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Determination of Chemical and Microbiological Quality in Commercial Tahini Samples[#]

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ABSTRACT

Tahini is a food product that is frequently preferred both directly and as a main ingredient in various ready-to-eat food products and is consumed with interest, especially in the Middle East geography. Its reputation has recently spread across continents to countries like Canada and the United States of America. Tahini was subjected to a number of analyses to ascertain its physicochemical and microbiological quality within the context of the study since it is a highly consumed product with high consumption and demand values. In this context, tahini samples of 10 different brands were collected from producers and commercially sold markets in Balikesir and Bursa. Samples were taken from two different lot numbers for each company. As a result of the analyzes made on the tahini samples, it was determined that the total oil amount of the samples changed between 49.76-58.7%, the salt amount changed between 0.001-0.0027%, the ash amount was between 1.02%-1.28%, and the moisture value was between 1.1-1.5%; as a result of microbiological cultivations in which the presence of yeast and mold were analyzed, an average of 75 CFU/g viability was determined, while *Escherichia coli*, which was screened as an indicator of fecal contamination, *Staphylococcus aureus* and *Salmonella spp*, which are pathogenic microorganisms, were not found to be contaminated in all tahini samples. One of the tahini samples was not found in accordance with the Turkish Food Codex Tahini Communiqué (TFC) in terms of the amount of oil. It is concluded that 90% of the samples were manufactured in line with the TFC when the results of the chemical and microbiological analyses were combined.

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Introduction

Tahini, one of the essential flavors of Turkish cuisine, is made from sesame as its primary ingredient. In our country, sesame is primarily grown in Antalya, Mugla, Manisa, Balikesir, Izmir, Aydin, Bursa, and Denizli. "White sesame" grown in Turkey is the best sesame in the world (Karakahya, 2006).

Tahini can be briefly expressed as a semi-fluid, viscous, and nutritionally rich product obtained by removing and grinding sesame seeds after roasting. To ease the separation of their shells, organic and inorganic elements in sesame (*Sesamum indicum L.*) are sieved or maintained in salt brine, washed, and then soaked. The dusty taste that may come from the brine is removed by washing. Afterwards, it is roasted in the oven at 100-150ºC, cooled, and ground in mills for easy grinding and tahini's unique smell. This oily mixture, which is ground and paste-like, is called tahini (Yazıcıoğlu, 1953; Uluöz et al., 1975).

According to Turkish Food Codex Tahini Communiqué (2015/27), tahini is the product obtained by crushing sesame (*Sesamum indicum L.*) seeds suitable for tahini production after being separated from their shells in accordance with the technique, dried and roasted in the oven (TGK, 2015a). Tahini is essentially a suspension of sesame oil and hydrophilic solids dispersed in this oil (Lindner and Kinsella, 1991). The main stages in the production of tahini can be summarized;

- Cleaning,
- Peeling,
- Shell separation,
- Roasting,
- Grinding (Yazıcıoğlu, 1945).

Tahini, which consists directly of grinding (mashing) the peeled and roasted sesame seeds, is widely consumed in Turkey by mixing it with sugar, honey, or molasses. In addition, it can be used in regional cuisines as a salad, muffin, fish, dessert sauce, or as a direct addition to some types of bread and buns. Most of the tahini is used in the production of tahini halva (Batu and Elyıldırım, 2009).

There are various studies on the production and composition of tahini (Sawaya et al., 1985; Örenli, 1976, Özcan and Akgül, 1993). The chemical composition of tahini according to the Turkish Food Codex Tahini Communiqué (2015/27) is summarized in Table-1.

Tahini includes B vitamins, 28% high-quality protein, and 54% fat. Tahini is regarded as a valuable food because of this at least when compared with milk and meat (Karakahya, 2006). Tahini is a food that is abundant in tryptophan and sulphurous amino acids like methionine and cysteine, which are uncommon in many foods. For this reason, it is a good alternative that can be used to increase the nutritional value of legumes that are weak in terms of sulphurous amino acids. 100 g of tahini can meet 7.6% of calcium, 86.5% of phosphorus, more than 100% of magnesium, 52.1% of zinc, 72% of iron, 65-98% of copper, 29-58% of manganese, which an adult human should take in a day (Lokumcu, 2000).

