Original Article

Physicochemical Properties and Antioxidant Activity of Honey Brands Distributed in Tehran City, Iran

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ABSTRACT

Background: Honey, a naturally sweet food product, exhibits several health beneficial effects. The quality of honey differs by its microbiological, physicochemical, and antioxidant properties, which can significantly vary from brand to brand and country to country.

Objectives: This study aimed to assess the physicochemical properties and antioxidant activity of honey brands distributed in Tehran City, Iran, and compare these parameters with national and international standards.

Methods: Five brands (Shakelli, Khansar, Golagin, Shafi, and Kral) of honey in Tehran were selected, and 5 samples of each brand were collected from supermarkets and analyzed by standard methods for physicochemical properties and antioxidant activity. The collected data were analyzed using SPSS software, version 20.

Results: The results depicted significant differences among studied honey brands in all physicochemical properties (except for ash, total reducing sugars, and sucrose content) and antioxidant activity ($P<0.05$). The moisture, ash, pH, free acidity, total reducing sugars, sucrose, diastase, and 5-hydroxymethylfurfural (HMF) contents of honey brands ranged within 16.30%-15.34%, 0.24%-0.40%, 4.27-4.39 units, 9.15-10.68 meq/kg, 77.84%-79.74%, 3.66%-4.57%, 2.28-3.28 DN (diastase number), and 6.67-11.84 mg/kg, respectively. Thus, the physicochemical properties of studied honey brands, except for diastase activity, were within national and international legal ranges. Moreover, total phenolic contents (TPC) and radical scavenging activity (RSA) of 1,1-diphenyl-2-picrylhydrazyl (DPPH) of honey brands ranged within 28.72-39.36 mg GAE/100 g and 63.83%-73.91%, respectively. In addition, a highly significant positive correlation was observed between TPC and RSA of DPPH of honey samples ($r=0.798$, $P<0.01$).

Conclusion: The studied honey brands were of good quality and met national and international standards.

Keywords: Antioxidant activity, Honey, Honey brands, Physicochemical parameters, Standards

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Introduction

Honey is used as food and medicine (Cabrera & Santander, 2022). It is defined as a "natural sweet substance produced by honey bees from the nectar of plants or from secretions of living parts of plants or excretions of plant-sucking insects on the living parts of plants, which the bees collect, transform by combining with specific substances of their own, deposit, dehydrate, store and leave in the honeycomb to ripen and mature" (Codex Alimentarius Commission, 2001). In addition to sweetness, honey exhibits health-beneficial effects, such as antibacterial, antifungal, cytostatic, hepatoprotective, hypoglycemic, antihypertensive, gastroprotective, antitumor, anti-inflammatory, antioxidant, and wound healing (Rahman et al., 2017; Soares et al., 2017).

The physicochemical parameters of honey, such as water activity, moisture, sugar content, pH, acidity, ash, electrical conductivity, hydroxymethylfurfural, and color, differ based on the type of botanical origin, geographical origin, handling (Sakač et al., 2019), beekeeping practices (Kamal et al., 2019), and even bee species (Al-Farsi et al., 2018a). The major components of honey are different sugars (70%–85%), mainly glucose and fructose and water (10%–20%) (Al-Farsi et al., 2018a; Pita-Calvo & Vázquez, 2017). Besides, more than 200 constituents consist of oligosaccharides, polysaccharides, organic acids, lipids, phenolic compounds, flavonoids, vitamins, minerals, enzymes, amino acids, pollen grains, and other phytochemicals are present in honey (Amiry et al., 2017; Manzanares et al., 2014; Ramanauskiene et al., 2012; Roshan et al., 2017). Among these, enzymes (diastase and invertase), 5-hydroxymethylfurfural (HMF) (Kamboj et al., 2019), and amino acids are considered quality factors of honey. Storage and temperature elevation affect honey's enzymes (Belay et al., 2017). HMF, a cyclic aldehyde, is either absent or present in quite lower quantities in fresh honey, which can be raised by excessive heating, prolonged and poor storage (Shapla et al., 2018), or by adulteration with inverted sugars (Ajlouni & Sujirapinyokul, 2010; Se et al., 2019).

