

## Evaluation of Total Antioxidant Activity and Total Phenolic Content of Different Tahini (Sesame Paste) Brands in Iran's Market

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### ABSTRACT

**Background and Objectives:** Tahini (sesame paste) is a condiment made from sesame seeds. Given the possible high antioxidant activity and polyphenol content of sesame seeds, we aimed to measure the total antioxidant activity and total phenolic content of different tahini brands in Iran's market.

**Methods:** In this study, 111 tahini samples from 37 commercial brands (three samples from each brand) were purchased from the Iran's market. The ferric reducing ability of plasma (FRAP) method was used to measure the total antioxidant activity in each sample. Total phenolic content was measured by the Folin–Ciocalteu method.

**Results:** The results showed that Mino-dates ( $119.93 \pm 0.159 \mu\text{mol/mL}$ ), Trang-Chocolate ( $56.30 \pm 0.056 \mu\text{mol/mL}$ ), Barsam-coffee ( $45.13 \pm 0.094 \mu\text{mol/mL}$ ) and Chocolate-barsam ( $53.23 \pm 0.112 \mu\text{mol/mL}$ ) had significantly higher antioxidant activity compared to other brands ( $p < 0.001$ ). Moreover, Mino-dates ( $2057.33 \pm 0.094 \mu\text{mol/mL}$ ), Barsam-coffee ( $805.51 \pm 0.041 \mu\text{mol/mL}$ ), Chocolate-barsam ( $807.42 \pm 0.095 \mu\text{mol/mL}$ ) and Trang-Chocolate ( $685.75 \pm 0.086 \mu\text{mol/mL}$ ) contained higher level of phenolic compounds compared to other brands ( $p < 0.001$ ).

**Conclusion:** This study is among the first to assess total antioxidant activity and total phenolic content of different tahini brands in Iran. Our results indicate that tahini brands with a higher phenolic content also have higher antioxidant activity. It can be concluded that tahini may be used as rich source of antioxidant compounds in people's routine diet.

**Keywords:** Antioxidant Activity, Phenolic Content, Sesame Paste, Tahini.

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## INTRODUCTION

Free radicals can damage the biological system of the body (1,2). Free radicals are one of the most important causes of diseases, including cancer (3,4), neurological disorders (5) and cardiovascular disease (6). Today, the beneficial health effects of using some herbal have been proven. These effects originate from the antioxidant activity of plant's phytochemical compounds, especially phenolic compounds, which could contribute to prevention of many diseases such as cancer or cardiovascular disease (7). Sesame seed has a high nutritional value and is a rich source of proteins. It is also a good source of calcium, iron, zinc and folic acid as well as linoleic acid and oleic acid (8). Tahini (sesame paste) is condiment made from toasted ground hulled sesame seeds (9). According to the reports by the USDA National Nutrient Database, two tablespoons of tahini contain 178 calories, 16 g of fats, 6 g of carbohydrates and 5 g of proteins. The major mineral and vitamin components of tahini are thiamine (30%), magnesium (24%), phosphorus (22%), iron (14%) and calcium (12%) (10). According to previous studies, sesame seeds can exert beneficial health effects by preventing symptomatic knee osteoarthritis (11), help preventing/treating cancer (12), decreasing the risk of atherosclerosis and cardiovascular disease (13, 14) and lowering low-density lipoprotein levels while maintaining high-density lipoprotein levels (15). [These effects are probably due to the high antioxidant capacity of tahini owing to its high sterols, polyphenols and flavonoids content (16). Moreover, sesame oil shows great stability against oxidation compared to other vegetable oils (17).

In recent years, various methods have been developed for measuring total antioxidant activity (18). Among these methods, ferric reducing ability of plasma (FRAP) has many advantages including no need for prior preparation, simplicity and rapidness. It is also the only method that directly measures the amount of antioxidant compounds. However, the FRAP reagent does not react with thiol compounds, including glutathione (19). Nevertheless, thiol compounds have little contribution to the antioxidant activity of plants. Given the beneficial health effects of tahini and the contribution of reactive oxygen species to development of several disease, for

the first time, we aimed to measure the total antioxidant activity and total phenolic content of different tahini brands in Iran's market.

