a viable alternative to sesame in food production.

In this study, halva was produced using sesame tahini, peanut tahini, and a blend of the two tahini types in equal proportions. The mineral content of the halva samples was analyzed to assess the nutritional impact of using different tahini varieties.

MATERIALS AND METHODS

Halva Production

The control sesame tahini halva was produced following the method described by Karakahya (2006). Initially, wax was prepared for halva production. %45 crystalline sugar powder, water, and %0.01 citric acid was added to the tahini boiler and heated. Once the mixture was cooked, %0.28 Saponaria officinalis extract was introduced to bleach the sugar syrup, and the mixture was heated to 150°C. %53 tahini was then added to the halva kneading bowl, followed by the wax, %0.01 vanillin, and %1.7 emulsifier. The mixture was initially stirred using a wooden paddle and then hand-kneaded until the desired consistency was achieved. The halva was subsequently packaged into 1000 g plastic containers.

Peanut tahini used in this study was commercially sourced from a company in Osmaniye. Two formulations were prepared for the study: 100% peanut tahini and a 50% peanut tahini + 50% sesame tahini blend. These were processed similarly to the control sesame tahini halva. Each halva type was produced in two replicates.

Mineral Content Analysis of Halva

Sample preparation for mineral content analysis was done according to the protocol established by Chapman and Pratt (1961). For mineral analysis, halva samples were subjected to dry ashing in a muffle furnace. Specifically, 0.5 g of halva samples were placed in 50 ml porcelain crucibles and incinerated at 550°C for 5 hours. Once cooled, the ash was dissolved in 5 ml of 2 N HCl solution. The resulting solution was then diluted with purified water to a final volume of 50 ml and filtered using Whatman No. 42 filter paper.

Macro minerals (Ca, K, Na, Mg, and P) and micro minerals (Fe, Zn, and Mn) were analyzed using atomic absorption spectrometry (Agilent 240 FS, UK). The concentrations of these elements were reported in mg/kg (Kıvrık et al., 2022).

Statistical Analysis

One-way analysis of variance was applied to all data belonging to halva samples. Significant differences among groups were assessed using Duncan's multiple comparison test. For this purpose, the SPSS 20.0 Statistical package program was used.

RESULTS AND DISCUSSION

Mineral Content of Halvas

Calcium (Ca) is an essential mineral for human health, comprising approximately 1.5-2.2% of total body weight. Most Ca is stored in bones as calcium phosphate, providing structural strength. In soft tissues, extracellular fluid, and blood, calcium exists in its ionic form, maintaining a delicate balance with the calcium in bones (Lin et al., 2024).

The macro mineral content of the halva samples is presented in Table 1. According to the results, Ca content of the halva ranged from 527 mg/kg to 940 mg/kg. The highest Ca concentration was found in the halva made with 100% sesame tahini (X), while the lowest Ca content was observed in the halva made with 100% peanut tahini (Z). The type of tahini used in halva production had a statistically significant effect on its ca content ($p<0.01$).

In a study on conventional and organic sesame tahini production, Kaplan (2022) reported that the Ca content of sesame tahini ranged between 2030 and 2847 ppm. The Ca levels identified in this study were lower than those reported by Kaplan (2022). This discrepancy was likely due to the addition of ingredients such as sugar, citric acid, and emulsifiers in halva production, which could have diluted the Ca concentration derived from tahini.

Potassium (K) is an essential mineral in human nutrition, playing a critical role in regulating blood pressure. Many studies have shown an inverse relationship between K intake and blood pressure, showing that potassium-rich diets contribute to cardiovascular health, independent of their effects on blood pressure (D'Elia et al., 2023).

Table 1. Macro Mineral Content of Halvas (mg/kg)

Halvas	Ca	K	Na	Mg	P
X	940$^{a≠}$±21.21	1525$^{c≠}$±49.50	985$^{a≠}$±35.36	1052$^{a≠}$±53.39	1505$^{a≠}$±50.21
Y	690^{b}±35.36	2327^{b}±45.86	725^{b}±63.66	890^{b}±11.14	1100^{b}±13.12
Z	527^{c}±3.55	2952^{a}±38.89	270^{c}±14.15	747^{c}±16.17	725^{c}±11.02

X: halva made with 100% sesame tahini, Y: halva made with 50% sesame tahini and 50% groundnut tahini, Z: halva made with 100% groundnut tahini. ≠: Means with different letters in the same column are statistically different from each other (p<0.05).