The antioxidant activity of honey mainly results from both enzymatic and non-enzymatic antioxidants, which include polyphenols, carotenoids, organic acids, vitamin C, vitamin E, enzymes (e.g. catalase, peroxidase), amino acids, proteins, trace elements and products of the Millard reaction (Dżugan et al., 2018; Gül & Pehlivan, 2018; Karabagias et al., 2016; Smetanska et al., 2021). Among these compounds, polyphenols (flavonoids and phenolic acids) are mainly responsible for the antioxidant activity of honey (Dong et al., 2013). These constituents can be affected by their geographic and floral origin, environmental factors, storage, and maybe the processing of honey (Ramanauskiene et al., 2012). The correlation between phenolic compounds and the antioxidant activity of honey is significant and could be assessed by several methods (Vasić et al., 2019). In this sense, several studies have reported a significant positive correlation between phenolic contents, antioxidant activity, and the color intensity of honey (Beretta et al., 2005; Bertoncelj et al., 2007).

The composition and quality factors of honey could differ from country to country and even within a country due to differences in region, floral origin, and other factors (Alqarni et al., 2016). There is plenty of information concerning the physicochemical properties and antioxidant activity of Iranian honey from different origins and floral sources. Still, information on the characteristics mentioned for Iranian honey brands was unavailable. Thus, this study was designed to investigate the physicochemical and antioxidant properties of 5 well-known honey brands distributed in the Tehran Province, Iran. Then, we compared the studied parameters with present national and international standards.

Materials and Methods

Twenty-five honey samples (5 samples from each brand and different supermarkets) from 5 well-known brands, namely Shakelli, Khansar, Golagin, Shafi, and Kral, were collected from chain supermarkets of Tehran City through random sampling and were analyzed for physicochemical and antioxidant activity at the Laboratory of Food Hygiene and Quality Control of Veterinary Medicine Faculty, University of Tehran. All tests were performed in duplicate.

Physicochemical analysis

The physicochemical analysis included the examination of moisture, ash, pH, free acidity (Silva et al., 2009; Zarei et al., 2019), diastase activity (Bogdanov et al., 2002), hydroxymethylfurfural (Zarei et al., 2019) and sugar contents (Kamal et al., 2019).

Moisture determination

The moisture of honey samples was determined according to the refractometry using an Atago (Japan) model lT Abbe refractometer. All measurements were carried out at 25°C.

Ash determination

Ash content was measured using a muffle furnace. Five grams of honey were heated at 550°C until the constant weight was achieved. The ash percentage was calculated using the Equation 1:

$$1.\ \text{Ash}\% = \frac{W1-W2}{W0} \times 100$$

, Where W1 is the weight of the crucible with ash content, W2 represents the weight of the empty crucible, and W0 indicates the weight of the honey sample.

Measurement of pH and free acidity

A digital pH meter (Jenway, England) was used to measure the pH of honey samples. To determine the pH, a solution of honey (10 g of honey was dissolved in 75 mL of CO_2-free distilled water) was used. Free acidity was determined by the titrimetric method using 0.05 M NaOH for titration. The titration was continued until pH 8.50. A 1% alcoholic solution of phenolphthalein was used as an indicator. The results were reported as meq of acid/kg of honey. The free acidity of honey samples was calculated by Equation 2:

2.

$$\text{Free acidity (meq/kg)} = \frac{(\text{mL of NaOH used for sample} - \text{mL of NaOH used for blank})}{\text{Weight of sample}} \times 0.05 \times 1000$$