## MATERIALS AND METHODS

In the present study, 111 samples were collected from 37 commercial tahini brands (three samples for each brand) purchased from Iran's market. Then, 2 g of each sample were weighed (Sartorius BP 61, sensitivity 0.1mg) and poured into plastic falcons. Each sample was mixed with 2 mL of methanol 50% for 120 minutes on a rotary shaker (200 rpm) and then centrifuged at 6000 rpm for 10 minutes. Each sample was strained and mixed with 2 mL of methanol 50%, and then the above steps were repeated again. The essence derived from the first and second stages were mixed together and centrifuged at 6000 rpm for 15 minutes. Finally, the antioxidant activity and total phenolic content of each tahini essence was measured.

Spectrophotometric analysis was performed by a GBC UV-visible spectrophotometer (Cintra 40, Australia). The extraction process was performed by an ultrasound-assisted extractor (Tecno-Gaz SpA, Italy) at 40 kHz and 0.138 kW for 15 min. Other instruments used in the study included a digital balance (Sartorius TE-153S-DS-MG, Germany) and a Bain-Marie (37±0.5 °C).

In this study, the FRAP method was used to measure the total antioxidant activity in each sample. In this method, 2, 4, 6-tripyridyl-s-triazine (TPTZ, purchased from Sigma-Aldrich) was used as the complexing reagent. A mixture of 5 mL of TPTZ (10 mmol/L) in 40 mmol/L HCL, 50 mL of acetate buffer and 5 mL of FeCl<sub>3</sub>·6H<sub>2</sub>O solution were used as the FRAP reagent. The aqueous solution of FeSO<sub>4</sub>·7H<sub>2</sub>O was used for calibration. A quantity of 1.5 mL of the FRAP reagent was added to each of tube. After placing the tubes at 37 °C for 5 minutes, 50 µl of the test sample or the calibration curve standard were added to the tubes. After incubation at 37 °C for 10 minutes, absorbance of the samples and control (distilled water) was read at 593 nm using a spectrophotometer. Calibration curve for the FRAP method was plotted based on the absorbance of seven standard concentrations, and the value of the measured concentrations was calculated from the curve. This method was based on a protocol described by

The Folin–Ciocalteu method was used to measure total phenolic content in tahini samples (21, 22). First, 1.5 mL of the Folin–Ciocalteu reagent (Sigma-Aldrich) diluted 1:10 by double-distilled water, was added to each tube. Then, 200  $\mu$ L of the sample were added and the tubes were maintained at 22 °C for 5 minutes. Next, 1.5 mL of sodium carbonate was added and the tubes were kept at 22 °C for 90 minutes. Absorbance of the sample was read at 725 nm and compared with that of the control. For plotting the standard curve of gallic acid, a stock solution was prepared at a concentration of 100  $\mu$ g/mL. Then, different concentrations (25, 50, 75, 100, 125, 150, and 200  $\mu$ g/mL) was prepared

from the solution. The absorbance of samples was read based on the calibration curve plotted for the standard solutions. Finally, total phenolic contents were reported as gallic acid equivalents (GAE)(23). Statistical Package for the Social Sciences (SPSS, version 16) was used for data analysis (24). One-way ANOVA was used for comparing mean total antioxidant activity and total phenolic contents between different brands of tahini. Data were expressed as mean  $\pm$  standard deviation.

## RESULTS

The results for measuring the total antioxidant activity of different brands of tahini are presented in table 1.

