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Effect of Fruit Juice Addition on Bioactive and Sensory Properties of Tahini Halva

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Abstract

In this study, sensory properties, total phenolic contents, total flavonoid contents, antioxidant activities and phenolic components of tahini halva prepared with the addition of orange juice and lemon juice in a halva enterprise in Akşehir district of Konya were investigated. The highest total phenolic content was found in the sample containing lemon juice (120.17 mg/100 g). The highest value in total flavonoid content was observed in the sample prepared with the addition of lemon juice (19.00 mg/100 g). Antioxidant activity of halva increased slightly with the addition of fruit juice. While the gallic acid and cinnamic acid contents of the samples decreased with the addition of fruit juice, it was determined that the 3,4-dihydroxybenzoic acid and catechin components increased with the addition of orange juice. When the fatty acid compositions were examined, while the oleic acid content decreased slightly with the addition of fruit juice (38.03-37.65%), no significant difference was found in the linoleic acid content (46.30-46.70%). Considering the general impression in this study, tahini halva with added fruit juice received high scores and was presented as an innovative taste.

Key Words: *Halva, Fruit juice, Phenolic compounds, Sensory properties*

Introduction

Halva (halva, halaweh, havah), one of the oldest and traditional flavors, is very famous in the Middle East and North African countries. Halva production is in the range of 35.000-40.000 tons per year in our country. It is a traditional Turkish dessert that is usually consumed at breakfast (Birer, 1985). Tahini (tehinah, tehena, tehineh), the raw material of halva, is mainly composed of 57-65% oil (oleic and linoleic acid), 23-27% protein (rich in methionine, cystine and tryptophan) and some minerals (calcium, phosphorus, potassium, magnesium) (Abu-Jdayil et al., 2002; Yamani and Isa, 2006). The lean fraction of sesame oil contains sesamol, sesamolin and sesamin compounds that are not found in other oils. These compounds retain their properties after hydrogenation (Nas, 1998). Sesame oil shows a significant antioxidant activity according to the amount of tocopherol in its composition. Sesamol, sesamolin and sesamin, which are natural antioxidant compounds, also affect the stability of the oil (Altuğ, 2001). Sesame oil is obtained by pressing, cleaning and roasting sesame seeds. Sesame oil can be stored for a longer period of time than other vegetable oils, and the quality of sesame oil is affected from roasting time and temperature (Özcan, 1993). Generally, it is mixed with tahini, sugar, citric acid, tartaric acid and Radix saponariae albae sive L. (soup) root extract to prepare halva. The prepared mixture can be cooked together with flavoring agents such as cocoa, pistachio, vanilla, bergamot, natural essences and milk powder (Var et al., 2007). Tahini halva has a shelf life of approximately two years from the date of production, thanks to its low moisture content (3.0%). Changes during production, storage, distribution and usage (depending on humidity and temperature conditions) can cause condensation problems. This may cause the growth of microorganisms (Sengun et al., 2005). In addition, improper usage and poor production processes can affect the hygienic and chemical quality of halva.

In this study, the effects of the addition of orange juice and lemon juice on the sensory properties, total phenolic, total flavonoid contents, antioxidant activities phenolic components and fatty acid composition of tahini halva were investigated.

Materials and Methods

Material

Tahini halvah is prepared in a halva business in Akşehir district of Konya. Sugar (500 g) and orange juice/lemon juice (200 ml) mixture were boiled at 145 oC. Soapwort water (12 ml) was added into the sugar syrup (malt). At the end of the mixing, the syrup (malt) turned white, softened and sponge-like with the effect of soapwort water. The bleached mesh cooled to 70-80 oC was poured on the tahini in a separate bowl at a ratio of 1:1 and shoveling was performed. The tahini and wax taken into the kneading boiler were shoveled homogeneously. The shoveling process ended when the wax completely absorbed the tahini. After kneading, the halva was molded and left to cool.

Methods

Moisture content

The moisture content of the tahini halva sample was determined by Kern Dbs 60-3 moisture analyzer (AOAC, 2000).

Extraction process

For extraction, 30 ml of MeOH:H2O was added to 5 g of tahini halva. It was kept in an ultrasonic water bath for 30 min. Afterwards, the samples were centrifuged for 10 minutes.