Diastase activity

The diastase activity of honey samples was carried out according to harmonized methods of the International Honey Commission (IHC) using buffered solutions of starch and honey. Briefly, 10 mL of prepared honey solution was transferred to a 50-mL flask and heated at 40°C using a water bath (WiseBath, Daihan, Korea) for 15 minutes. Meanwhile, a flask containing 10 mL of starch solution was also heated in the same conditions. Afterward, 5 mL of starch solution was transferred to the honey solution and mixed well. After every 5 minutes, 0.5 mL aliquots were rapidly transferred to 5 mL diluted iodine solution. After that, 20, 21, 22, 23, 24, and 25 mL of distilled water were added to each mixture. The prepared mixtures' absorbance was read at 660 nm using a spectrophotometer (6100, Jenway, England), and water was used as blank. Finally, the absorption data from different time intervals were plotted using regression until the 0.235 absorbance was achieved, and the outcomes were reported as diastase number (DN).

HMF content

To determine HMF content, 5 g of honey samples were liquified in 25 mL of distilled water. The prepared solution was then treated with 0.5 mL of Carrez solution I (D-1600, Merck, Germany) and 0.5 mL of Carrez solution II (KGG9A, Merch, Germany), and the volume of the resultant solution was raised to 50 mL by distilled water. Afterward, the solution was filtered through a filter paper, and the first 10 mL was discarded. The absorbance of the filtered solution was measured at 284 and 336 nm against the filtered solution treated with $NaHSO_3$ (GH5643F, Sigma-Aldrich, USA) using a spectrophotometer. HMF was determined using the Equation 3:

3.

$$\text{HMF (mg/kg)} = [A284 - A336] \times 149.7 \times 5 \times \text{weight of sample}$$

Sugar analysis

The reducing sugar contents of honey samples were estimated using the harmonized methods of the IHC. Concisely, 5 mL of Fehling A and 5 mL of Fehling B solutions were transferred to a 250-mL Erlenmeyer flask containing 7 mL H_2O and 15 mL of honey sample. Consequently, 1 mL of 0.2% methylene blue indicator was added to the solution prepared in an Erlenmeyer flask and titrated with heating until the indicator was decolorized. The inversion process was used for the determination of sucrose. Briefly, 50 mL of honey sample was taken in a 100-mL volumetric flask, 10 mL of diluted HCL was added to the flask and heated in a water bath, and the volume was made up to the mark. Again, the Lane–Eynon procedure was applied to this solution. The sucrose contents were calculated using the Equation 4:

4. $\text{Sucrose \%} = (\text{Total sugar} - \text{Total reducing sugar}) \times 0.95$

Antioxidant characterization

The total phenolic contents (TPC) and radical scavenging activity (RSA) of 1,1-diphenyl-2-picrylhydrazyl (DPPH) were determined according to the methods reported by Vela et al. (2007) and Duzgan et al. (2018), respectively.

TPC measurement

The Folin-Ciocalteu reagent (53H5010, Sigma-Aldrich, USA) was used to determine TPC. Briefly, 0.2 mL of honey solution was added to 1 mL of 10% Folin-Ciocalteu reagent and 0.8 mL of 7.5% w/v sodium carbonate (Na_2CO_3) (SLBL4377V, Sigma-Aldrich,