Table 1- Mean level of total antioxidants in different brands of tahini

Brand	Mean( $\mu$ mol/mL)	Standard deviation	CV (%)	P-value
Foladi	20.86	0.086	16.50	< 0.001
Oghab	26.64	0.102	14.98	
Behjati	28.70	0.033	4.55	
Shaboli	20.27	0.083	16.44	
Barsam	24.46	0.025	4.10	
Ideal	28.61	0.027	3.64	
Shayan	26.50	0.027	4.07	
Niakaan	23.11	0.070	11.98	
Trang	29.33	0.017	2.33	
Ghadima	26.29	0.069	10.60	
Halvaeyan	16.43	0.031	7.63	
Mino-dates	119.93	0.159	4.87	
Barsam-coffee	45.13	0.094	7.87	
Abe hayat	20.81	0.069	13.24	
Shiri reza	34.71	0.042	4.64	
Tohid	16.78	0.040	9.75	
Eradat	26.78	0.066	9.61	
Barzegar va beheshti	24.81	0.047	7.41	
Kakh	31.46	0.044	5.43	
Mandegar	33.26	0.050	5.75	
Mahdi	20.47	0.046	8.96	
Trang-chocolate	56.30	0.056	3.75	
Trang-vanilla	16.34	0.023	5.88	
Mahpor	17.87	0.009	2.24	
Keshavarz	20.16	0.005	1.14	
Kila	28.39	0.079	10.87	
Shiri- Chocolate-barsam	24.57	0.124	19.70	
Javaher	24.83	0.009	1.41	
Mostafa	26.76	0.017	2.52	
Chocolate-barsam	53.23	0.112	7.94	
Shah hamze	24.51	0.009	1.51	
Barpaz	19.76	0.019	3.91	
Sonati dezfol	28.02	0.063	8.80	
Sonati shoshtar	24.10	0.066	10.82	
Sadeghi	34.36	0.058	6.51	
Dobar tafta dezfol	26.02	0.007	1.18	
Yekbar tafta dezfol	27.49	0.025	3.54	

\*P-value shows significant difference between the brands.

The results showed that Mino-dates ( $119.93 \pm 0.159 \mu\text{mol/mL}$ ), Trang-Chocolate ( $56.30 \pm 0.056 \mu\text{mol/mL}$ ), Barsam-coffee ( $45.13 \pm 0.094 \mu\text{mol/mL}$ ) and Chocolate-barsam ( $53.23 \pm 0.112 \mu\text{mol/mL}$ ) had significantly higher total antioxidant activity than other brands ( $p < 0.001$ ). Among these, the

antioxidant activity of Mino-dates and Barsam-coffee was significantly higher than that of the other two brands ( $p < 0.001$ ). Also, there was a significant difference between the antioxidant activity of Mino-dates and Barsam-coffee brands ( $p < 0.001$ ). However, the difference between the antioxidant activity

of Chocolate-barsam and Trang-Chocolate was not significant. The remaining 33 brands were divided into six groups. There was significant differences between these groups in terms of antioxidant activity ( $p < 0.001$ ), but there was

no significant intra-group difference found within the groups. Table 2 shows the antioxidant activity of these six groups in a descending order from the highest to the lowest.

Table 2- Classification of tahini brands based on the total antioxidant activity

Antioxidant activity	Brands
1 (Highest)	Mino-dates, Trang-chocolate, Barsam-coffee, and Chocolate-barsam
2	Shiri reza, Sadeghi, Mandegar
3	Kakh, Trang, Behjati, Ideal, Kila, Sonati dezfol, Yekbar tafte dezfol
4	Eradat, Mostafa, Oghab, Shayan, Dobar tafte dezfol, Ghadima, Barzegar va beheshti, Shiri-chocolate-barsam, Shah hamze, Barsam, Javaher sonati shoshtar
5	Niakaan, Abe hayat, Foladi
6	Mahdi, Shaboli, Keshavarz, Barpaz
7 (Lowest)	Mahpor, Halvaeyan, Tohid, Trang-vanilla

The results for measuring phenolic compounds of different brands of tahini are presented in table 3. Based on the results, the level of phenolic compounds was significantly higher in Mino-dates ( $2057.33 \pm 0.094 \mu\text{mol/mL}$ ), Barsam-coffee ( $805.51 \pm 0.041 \mu\text{mol/mL}$ ), Chocolate-barsam ( $807.42 \pm 0.095 \mu\text{mol/mL}$ ) and Trang-Chocolate ( $685.75 \pm 0.086 \mu\text{mol/mL}$ ) than in other brands ( $P < 0.001$ ). Among these four brands, the phenolic content of Mino-dates and Trang-Chocolate differed significantly with that of the other two brands ( $p < 0.001$ ). Also, there was a significant difference between Mino-dates and Trang-Chocolate in total phenolic content ( $p < 0.001$ ), but there was no significant difference between the other two brands (Barsam-coffee and Chocolate-barsam). The other 33 brands were divided into six groups. The phenolic content differed significantly between these groups ( $p < 0.001$ ). However, there was no significant intra-group difference in the total phenolic content of these six groups (Table 4).