Table 1. Chemical Properties of Tahini (TFC, 2015a)

Components	Mass Percent
Sesame Oil (least, %)	50
Moisture (most, %)	1.5
Protein (least, %)	20
Ash (most, %)	3.2
Acidity (as oleic acid) (most, %)	2.4

Bitterness: Kreis Test result should be negative, no bitterness

Tahini is a critical food product for producers since it could be contaminated by microorganisms as a result of poor hygienic conditions during the grinding of sesame, packaging, and transportation of the final product (Lake et al., 2010). During the growing, storing, and processing stages of production, sesame seeds are susceptible to contamination with foodborne pathogens (Torlak et al., 2013). *Salmonella spp.* cannot grow in tahini due to the low water activity value of the sesame used in its manufacturing before roasting. It can ensure pathogenic microorganisms' survival, particularly (Zhang et al., 2017). In addition, if a microbial contamination occurs due to insufficient hygienic conditions in the production area after the roasting process, which can be considered as a heat treatment application, food pathogens such as *Staphylococcus aureus, Salmonella spp* can still survive in the final product, tahini (Brockmann et al., 2004). According to reports, due to *Salmonella spp* contamination many tahini products was recalled from stores in 2015 (Osaili and Al-Nabulsi, 2016). It has been reported that coliform bacteria were detected in 79% of tahini samples collected from tahini producing enterprises in Jordan and *Staphylococcus aureus* was detected in 100% (Yamani and Isa, 2006). In a study conducted in Lebanon, it was stated that *Escherichia coli* was isolated from 17% of tahini samples (Karam, 2010). Therefore, *E. coli*, which is the most commonly screened indicator of fecal contamination in the production area, and *Salmonella spp.* and *Staphylococcus auresus* are among the important microbial quality indicators for tahini, and limit values for related microorganisms are specified in the Turkish Food Codex.

In consideration of this information, this study was carried out to determine the chemical and microbiological quality of 10 different tahini samples collected from retail markets and producers in Balikesir and Bursa. Tahini samples were taken from 10 different companies and from two different lot numbers for each company. Analyzes were carried out in triplicate and in two replications. The reasons for choosing the provinces of Balikesir and Bursa for the research can be summarized as; the high geographical importance of cities in terms of their locations, representing a transition corridor between Europe and Asia, and diversity in terms of both corporate businesses and small family businesses and sales points.

Materials and Methods

Material

The tahini samples used in the study consist of totally 20 samples, belonging to 10 different companies from the producers and commercially sold markets in Balikesir and Bursa. Each company's products were collected with two different lot numbers. All samples were picked up in their original packaging, delivered to the laboratory at 4-6ºC and kept at 4-6ºC until the analyzes were performed. Each analysis was carried out in duplicate and three copies.

Methods

Chemical Analysis

Determination of Oil Amount: After extraction using the soxhalet technique, the oil content of the tahini samples was calculated gravimetrically. Tahini sample weighing 10 g was put into the Soxhalet cartridge for analysis. Sand was also put to the cartridge and mixed with the sample to homogenize it and make the extraction process more efficient. After the extraction procedure, which lasted for roughly 6 hours, the leftover petroleum ether in the Soxhalet balloon was removed, and the cartridge was held at 100°C until it attained constant weight. (Cemeroğlu, 2007).

Determination of Salt Amount: Total salt amount in tahini samples was determined by Mohr method. Tahini sample weighing 10 g was titrated with a solution of silver nitrate for the analysis, whose normality was predetermined using a potassium chromate indicator (Chen et al., 2005).

Determination of Ash Amount: The total amount of ash in the tahini was obtained by dividing the mass of the remaining part after the test sample was burned at a temperature of 550 (±25)°C by the mass of the test sample. The results were calculated as a percentage (%) (Anonymous, 1988).

Determination of Moisture Amount: The vacuum oven method, which is used to analyze moisture in sweet solid food products, was used to analyze moisture in tahini samples. The results were calculated as a percentage (%) (AOAC, 2000).

Microbiological Analysis

Enumeration Results of Escherichia coli: In the analysis made according to Kornacki (2001), Violet Red Bile Agar medium was used and the petri dishes were incubated for 1 day at 44ºC.

Enumeration Results of Coagulase Positive Staphylococci (Staphylococcus aureus and Other Staphylococci Types): In the analysis performed according to Shimamura et al., (2006), Mannitol Salt Agar medium was used and the petri dishes were incubated for 2 days at 37ºC.