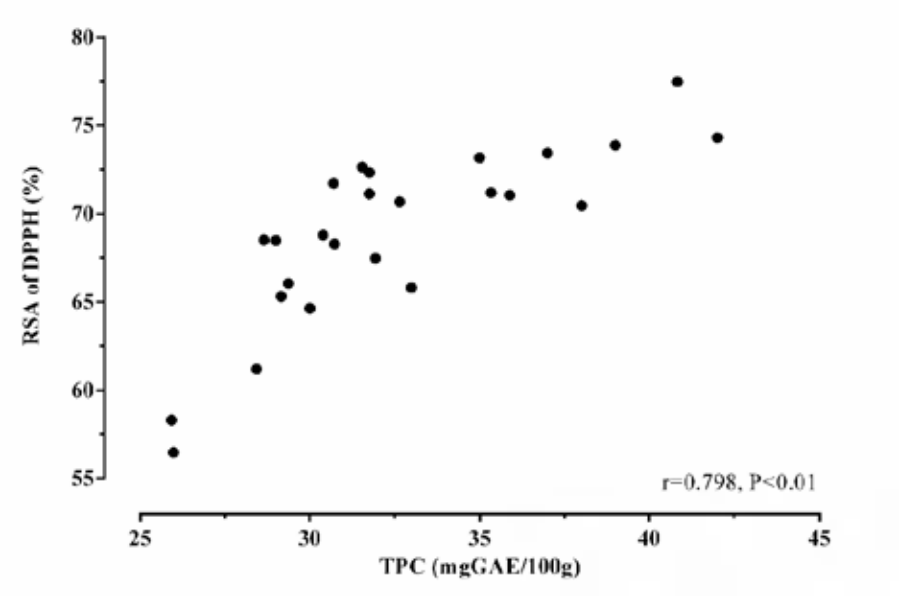

Figure 1. The correlation between TPC and RSA of DPPH of 25 honey samples

USA). The mixture was incubated at room temperature for 120 minutes. After incubation, a spectrophotometer measured absorbance at 760 nm against the blank. TPC was calculated based on a calibration curve prepared for gallic acid. Results were reported as mg of gallic acid equivalents (GAE) per 100 g of honey.

Radical scavenging activity of DPPH

The antioxidant activity of honey samples was measured spectrophotometrically using the stable free radical DPPH (DG9132-1G, Sigma-Aldrich, USA). In short, 1.25 mL of honey solution in deionized water (0.025 g/mL) was added to 1.5 mL of DPPH in methanol (90 µg/mL) solution. The prepared solution was incubated for 5 minutes. After incubation, the absorbance was read at 517 nm against a water/methanol (1:1 v/v) blank. A standard curve of ascorbic acid was used to estimate the scavenging activity of each honey sample. The results were reported as % equivalent of ascorbic acid in terms of DPPH depletion, which was calculated using the Equation 5:

$$\text{Radical scavenging activity \%} = \frac{[Aa-(Ab-Ac)]}{(Aa-Ao)} \times 100 \quad (5)$$

, where Aa denotes the absorbance obtained without the honey sample (DPPH and methanol only), Ab refers to the absorbance of the incubation mixture of DPPH and honey solution, Ac is the absorbance of the blank solution, and Ao refers to the minimum absorbance obtained when DPPH was completely scavenged.

Statistical analysis

The collected data was subject to IBM SPSS software, version 20 (SPSS Inc., Chicago, IL, USA) for statistical analysis. The differences among honey brands were analyzed using a one-way analysis of variance (ANOVA) followed by the Tukey multiple comparison test (MCT). The correlation between TPC and the radical scavenging activity of DPPH was analyzed using the Pearson correlation. The difference between the physicochemical properties and antioxidant activity of honey brands and the correlation between TPC and RSA of DPPH were considered statistically significant when $P<0.05$.

Results

Physiochemical analysis

The analysis of the physicochemical properties of 5 well-known honey brands distributed in Tehran City, Iran, is presented in Table 1. As the results depict, a statistically significant ($P<0.05$) difference was observed between all honey brands except in ash, total reducing sugars, and sucrose content ($P>0.05$). According to the results, the higher moisture and ash contents were 16.30% and 0.40%, respectively. Moreover, pH and acidity ranged from 4.27 to 4.39 and 9.15 to 10.68 meq/kg, respectively. The higher diastase enzyme activity and HMF contents were 3.28 DN and 11.84 mg/kg, respectively.