Total flavonoid content

The method used to determine the total flavonoid content of tahini halva extract was adapted from the aluminum chloride method. 0.3 ml of NaNO2, 0.3 ml of AlCl3 and 2 ml of NaOH were added to 1 ml of the extract, respectively. Absorbance values were read in the spectrophotometer at 510 nm. Results are given as mg quercetin (QE)/100 g (Hogan et al., 2009).

Total phenolic content

To determine the total phenolic content of tahini halva samples, the Folin-Ciocalteu method was used (Yoo et al., 2004). 2.5 ml of Folin-Ciocalteu reagent was added to 0.5 ml of extract and then 2 ml of Na2CO3 (7.5%) was added. At the last stage of the analysis, the samples were kept in the dark at room temperature for 2 hours. It was measured at a wavelength of 725 nm with a spectrophotometer (Shimadzu.Japan). Results are given as mg gallic acid equivalent (GAE)/100 g.

Antioxidant activity

In order to determine the antioxidant activity of the tahini halva samples, 2 ml of DPPH solution was added to the extract. The mixture was vortexed and left to stand in the dark at room temperature for 30 min. Absorbance was measured at 517 nm using a spectrophotometer (Lee et al., 1998). Results are given in mmol (TE)/kg.

Determination of phenolic compounds

The phenolic components of the extracts were carried out using HPLC (Shimadzu) equipped with a PDA detector and an Inertsil ODS-3 (5 µm; 4.6 mm × 250 mm) column. 0.05% acetic acid (A) and acetonitrile (B) in water were used as mobile phase at 30°C at a flow rate of 1 ml/min. The injection volume is 20 µL.

Oil content

The dried and ground tahini halva samples were placed in a Soxhlet apparatus. The extraction was performed using petroleum ether at 50°C for 5 hours. Petroleum ether was removed in the evaporator at 50°C. The crude oil content (%) was calculated gravimetrically.

Fatty acid composition

Fatty acid methyl esters of oils esterified according to the ISO 5509 method with some modifications. Gas chromatography (Shimadzu GC-2010, Kyoto, Japan) equipped with a flame ionization detector (FID) and a capillary column (Tecnocroma TR-CN100, 60 m × 0.25 mm, film thickness: 0.20 µm).

Sensorial properties

Hedonic test was applied to determine the sensory parameters of the tahini halva samples prepared with the addition of orange juice and lemon juice. Eight trained panelists were used to identify sensory characteristics. Each panelist evaluated the characteristics of the samples separately by giving the following scores (1 = very bad, 2 = bad, 3 = fair, 4 = good, 5 = very good).

Results and Discussion

Physicochemical Properties of Halva

Moisture contents, L*, a*, b* values and oil contents of halva containing fruit juice are given in Table 1. The highest moisture content was found in tahini halva (1.97%) obtained with the addition of lemon juice. When the oil contents of the samples were examined, it was observed that plain halva, which was the control sample, had the highest oil content (30.2%). In the study of Çetintaş (2022), the highest and the lowest oil contents of cheese halva were found as 20.83% and 19.32%, respectively. It was reported by Ünal (2011) that the oil content of lactitol-added cheese halva samples varied between 11.3-11.5%, and increasing lactitol rates had no effect on the oil amount.

While a* and b* values of halva samples were lower in the control sample, they increased with the addition of orange or lemon juice. On the other hand, L* value decreased with the addition of fruit juice. Pazir et al. (2013), the "L" (light-dark), "a" (redness) and "b" (yellowness) values of the samples were examined. Although there was a statistical difference ($P<0.05$) in the L values of the control and experimental samples, there was no statistical difference in the a and b values ($P>0.05$).). It was stated that this difference in L values was due to the white color of the maltodextrin in the structure of the gypsum extract powder (Radix saponariae Albae sive L.) used in the samples.