K content in the halva samples varied significantly depending on the type of tahini used, with values ranging from 1525 mg/kg in halva made with 100% sesame tahini (X) to 2952 mg/kg in halva made with 100% peanut tahini (Z) (Table 1). The difference in K content was statistically significant (p<0.01), indicating that the type of tahini plays a crucial role in determining the K levels in halva.

In a study by Oduma et al. (2020), peanut paste was produced by adding varying amounts of sesame, and it was found that increasing the proportion of sesame led to a decrease in K content. This finding aligned with the results of the current study, which showed that halva made with peanut tahini had greater K levels compared to halva made with sesame tahini.

Akbulut (2008) reported that the K content of tahini produced using different methods ranged from 4096 mg/kg to 6846 mg/kg. The K levels observed in this study were lower than those reported by Akbulut. This discrepancy may be attributed to the inclusion of other ingredients in halva production, such as sugar and emulsifiers, or variations in production methods.

Sodium (Na) plays a crucial role in maintaining fluid balance and regulating blood pressure in the human body. However, excessive Na intake is associated with an increased risk of health conditions such as cardiovascular disease, kidney disorders, hypertension, and certain cancers (Vidal et al., 2023).

Na content in the halva samples ranged from 270 mg/kg to 985 mg/kg. The highest Na content was detected in halva made with 100% sesame tahini (X), while the lowest was found in halva made with 100% peanut tahini (Z) (Table 1). The type of tahini used in halva production had a statistically significant impact on its N content (p<0.01).

In a study focused on sesame tahini, Akbulut (2008) reported Na levels ranging from 605 mg/kg to 2436 mg/kg. These values are significantly higher than those found in the present study. Additionally, a survey of Na content in 15 varieties of sesame tahini halva sold in the provinces of Balıkesir, Bilecik, Bursa, and Çanakkale revealed sodium levels between 1200 mg/kg and 3500 mg/kg (Kilci and Çetin, 2023). The Na values observed in this study are lower than these reported results.

Magnesium (Mg) is the fourth most abundant cation in the human body and is an essential electrolyte vital for maintaining cellular and organ function. It also plays a significant role in neuronal development and the functioning of the central nervous system by crossing the blood-brain barrier (Chen et al., 2024).

The type of tahini used in halva production was found to significantly affect the Mg content (p<0.05). The highest Mg concentration was observed in halva made with 100% sesame tahini (X), while the lowest was found in halva made with 100% peanut tahini (Z) (Table 1). Akbulut (2008) reported Mg levels in sesame tahini ranging from 2040 mg/kg to 2482 mg/kg, and the Mg values obtained in this study were lower than those reported by Akbulut (2008).

Phosphorus (P) is a vital element in the human body, essential for various processes such as ATP production, signal transduction, and bone mineralization. Around 85% of the body's phosphorus is found in bones and teeth as part of hydroxyapatite, while 14% is located inside cells, and only 1% exists in extracellular fluids, mainly as inorganic phosphate. P often occurs as a salt of phosphoric acid, serving as a crucial physiological buffer. It is also a key component of molecules like phospholipids, DNA, RNA, ATP, and creatine phosphate (Serna and Bergwitz, 2020).

P content in the halva samples ranged from 725 mg/kg to 1505 mg/kg. The highest P concentration was found in halva made with 100% sesame tahini (X), while the lowest P content was observed in halva made with 100% peanut tahini (Z) (Table 1). The type of tahini used significantly influenced the P levels ($p<0.01$).

Iron (Fe) is an essential nutrient vital for numerous biological functions, including oxygen transport and cellular respiration. The adult body contains approximately 3-5 g of Fe, with about 70% found in hemoglobin. The daily requirement for Fe, primarily for erythropoiesis, is estimated at 25-30 mg, largely fulfilled by recycling iron from aged red blood cells via tissue macrophages (Charlebois and Pantopoulos, 2023).