Table 1. Physicochemical parameters of 5 honey brands

Physicochemical Parameter	Mean±SD				
	Brand				
	A	B	C	D	E
Moisture (%)	15.36±0.19^{b}	15.50±0.22^{b}	16.30±0.074^{a}	15.42±0.39^{b}	15.34±0.36^{b}
Ash (%)	0.28±0.10^{a}	0.32±0.10^{a}	0.24±0.08^{a}	0.40±0.13^{a}	0.24±0.08^{a}
pH	4.37±0.05^{ab}	4.32±0.03^{bc}	4.37±0.02a^{b}	4.39±0.04^{a}	4.27±0.07^{c}
Free acidity (meq/kg)	10.41±0.89^{ab}	9.15±0.84^{b}	10.68±0.73^{a}	9.17±1.17^{b}	10.61±1.38^{a}
Total reducing sugars (%)	77.84±1.89^{a}	78.01±1.76^{a}	79.08±1.34^{a}	79.74±1.89^{a}	77.99±2.02^{a}
Sucrose (%)	4.57±1.06^{a}	4.22±0.41^{a}	4.08±1.04^{a}	4.40±0.77^{a}	3.66±0.46^{a}
Diastase (DN)	2.67±0.18^{b}	2.49±0.09^{bc}	2.44±0.12^{bc}	3.28±0.72^{a}	2.28±0.23^{c}
HMF (mg/kg)	7.51±0.43^{c}	6.67±0.90^{c}	9.06±1.94^{b}	11.84±0.82^{a}	6.74±0.38^{c}

$^{a, b, c}$Mean values in the same row with lowercase superscript followed by different letters are significantly different (P<0.05).

Antioxidant characterization

Table 2 presents the results of TPC and RSA of DPPH of 5 honey brands gathered from Tehran City, Iran. The results showed a significant difference between honey brands regarding TPC (P<0.05). Based on the results, the TPC of brand A (39.36 mg GAE/kg) was higher than the other honey brands. After brand A, the TPC contents were recorded from high to low for brands B, C, D, and E in this order.

The results of the present study concerning the antioxidant properties of investigated honey samples are shown in Table 2. As per the results, the antioxidant property of honey brands was significantly different (P<0.05). In addition, the RSA of DPPH of studied Iranian honey brands ranged from 63.83% to 73. 91%. Among these, brand A peaked in antioxidant activity, followed by brands B, C, D, and E.

The results of the present study also showed a strong, significant, positive correlation (r=0.798, P<0.05) between TPC and RSA of DPPH, as portrayed in Figure 1.

Discussion

Physiochemical analysis

The present study showed significant differences between the parameters of honey brands except for ash, total reducing sugars, and sucrose contents. These findings agreed with national and international standards except for diastase activity, which should not exceed 8 DN. According to the national standards of Iran, honey with acceptable parameters should have less than 20% moisture, less than 0.6% ash content, pH higher than 3.5, less than 40 meq/kg free acidity, less than 5% sucrose, more than 8 DN, and less than 40 mg/kg HMF content (INSO, 2013). Similarly, the physicochemical properties of honey have been stated in some international standards (CAC, 2001; EU, 2002) and reported by several authors (Nordin et al., 2018; Thrasyvoulou et al., 2018).

Table 2. Phenolic content and DPPH scavenging activity of 5 honey brands

Antioxidant Parameter	Mean±SD				
	Brand				
	A	B	C	D	E
Total phenolic contents (mg GAE/100 g)	39.36±1.92^{a}	33.69±1.58^{b}	30.95±2.58^{bc}	30.07±2.22^{bc}	28.72±1.69^{c}
DPPH scavenging activity (%)	73.91±2.50^{a}	69.63±2.96^{ab}	68.79±2.68^{ab}	68.39±6.83^{ab}	63.83±4.01^{b}

$^{a, b, c}$Mean values in the same row with lowercase superscript followed by different letters are significantly different (P<0.05).

DPPH: 1,1-diphenyl-2-picrylhydrazyl.