Table 1. Physicochemical properties of halva

Samples	Moisture Content (%)			*L**			*a**			*b**			Oil Content (%)		
Control	1.44	±	0.16	83.07	±	1.71	0.14	±	0.04	22.18	±	0.48	30.2	±	1.84
Containing orange juice	1.63	±	0.50	66.82	±	0.65	3.61	±	0.28	33.77	±	4.43	26.15	±	0.07
Containing lemon juice	1.97	±	0.02	64.96	±	0.09	5.98	±	0.17	34.24	±	0.24	25.95	±	0.78

Bioactive Properties of Halva

Total flavonoid contents, total phenolic contents and antioxidant activities of tahini halva samples are given in Table 2. The highest total flavonoid content was observed in the tahini halvah sample made with the addition of lemon juice (19.99 mg/100 g), while the lowest total flavonoid content was obtained from the control sample (3.57 mg/100 g). The highest total phenolic content was determined in the sample with added lemon juice (120.17 mg/100 g). The lowest total phenolic content was found in the control sample (38.50 mg/100 g). In a study by Çetintaş (2022), the highest total phenolic content was found to be 0.50 mg GAE/g, while the lowest total phenolic content was found to be 0.27 mg GAE/g. While the total phenolic content of halva was found to be high (215.8 mg GAE 100 g-1) after tahini processing, a decrease was detected after six months of storage at 25 °C (156.41 mg GAE 100 g-1) (Rababah et al., 2020). A slight increase in antioxidant activity results was observed with the addition of fruit juice. The highest antioxidant activity was determined in the halva sample with orange juice (0.47 mmol/kg). In a study, it was reported that storage time and temperature caused a decrease in the antioxidant activity of tahini halva. After processing in tahini halva, it was observed that the total phenolics and antioxidant activity content decreased by 38.5% and 16%, respectively (Rababah et al., 2020).

Table 2. Bioactive properties of halva

Samples	Total Flavonoid Content (mg QE/100g)			Total Phenolic Content (mg GAE/100g)			Antioxidant activity (mmol/kg)		
Control	3.57	±	1.31	38.50	±	5.08	0.41	±	0.00
Containing orange juice	4.71	±	0.86	48.50	±	1.24	0.47	±	0.00
Containing lemon juice	19.00	±	2.16	120.17	±	1.86	0.44	±	0.00

Phenolic Components of Tahini Halva

Table 3 shows the phenolic compounds of tahini halva prepared with the addition of orange juice and lemon juice. Major phenolics of the samples were gallic acid (84.64-104.32 mg/100 g), cinnamic acid (4.07-17.50 mg/100 g), catechin (0.92-15.47 mg/100 g), and 3,4-dihydroxybenzoic acid (4.11-6.45 mg/100 g). The addition of fruit juice caused a decrease in the gallic acid and cinnamic acid contents of halva. While the 3,4-dihydroxybenzoic acid and catechin contents of halva samples increased with the addition of orange juice, the addition of lemon juice led to a decrease.

Table 3. Phenolic Compounds of tahini halva

Phenolic compounds (mg/100 g)	Control			Containing orange juice			Containing lemon juice		
Gallic acid	104.32	±	1.27	84.64	±	7.27	99.08	±	0.00
3,4-Dihydroxybenzoic acid	4.57	±	0.05	6.45	±	2.73	4.11	±	0.09
Catechin	0.92	±	0.47	15.47	±	0.19	2.02	±	0.29
Caffeic acid	0.07	±	0.03	0.12	±	0.05	0.17	±	0.01
Syringic acid	0.10	±	0.01	0.18	±	0.05	0.14	±	0.02
Rutin	0.35	±	0.11	0.47	±	0.15	0.60	±	0.34
p-Coumaric acid	0.03	±	0.00	0.04	±	0.02	0.05	±	0.02
Ferulic acid	0.07	±	0.03	0.10	±	0.04	0.07	±	0.02
Resveratrol	0.12	±	0.01	0.20	±	0.04	0.15	±	0.02
Quercetin	0.79	±	0.18	0.84	±	0.18	0.69	±	0.39
Cinnamic acid	17.50	±	1.26	16.84	±	1.47	4.07	±	3.10
Kaempferol	0.09	±	0.03	0.24	±	0.09	1.46	±	0.77

Fatty Acid Composition of Halva

In Table 4, while the value of oleic acid decreased slightly with the addition of fruit juice (38.03-37.65%), no significant change was found in the amount of linoleic acid (46.30-46.70%). It was determined that the addition of fruit juice did not cause a significant change in other fatty acid contents. In a study by Özcan (1993), sesame oil samples contained 9.10-11.38% palmitic, trace-0.15% stearic, 31.61-57.19% oleic, 30.79%-57.33% linoleic, 0.30-0.79% linolenic and trace-2.62% arachidic acid. In tahini oil, these values were determined as 9.55-10.32% palmitic, % trace stearic, 37.42-45.04% oleic, 43.25-52.34% linoleic, 0.34-1.93% linolenic and trace-0.82%

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arachidic acid. Yazıcıoğlu and Karaali (1983) reported that native sesame oil contains 10.44% palmitic, 6.29% stearic, 36.31% oleic and 45.69% linoleic acid.