Enumeration Results of Salmonella spp. In the analysis performed according to US-FDA BAM (2008), Salmonella-Shigella Agar medium was used and the petri dishes were incubated for 1 day at 37ºC.

Enumeration Results of Mold and Yeast: Potato Dextrose Agar medium was used in the analysis according to Beuchat and Cousin (2001) and the petri dishes were incubated for 5 days at 25ºC.

Results and Discussion

Chemical Analysis Results of Tahini Samples

The chemical analysis results of a total of 20 tahini samples belonging to 10 different companies and 2 different batch samples of these companies are summarized in Table-2. The samples of one brand included in the tahini samples have been found to not be comply with the Turkish Food Codex in terms of the amount of oil they contain when compared to the limit values of the pertinent analyses in the Turkish Food Codex.

The percentage of oil found in the tahini samples was found to range from 49.76% at the lowest to 58.7% at the maximum, according to the table. The Turkish Food Codex Tahini Communiqué (2015/27) states that tahini must contain at least 52% oil. The oil content value of the tahini samples belonging to one particular company has been found to be just a little under the limit value outlined in the Codex. It is believed that the product of the sample in question should not have been released onto the market for this reason. When a literature search is made on the results of the analysis; Sawaya et al., (1985) stated in their study that they measured an average of 58.9% oil in tahini samples. In a study by Özcan and Akgül (1993), in which the chemical properties of different tahini samples were examined, it was stated that the oil contents of the samples varied between 46.9-58.7%. The data obtained in the literature review and the results we found in our study are compatible.

The salt level of the 20 tahini samples that were analyzed was found to range from 0.001% for the lowest to 0.0027% for the highest. The Turkish Food Codex Tahini Communiqué (2015/27) states that 0.004% of salt is the maximum that should be present in tahini. It can be shown that the tahini samples' salt content value is within the limit ranges outlined in the Codex. There weren't many studies on the estimation of salt content when the studies on tahini in the literature were investigated. In a study conducted in 1993, it was stated that the salt content of tahini was analyzed and the results were 0.38% on average, and it can be stated that it is in a similar scope to our study (Özcan and Akgül, 1993).

The ash concentration of the tahini samples was found to range between 1.02% and 1.28%, according to the table. Tahini must have a maximum of 3% ash, according to the Turkish Food Codex Tahini Communiqué (2015/27). From this point of view, it is possible to conclude that the tahini samples fit within the Codex's permitted ranges for ash content. According to research done by Lindner and Kinsella in 1991, the average ash content value of the tahini samples analyzed was 2.65%. Sawaya et al., (1985) stated that they measured an average of 3% ash in tahini samples in their study, and it can be stated that the relevant studies contain results similar to our study.

The results were measured in accordance with the limit value stated for tahini in the Turkish Food Codex, with the moisture content determined as the lowest 1.1% and highest 1.5% among the 20 tahini samples analyzed. When Sawaya et al. (1991) conducted their literature analysis, they discovered that Özcan and Akgül (1993) had found similar moisture values in tahini samples (0.7%; 0.86%).

Microbiological Analysis Results of Tahini Samples

The microbiological analysis results of a total of 20 tahini samples belonging to 10 different companies and 2 different batch samples of these companies are summarized in Table-3. Tahini samples are determined to be in accordance with the TFC in terms of microbiological quality when compared to the limit values of the relevant analyses in the Turkish Food Codex.

Coliform bacteria in general and *Escherichia coli* in particular are signs of fecal contamination. It is preferred that the coliform group bacteria or *E. coli*, which is the most common fecal contamination indicator, be either absent or not exceed a certain limit because it is an indication of direct or indirect fecal contamination from the stage of raw material procurement to any stage where the final product is transported (Engün et al., 2005). In the tahini samples analyzed as part of our study, *E. coli* was not found.

Many healthy people carry the potentially harmful microbe *Staphylococcus aureus* in their nose, throat, or skin. It can lead to numerous outbreaks of foodborne illness (Bremer et al., 2004). According to the US Food and Drug Administration (FDA, 1992), populations of *S. aureus* exceed 10^5 cells per gram of food being examined before staphylococcal enterotoxins are effective in producing foodborne illness. The tahini samples examined as part of our study's analysis did not contain any *S. aureus*.