However, international standards state free acidity as less than 50 meq/kg. The lower diastase number of honey samples could be due to improper heat treatment during honey processing or inappropriate storage. Similarly, the quality of Omani honey was evaluated, and its diastase activity was reported within 1.46-18.4 Schade units. The researchers reported that the diastase activity could be altered by botanical origin, climate conditions, heat treatment, and storage (Al-Farsi et al., 2018b). Ajlouni and Sujirapinyoku (2010) reported a positive correlation between heat treatment and amylase destruction level. Wang and Li (2011) reported that the time of storage and heat treatment strongly contribute to the alteration of diastase activity. Furthermore, the pH of honey also affects the diastase activity as an increase in pH decreases the level of diastase activity. Also, Zarei et al. (2019) reported a lower effect ($P>0.05$) of thermal treatment on moisture, pH, and free acidity of honey samples.

So far, several studies have been carried out to investigate the physicochemical properties of honey in Iran and different parts of the world and study the effective parameters. Jahed Khaniki and Kamkar (2005) studied the physicochemical properties of honey samples in Garmsar City, Iran. Their study results indicated that the honey samples' pH, free acidity, ash, and solid matter were 4.54, 16.33 meq/kg, and 0.287%, respectively. Likewise, Kamkar et al. (2012) studied the physicochemical properties of honey samples from Tehran City, Iran. Their study showed that most studied parameters of honey samples were within the desired range. According to their results, 3.3% and 33.3% of honey samples were positive for HMF and diastase, respectively. Moreover, the samples' pH, acidity, solid matter, moisture, and reducing and non-reducing sugars were 3.84, 16.80 meq/kg, 84%, 15.7%, 66.54%, and 4.38%, respectively. The results of the present study also documented that the physicochemical properties of collected honey samples from different supermarkets were within the national and international standards. In another research, the physicochemical properties of Harenna Forest honey were investigated. Based on their results, hive type significantly affected moisture, reducing sugars, ash, and HMF contents. After all, moisture, water-insoluble solids, ash, electrical conductivity, and specific rotation of honey samples were significantly altered by sampling location (Belay et al., 2013). Moniruzzaman et al. (2013) studied Malaysian honey's physicochemical and antioxidant properties from different botanical and entomological sources. Based on their results, the physical properties of four Malaysian honey types, namely Acacia (*Apis mellifera*), Pineapple (*Apis mellifera*), Borneo (*Apis cerana*), and Tualang (*Apis dorsata*), were significantly different ($P<0.05$). The physicochemical and antioxidant properties of Bangladeshi honey samples stored for over one year were investigated. Their study showed that HMF content remained at the recommended level (10.93 mg/kg) after 1.5 years of storage at 20˚C-25˚C. They reported that the low moisture and pH might contribute to the low HMF content (Islam et al., 2012). Manzanares et al. (2014) physicochemically characterized some minor monofloral honey from Tenerife Island, Spain. The results of their study showed a significant difference between monofloral honey samples. Moreover, the HMF contents were within the 0.4-27.7 mg/kg range, which agrees with international standards. They further stated honey with HMF contents lower than 15 mg/kg is considered quality honey. Thus, the Iranian honey brands in the present study could be considered quality honey for their lower HMF contents.

Antioxidant characterization

The results of the present study outlined a significant difference between the studied honey brands in terms of TPC content. The content could be significantly altered and reduced by thermal processing. Based on the results of Zarei et al. (2019), the phenolic contents were not significantly reduced in the first 20 minutes of thermal processing but became significant after 30 minutes. Moreover, the TPC is a good criterion for the determination of the quality and curative properties of honey (Al-Mamary et al., 2002). Some Saudi Arabian and international honey samples were investigated for TPC. The results showed a significant difference between honey samples; the TPC values ranged from 0.44 to 0.84 mg/g. They reported that the TPC of honey samples could be altered according to their floral source and contribute to the darkness of honey (Alqarni et al., 2016). Gül and Pehlivan (2018) investigated some monofloral Turkish honey for its antioxidant activities. According to their results, the TPC content of different Turkish honey ranged from 34. 37 to 470.70 mg GAE/100g. The highest amount of TPC was recorded for Parsely (470.70 mg GAE/100 g), followed by Rhododendron, Carob, and Chestnut honey. The lowest phenolic content was recorded for wild mint (34.37 mg GAE/100 g) and Acacia (51.91 mg GAE/100 g) honey. Another study recorded lower TPC for Agastache honey (853.6 µg GAE/g) than other commercial Australian honey (Anand et al., 2018). Do Nascimento et al. (2018) analyzed Brazilian *A. mellifera* honey for phenolic compounds, antioxidant activity, and physicochemical properties. Based on their results, The TPC values were in the range of 26-100 mg GAE/100 g for Eucalyptus, Mastic, wildflower, Japanese grape, Quitoco, and polyfloral honey as higher TPC values