Table 4. Fatty acid composition of halva

Fatty acids (%)	Control			Containing orange juice			Containing lemon juice		
Palmitic	9.08	±	0.20	9.40	±	0.19	9.13	±	0.08
Stearic	5.45	±	0.02	5.41	±	0.04	5.38	±	0.01
Oleic	38.03	±	0.12	37.57	±	0.06	37.65	±	0.01
Linoleic	46.30	±	0.06	46.56	±	0.05	46.70	±	0.06
Arachidic	0.58	±	0.02	0.54	±	0.03	0.55	±	0.00
Linolenic	0.43	±	0.02	0.41	±	0.01	0.41	±	0.00
Behenic	0.13	±	0.01	0.11	±	0.01	0.12	±	0.00
Erucic	ND*			ND			0.06	±	0.01

*ND: Not dedected

Sensory Properties of Halva Samples

Hedonic test was performed to determine the sensory parameters of tahini halva. The results are given in Table 5. The control sample, tahini halvah obtained with the addition of orange juice and lemon juice, was scored between 1 and 5. In the taste criterion, tahini halva containing lemon juice showed the highest score with 4.57, and the control sample had the lowest score with 3.71. When we look at the results of the odor parameter, the lowest score was 4.57 in the tahini halva containing lemon juice, the highest score was observed in the control sample with 4.86. Tahini halva added both lemon juice and orange juice exhibited the highest score in the color factor with 4.57, and the control sample got the lowest score with 4.43. In the results of the texture parameter, tahini halva containing both lemon juice and orange juice showed the highest score with 4.43, and the control sample got the lowest score with 4.14. In the comparison of sandiness, tahini halva added lemon juice had the highest score with 4.29, and the control sample got the lowest score with 4.00. However, the general appearance showed the best score with 4.71 in halva containing lemon juice, followed by tahini halva added orange juice (4.29), and plain halva (4.14).

In a study by Çetintaş (2022), it was reported that halva prepared with semolina and sugar has the best properties based on the results of sensory analysis, but amaranth can be used instead of semolina. It has been stated that stevia can be used by substitution to a certain extent due to its bitter taste.

Table 5. Sensorial properties of halva samples

Samples	Flavour			Smell			Color			Texture			Grittiness			General View		
Control	3.71	±	0.95	4.86	±	0.38	4.43	±	0.79	4.14	±	0.90	4.00	±	1.15	4.14	±	0.69
Containing orange juice	4.14	±	0.90	4.71	±	0.49	4.57	±	0.53	4.43	±	0.53	4.14	±	0.69	4.29	±	0.95
Containing lemon juice	4.57	±	0.79	4.57	±	0.53	4.57	±	0.79	4.43	±	0.79	4.29	±	0.76	4.71	±	0.76

Conclusion

In this study, the effects of the addition of orange juice and lemon juice on the sensory properties, total phenolic and total flavonoid contents, antioxidant activities, phenolic compounds and fatty acid composition of tahini halva were investigated. The presence of bioactive compounds such as vitamin C, carotenoids and phenolic compounds in fruit juices represents the nutritional value of the product. It is known that the antioxidant substances found in fruit juices have positive effects on health, such as reducing the rate of cancer and preventing cardio and cerebrovascular diseases. For this reason, it is important to determine the effects of applied processes on bioactive and antioxidant components.

According to the results, it was observed that the adding orange and lemon juices caused an increase in moisture content and a decrease in oil content. When the total flavonoid content and total phenolic content results are examined, they are listed from high to low as halva with lemon juice, halva with orange juice and control sample. While no significant change was observed in the fatty acid compositions of halva samples with the addition of fruit juice, there was a decrease in the gallic and cinnamic acid contents of the samples with the addition of fruit juice. An increase in catechin content was detected. Considering the general taste in this study, tahini halva with fruit juice showed high scores.

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