Table 2. Chemical Analysis Results of Tahini Samples

Parameter	Least	Most	Average	Turkish Food Codex Criteria
Oil Content (%)	49.76	58.7	56.8	≥ 52
Salt Content (%)	0.001	0.0027	0.0012	≤ 0.04
Ash Content (%)	1.02	1.28	1.14	≤ 3
Moisture Content (%)	1.1	1.5	1.2	≤ 2

Table 3. Microbiological Analysis Results of Tahini Samples

Analysis	Result (CFU/g)	Turkish Food Codex Criteria (CFU/g)
E. coli Count	0.00	0.00
Staphylococcus aureus Count	0.00	0.00
Salmonella spp Count	0.00	0.00
Mold and Yeast Count	75	≤ 100 CFU/g

Salmonella spp is one of the most important pathogenic genera that plays a role in foodborne bacterial outbreaks, and it is known that various *Salmonella* species have been detected in different foods in the past years and have caused poisoning cases (De Jong et al., 2001). A *Salmonella typhimurium* phage contaminated with tahini halva was demonstrated to create an epidemic in Sweden in 2001, which resulted in 27 cases (Andersson et al., 2001). In the tahini samples we gathered for our research *Salmonella spp.* were not detected.

Mold and yeast are simple food contaminants that can be brought on by environmental toxins found in the air, water, soil, and dust. The contamination of the raw materials and inadequate hygienic conditions in the production and storage facilities can be attributed to the discovery of yeast and/or mold in food samples. Among the most important reasons why mold and/or yeast contamination in foods are undesirable are mycotoxins, which are toxic metabolites produced by molds, posing a potential threat to consumer health, and the potential of yeast-mold metabolites to trigger allergic reactions in general and cause dangerous situations for consumer health (Jarvis et al., 1983). Although it can have harmful effects, yeast-mold contamination is supposed to be tolerable in small doses for tahini. It should be underlined that although yeast-mold development was seen in the samples analyzed for the study, the results obtained were not above the standards and values.

Conclusion

In this study, in which some chemical and microbiological quality criteria of a total of 20 tahini samples belonging to 10 different companies and 2 different batch samples of these companies were tried to be determined, percentage oil, salt, ash, and moisture values of tahini samples were determined. As a result of chemical analysis, it has been determined that the oil content value of a tahini sample belonging to a company is not suitable according to the Turkish Food Codex Tahini Communiqué (2015/27). In order to determine the microbiological quality, analyzes were made on the samples for *Escherichia coli, Staphylococcus aureus Salmonella spp*, yeast and mold. As a result of microbiological analysis, *E. coli, Staphylococcus aureus,* and *Salmonella spp* were not detected in the samples, and the number of yeast and molds was found 75 CFU/g on average and within the permissible limits. As a result, in order to ensure the quality criteria in tahini production, it is important to determine the characteristics of the raw materials and components used, as well as to make controls specific to each batch and to determine the product properties. According to the analysis results, the production processes should be reviewed and improvements should be made in the problematic processes

References

Akbulut S, Kuleaşan H. 2022. Konserve hindi sosis üretiminde ısıl işlem ve depolama süresinin bazı kalite özellikleri üzerindeki etkisi. Gıda, *47*(2), 157-168.

Al-Tahiri R. 2005. A comparison on microbial conditions between traditional dairy products sold in Karak and same products produced by modern dairies. Pakistan Journal of Nutrition, Vol. 4, pp. 345-8.

Andersson Y, De Jong B, Hellstro¨m L, Stamer U, Wollin R, Giesecke J. 2001. *Salmonella typhimurium* outbreak in Sweden from contaminated jars of helva (or halva). Eurosurveillance Weekly, Vol. 5, 1 July.

Anonim, 1988. Gıda Maddeleri Muayene ve Analiz Metotları. T.C. Tarım Orman ve Köyişleri Bakanlığı Koruma ve Kontrol Genel Müdürlüğü Bursa.

AOAC, 2000. Offical Methods of Analysis of AOAC International. Volume I, Volume 2, 17th Edition.

Batu A, Elyıldırım F. 2009. Geleneksel helva üretim teknolojisi. Gıda Teknolojileri Elektronik Dergisi, *4*(3), 32-43.

Beuchat LR, Cousin MA. 2001. Yeasts and molds. Compendium of methods for the microbiological examination of foods, *4*, 209-215.

Bremer PJ, Fletcher GC, Osborne C. 2004. *Staphylococcus aureus*. New Zealand Instit.