were documented for Eucalyptus (66.45), Mastic (63.5), and wildflower (56.50) honey compared to others.

The antioxidant activity of the studied honey brand was significantly different. These findings were similar to Noor et al. (2014) research findings. They reported the DPPH radical scavenging activity in the range of 30.50-77.43 for natural Pakistani honey. The RSA percentages of DPPH for honeydew, linden, and Acacia were reported to be 86.91%, 62.37%, and 23.96%, respectively (Kowalski, 2013). In another study, the antioxidant activity of some Portuguese monofloral honey was investigated by Alves et al. (2013). Their results reported DPPH inhibition (%) over 50% for studied honey samples, while the DPPH inhibition (%) of some honey samples like Rosemary (4.5%–59.3%), Orange (8.8%–23.2%), Thyme (35.8%–47.3%), and Eucalypt (27.7%) were below 50%. Moreover, honey samples of Arbutus (64.2%), Locust podshrub (61.6%), and some heather samples showed higher DPPH inhibition (%). The DPPH inhibition (%) is correlated to the darkness of honey, as dark honey showed 70% DPPH inhibition, whereas the DPPH inhibition for light honey was below 40% (Estevinho et al., 2008).

The results of the present study depicted a strong positive and significant correlation between TPC and the antioxidant activity of honey. These findings are supported by those reported by Beretta et al. (2005). According to their results, the phenolic content and DPPH radical savaging activity had a strong positive correlation (r=0.918). In another study, it was reported that honey's antioxidant activity depends on TPC. Their results showed a positive correlation between TPC and RSA of DPPH (r=0.826) (Anand et al., 2018), similar to our research findings. Likewise, similar results were obtained by Gül and Pehlivan (2018) as they documented a significant positive correlation between TPC and DPPH radical scavenging activity (r=0.704, P<0.01). In addition, several authors indicated that TPC and antioxidant activity of honey are positively correlated (Alvarez-Suarez et al., 2010; Alves et al., 2013; Bertoncelj et al., 2007; Chua et al., 2013; da Silva et al., 2013; Silici et al., 2010).

Conclusion

In the present study, the 5 well-known Iranian honey brands distributed in the Tehran Province of Iran were analyzed for their physicochemical properties and antioxidant activity. Then, the studied parameters were compared with existing national and international standards. Based on the results, all brands were within legal ranges except diastase activity, as this parameter was lower than those presented in national and international standards. This inconsistency could be attributed to improper heat treatment in honey industries and inappropriate storage in chain supermarkets. From the HMF content point of view, all brands were in the category of quality honey as the HMF contents of all samples were lower than 15 mg/kg. Moreover, all brands obtained good values in terms of TPC and RSA of DPPH as brand A peaked for both characteristics. As expected, a significant positive correlation was observed between TPC and RSA of DPPH of honey samples. Altogether, it can be argued that the studied Iranian honey brands were of good quality from the point of view of physicochemical properties and antioxidant activity.

Ethical Considerations

Compliance with ethical guidelines

There were no ethical considerations to be considered in this research.