The concentrations of trace minerals in halva produced with different tahini blends are shown in Table 2. The Fe content of the halva samples varied between 30.91 mg/kg and 42.85 mg/kg. The highest Fe concentration was recorded in halva made with 100% peanut tahini (Z), whereas the lowest was found in halva made with 100% sesame tahini (X). The type of tahini used had a statistically significant effect on the Fe content of halva ($p<0.01$).

Table 2. Minor Mineral Content of Halvas (mg/kg)

Halvas	**Fe**	**Zn**	**Mn**
X	$30.91^{c\neq}\pm0.71$	$28.46^{a\neq}\pm0.56$	$3.26^{c\neq}\pm0.07$
Y	$34.15^{b}\pm0.49$	$23.18^{b}\pm0.30$	$4.86^{b}\pm0.05$
Z	$42.15^{a}\pm0.50$	$19.38^{c}\pm0.06$	$5.97^{a}\pm0.42$

X: halva made with 100% sesame tahini, Y: halva made with 50% sesame tahini and 50% groundnut tahini, Z: halva made with 100% groundnut tahini. ≠: Means with different letters in the same column are statistically different from each other ($p<0.05$).

In a study conducted by Kilci and Çetin (2023), the Fe content of halva made with sesame tahini was reported to range from 14.27 mg/kg to 22.33 mg/kg. Fe levels identified in the current study were significantly higher than those reported by Kilci and Çetin (2023). This discrepancy is likely attributable to the differing ingredient ratios utilized in the production processes.

Zinc (Zn) plays a vital role in regulating numerous physiological functions in the human body, acting as an activator of enzymes, a structural component of zinc-dependent proteins, and a contributor to protein anabolism, growth, and development (Duan et al., 2023).

In this study, the Zn content of halva samples ranged from 19.36 mg/kg in halva made with 100% peanut tahini (Z) to 28.46 mg/kg in halva made with 100% sesame tahini (X) (Table 2). The type of tahini used had a statistically significant impact on the Zn content of halva ($p<0.05$). A study by Oduma et al. (2020) found that varying ratios of sesame added to peanut butter resulted in increased Zn levels, which aligns with the findings of the present study.

Manganese (Mn) is essential for various metabolic processes, including glucose and lipid metabolism, protein synthesis, and the functioning of vitamins C and B. It also plays a role in haematopoiesis, endocrine regulation, bone and tissue formation, skeletal growth, reproduction, and immune function (Mehri, 2020).

The type of tahini used in halva production significantly influenced the Mn content ($p<0.01$). The highest Mn concentration was found in halva made with 100% peanut tahini (Z), while the lowest was recorded in halva made with 100% sesame tahini (X) (Table 2). Arifoglu et al. (2017) reported Mn levels in summer tahini halva ranging from 0.099 to 0.124 mg/kg. The Mn values observed in this study were lower than those reported by Arifoglu et al (2017). This difference is likely attributed to variations in raw materials and production methods.

CONCLUSIONS

This study investigated the production of halva using varying ratios of peanut tahini (50% and 100%) alongside 100% sesame tahini as a control. The mineral content of the resulting halva samples was analyzed, revealing the presence of seven key minerals: calcium, potassium, sodium, magnesium, phosphorus, iron, zinc, and manganese.

The findings demonstrated that the incorporation of peanut tahini significantly influenced the mineral composition of halva ($p<0.05$). Specifically, halva produced with sesame tahini exhibited higher levels of Ca, Na, Mg, P, and Zn. In contrast, halva made with peanut tahini showed elevated levels of K, Fe, and Mn.

Based on these results, the use of peanut tahini at a 50% ratio is recommended as a viable approach to enhance the mineral content of halva. Future research could explore additional ingredient combinations and production techniques to further optimize the nutritional profile of this traditional dessert. Additionally, consumer acceptability and sensory evaluations of halva made with varying tahini ratios should be investigated to ensure market viability.

ACKNOWLEDGEMENT

This article is derived from Venüs KARAKUŞ's master's thesis. This study was supported by the Osmaniye Korkut Ata University Scientific Research Project Fund (OKÜBAP-2021-PT3-020).

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