Brockmann, S. O., Piechotowski, I., & Kimmig, P. (2004). *Salmonella* in sesame seed products. *Journal of Food Protection*, *67*(1), 178-180.

Cemeroğlu B. 2007. Gıda analizleri. Gıda Teknolojisi Derneği Yayınları, 34, 168-171.

Chen MJ, Hsieh YT, Weng YM, Chiou, RYY. 2005. Flame photometric determination of salinity in processed foods. Food chemistry, 91(4), 765-770.

Jarvis B, Seiler DAL, Ould AJ, Williams AP. 1983. Observations on the enumeration of moulds in food and feedingstuffs. Journal of Applied Bacteriology, *55*(2), 325-336.

Karakahya E. 2006. Tahin helvası üretiminde farklı bitkisel yağ ve soya proteini kullanımının kalite özellikleri üzerine etkisi. Master's thesis, Trakya Üniversitesi Fen Bilimleri Enstitüsü.

Karam, L. A. (2010). *The determination and validation of microbial criteria for tahini and halawi products-by Laura Antoine Karam* (Doctoral dissertation).

Kornacki JL. 2001. Enterobacteriaceae, coliforms and *Escherichia coli* as quality and safety indicators. Compendium of methods for the microbiological examination of foods, 69-82.

Lindner P, Kinsella JE. 1991. Study of the hydration process in tehina. Food chemistry, 42(3), 301-319.

Lokumcu F. 2000. *Tahinin reolojik karakterizasyonu*. Doctoral dissertation, İstanbul Teknik Üniversitesi Fen Bilimleri Enstitüsü.

Osaili, T. M., & Al-Nabulsi, A. (2016). Inactivation of stressed *Escherichia coli* O157: H7 in tahini (sesame seeds paste) by gamma irradiation. *Food Control*, *69*, 221-226.

Özcan M, Akgül A. 1993. Tahinde Fiziksel-Kimyasal Analizler ve Yağ Asitleri Bileşiminin Belirlenmesi. Gıda, 19(6).

Saway, WN, Ayaz M, Khalil JK, Al-Shalhat AF. 1985. Chemical composition and nutritional quality of tehineh (sesame butter). Food chemistry, 18(1), 35-45.

Şengün IY, Hancioglu O, Karapinar M. 2005. Microbiological profile of helva sold at retail markets in İzmir city and the survival of *Staphylococcus aureus* in this product. Food Control, 16(10), 840-844.

Shimamura Y, Kidokoro S, Murata M. 2006. Survey and properties of *Staphylococcus aureus* isolated from Japanese-style desserts. Bioscience, biotechnology, and biochemistry, 0606070009-0606070009.

TGK, 2015a.Türk Gıda Kodeksi Tahin Tebliği (Tebliğ No 2015/27), Resmi Gazete 13 Haziran 2015, Sayı 29385, 2015.

TGK, 2015b.Türk Gıda Kodeksi Tahin Helvası Tebliği (Tebliğ No 2015/28), Resmi Gazete 13 Haziran 2015, Sayı 29385, 2015.

Torlak E, Sert D, Serin P. 2013. Fate of *Salmonella* during sesame seeds roasting and storage of tahini. *International Journal of Food Microbiology*, *163*(2-3), 214-217.

U.S. Food and Drug Administration April 2003. *Salmonella*, chap. 5. *In* Bacteriological analytical manual online. Available at: http:// www.cfsan.fda.gov/;comm/bam-5.html. Accessed 16 June 2003.

Uluöz M, Yiğit V, Gözlü S. 1975. Tahin Helvasında Yağın Stabilitesinin Arttırılması Üzerinde Araştırmalar. TÜBİTAK Marmara Bilimsel ve Endüstriyel Araştırma Enstitüsü, Beslenme ve Gıda Teknolojisi Bölümü Yay. No:9, Gebze-Kocaeli.

Yamani MI, Isa JK. 2006. Microbiological quality of tehena and development of a generic HACCP plan for its production. *World Journal of Agricultural Sciences*, *2*(3), 290-297.

Yazıcıoğlu T. 1953. Tahin Helvası Yapılışı ve Terkibi. Ankara Üniv. Ziraat Fak. Yıllığı 1-2:109-116.

Zhang, Y., Keller, S. E., & Grasso-Kelley, E. M. (2017). Fate of *Salmonella* throughout production and refrigerated storage of tahini. *Journal of food protection*, *80*(6), 940-946.