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Authors' contributions

Conceptualization, methodology, supervision, data analysis, funding acquisition and resources: Abolfazl Kamkar; Data collection: Sayed Attaul Haq Banuree; Investigation and writing the original draft: Atiqullah Miakhil; Review and editing: All authors.

Conflict of interest

The authors declared no conflict of interest.

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مقاله پژوهشی

ویژگی‌های فیزیکوشیمیایی و فعالیت فعالیت آنتی‌اکسیدانی برندهای عسل توزیع‌شده در تهران، ایران

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چکیده

زمینه مطالعه: عسل یک فرآورده غذایی شیرین طبیعی است که با فواید سلامتی متعددی همراه است. کیفیت عسل با خواص میکروبیولوژیکی، فیزیکوشیمیایی و آنتی‌اکسیدانی آن تعیین می‌شود که می‌تواند تا حد زیادی از برند به برند و کشور به کشور متفاوت باشد.

هدف: این مطالعه باهدف بررسی خواص فیزیکوشیمیایی و فعالیت آنتی‌اکسیدانی برندهای عسل توزیع‌شده در شهر تهران و مقایسه این پارامترها با استانداردهای ملی و بین المللی انجام شد.

روش کار: پنج برند عسل معروف (شاکلی، خوانسار، گلاگین، شافی و کرال) توزیع‌شده در تهران انتخاب و پنج نمونه از هر برند از فروشگاه‌های زنجیره‌ای جمع‌آوری و با روش‌های استاندارد خواص فیزیکوشیمیایی و فعالیت آنتی‌اکسیدانی آن تحلیل شدند. داده‌های جمع‌آوری‌شده با استفاده از نرم‌افزار SPSS، نسخه ۲۰ مورد تجزیه‌وتحلیل قرار گرفت.

نتایج: نتایج نشان‌دهنده تفاوت معنی‌دار بین برندهای عسل موردمطالعه در تمامی ویژگی‌های فیزیکوشیمیایی (به‌جز خاکستر، مجموع قندهای احیاکننده و ساکارز) و فعالیت آنتی‌اکسیدانی بود ($P<0/05$). رطوبت، خاکستر، pH، اسیدیته آزاد، کل قندهای احیاکننده، ساکارز، دیاستاز و ۵-هیدروکسی متیل فورفورال در برندهای عسل به‌ترتیب در محدوده ۱۶/۳۰-۱۵/۳۴ و ۴۰/۰-۲۴/۰ درصد، ۴/۳۹-۴/۲۷واحد و ۹/۱۵-۱۰/۶۸ میلی اکی والان/کیلوگرم، ۷۹/۷۴-۷۷/۸۴، ۳/۶۶-۴/۵۷ درصد و ۲/۲۸-۳/۲۸ واحد دیاستاز و ۶/۶۷-۱۱/۸۴ میلی‌گرم/کیلوگرم بود. بنابراین، ویژگی‌های فیزیکوشیمیایی برندهای عسل موردمطالعه به‌جز فعالیت دیاستاز در محدوده قانونی ملی و بین‌المللی قرار داشت. علاوه‌براین، محتوای فنلی تام و فعالیت مهار رادیکال DPPH برندهای عسل به‌ترتیب در محدوده ۲۸/۷۲-۳۹/۳۶ میلی‌گرم اسیدگالیک/۱۰۰گرم و ۶۳/۸۳-۷۳/۹۱ درصد بود. علاوه‌براین، بین محتوای فنلی تام و فعالیت مهار رادیکال DPPH نمونه‌های عسل همبستگی مثبت و بسیار معنی‌داری مشاهده شد ($r=0/798$، $P<0/10$).

نتیجه‌گیری نهایی: برندهای عسل موردمطالعه از کیفیت خوبی برخوردار بوده و درکل استانداردهای موجود ملی و بین‌المللی را دارا می‌باشند.

کلیدواژه‌ها: فعالیت آنتی اکسیدانی، عسل، برندهای عسل، پارامترهای فیزیکوشیمیایی، استانداردها

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