## DISCUSSION

As mentioned before, there is a strong association between antioxidant activity and total phenolic content of foods. Since tahini may be a good source of phenols, we evaluated the total phenolic content and antioxidant activity of different tahini brands in Iran's market. Then, the amount of total

phenolic compounds is measured by calorimetry. In line with the present study, several studies have shown that sesame seeds are a natural source of antioxidants and phenolic compounds (25-27). Tahini can be introduced as a beneficial ingredient with a high content of polyphenol and antioxidant compounds in the human diet. In order to prepare tahini, sesame seeds are soaked in water to facilitate peeling the brown skin, the obtained white seeds are ground, and the 50% remaining constituents are water and oil (28). Several studies showed that intake of sesame seeds and its by-products have favorable health effects including decreased risk of developing cardiovascular disease (29, 30), hypertension, hyperlipidemia (31) and knee osteoarthritis (11).

Our study demonstrated that some brands of tahini such as Mino-dates, Trang-Chocolate, Barsam-coffee and Chocolate-barsam have more antioxidants and phenolic compounds than other brands. This may be due to the diversity of sesame seeds types that are used in the production of tahini. It has been reported that white sesame seeds have more antioxidants and phenolic compounds compared to black sesame seeds (32, 33). In addition, certain processing procedures such as roasting time and temperature can affect the amount of antioxidants and phenolic compounds in the final product (34, 35).

Table 3- Mean phenolic content in different brands of tahini

Brand	Mean level (μmol/mL)	Standard deviation	CV (%)	P-value
Foladi	340.68	0.018	4.95	< 0.001
Oghab	372.05	0.082	19.68	
Behjati	493.75	0.049	8.70	
Shaboli	385.009	0.113	26.08	
Barsam	365.59	0.077	18.78	
Ideal	380.43	0.049	11.56	
Shayan	389.37	0.013	2.98	
Niakaan	317.32	0.060	17.06	
Trang	431.47	0.022	4.51	
Ghadima	447.41	0.037	7.29	
Halvaeyan	251.49	0.025	9.22	
Mino-dates	2057.33	0.094	3.87	
Barsam-coffee	805.51	0.041	4.39	
Abe hayat	375.78	0.029	7.04	
Shiri reza	397.53	0.027	6.06	
Tohid	331.88	0.006	1.88	
Eradat	367.32	0.015	3.81	
Barzegar va beheshti	415.33	0.018	3.99	
Kakh	399.89	0.016	3.75	
Mandegar	394.42	0.020	4.56	
Mahdi	357.55	0.009	2.45	
Trang-chocolate	685.75	0.086	10.95	
Trang-vanilla	286.64	0.033	10.49	
Mahpor	351.82	0.027	6.86	
Keshavarz	318.65	0.027	8.08	
Kila	427.009	0.013	2.79	
Shiri- Chocolate-barsam	510.24	0.020	3.54	
Javaher	362.97	0.014	3.54	
Mostafa	423.52	0.042	8.87	
Chocolate-barsam	807.42	0.095	10.12	
Shah hamze	362.21	0.035	8.70	
Barpaz	318.45	0.034	9.65	
Sonati dezfol	350.79	0.021	5.40	
Sonati shoshtar	375.08	0.055	13.19	
Sadeghi	442.04	0.023	4.72	
Dobar tafte dezfol	363.99	0.002	0.77	
Yekbar tafte dezfol	366.57	0.006	1.65	

\* P-value shows significant difference between the brands.

Table 4- Subgroups of tahini brands based on the total phenolic content

Phenolic content	Brands
1 (Highest)	Mino-dates, Barsam-coffee, Chocolate-barsam, and Trang-chocolate
2	Shiri-chocolate-Barsa, Behjati
3	Ghadima, Sadeghi, Trang, Kila, Mostafa, Barzegar va beheshti
4	Kakh, Shiri Reza, Mandegar, Shayan, Shaboli, Ideal, Abe hayat, Sonati Shoshtar, Oghab, Eradat, Yekbar tafte dezfol
5	Barsam, Shah hamze, Javaher, Mahdi, Mahpor, Sonati dezfol, Dobar tafte Dezfol, Foladi, Tohid
6	Keshavarz, Barpaz, Niakaan, Trang-vanilla
7 (Lowest)	Halvaeyan

## CONCLUSION

According to the results of this study, tahini brands with higher polyphenolic contents had higher antioxidant activity.

It can be concluded that tahini may be used as rich source of antioxidant compounds in people's routine diet.

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## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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