Academia Journal of Biotechnology 8(8): 181-185, August 2020
DOI: 10.15413/ajb.2020.0119
ISSN 2315-7747

Research Paper

Quality properties of date vinegar produced using conventional method

Accepted 20th June, 2020

ABSTRACT

Some physical, chemical, and sensory quality properties of vinegar produced from Iranian mazafati date (*Phoenix dactylifera* L.) by conventional method were investigated in this study. At the end of the study, Brix (%), density (g/cm3), and color (L,a,b) values were found to be 4.90±0.00, 1.00±0.00, L* (27.50±0.27), a* (1.58±0.27) and b* (1.61±0.17), respectively. Furthermore, it was found that the mean conductivity value was 4.92±0.04 µS/cm, pH was 3.44±0.02, and total acidity was 11.88±0.12 g/L. The total antioxidant and total phenolic content values of the samples were found to be 10300.00±671.43 and 2310.37±44.44 gauL/mL, respectively. Nevertheless, the presence of alcohol was not detected in any of the samples after six months of storage. The mineral material contents of date vinegar samples were found as K; 163.25±0.67 ppm, P; 39.43±0.50 ppm, Na; 31.68±0.08 ppm and Ca; 9.63±0.18 ppm, respectively. The sensory analysis scores of the samples were given by the panelists as follows: color; 6.75±0.25, aroma; 5.25±0.25, odor; 3.75±0.25, appearance; 6.75±0.25 and general appreciation; 6.25±0.25. Carotenoids, phytosterols, B-group vitamins, and phosphorus in the composition of date vinegar produced using conventional method are known to be extremely useful components for human health. Furthermore, it is considered that date vinegar can be useful for the prevention of various diseases (cholesterol-lowering, antioxidant properties, cancer, diabetes, and cardiovascular diseases) due to the bioactive components it contains.

Key words: Date, vinegar, fermentation, phytosterols, phosphorus.

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INTRODUCTION

Vinegar is produced by a two-stage fermentation process, ethyl alcohol and acetic acid fermentation of raw materials containing starch and/or sugar. Vinegar is the formation of acetic acid after the oxidation of ethanol by acetic acid bacteria followed by the conversion of sugars into ethanol by the fermentation of acetic acid yeasts in the composition of vinegar. During fermentation, acetic acid is oxidized to water in the presence of liquid oxygen-containing alcohol after the activity of acetic acid bacteria. Different types of vinegar with different properties are obtained by adding various fruits and their extracts, aromatic parts of plants, their extracts or natural aromas of them (Treck and Teuber, 2002; Garcia-Garcia et al., 2006; Budak, 2010).

Date palm (*Phoenix dactylifera* L.) is considered as one of the oldest and primary products in the Arabian Peninsula, the Middle East, and North Africa. Furthermore, it is also grown in Australia, Mexico, South America, South Africa, and the United States, especially Southern California, Arizona, and Texas (Chao and Krueger, 2007; Al-Harrasi et al., 2014; Hazzouri et al., 2015).

The date fruit is a food source with high nutritional value. The date is rich in carbohydrates, dietary fibers, proteins, minerals, and group B vitamins. It contains Thiamine (B1), Riboflavin (B2), Niacin (B3), Pantothenic (B5), Pyridoxine (B6) and Folate (B9) of Vitamin B groups. The date fruit also contains calcium, iron, magnesium, selenium, copper, phosphorus, potassium, zinc, sulfur, cobalt, fluorine, manganese, and boron as minerals (Chao and Krueger,

2007; Al-Harrasi et al.,2014).

In Arab communities, by-products of date fruits are usually and commonly used in the form of jam, jelly, fruit juice, syrup, fermented drinks, and vinegar. These products are rich in bioactive compounds. Therefore, vinegar has gained industrial value. It has been demonstrated by various studies that date vinegar is good for health in terms of antioxidant properties, cholesterol-lowering, cancer, diabetes, and the prevention of cardiovascular diseases due to its phytochemical properties (Chao and Krueger, 2007; Al-Harrasi et al., 2014; Hafzan et al., 2017).

In this study, dry matter, pH, ash, brix, density, conductivity, alcohol determination, color, total acidity, total antioxidant, total phenolic, mineral matter and sensory analysis values of vinegar produced from Iranian mazafati date using conventional method were determined.

MATERIALS AND METHODS

Iranian mazafati dates used in the study were obtained from Çakıroğlu Aktar operating in the central district of Afyonkarahisar province.

Procedure

The kernels of Iranian mazafati date were removed, washed, cleaned, and then aired in the laboratory environment for 1 day. The dates prepared were added in 1/3 of 10 L jars. Then, a mixture of 50 g honey and 50 g molasses was added for the fermentation process to take place. Fermentation conditions created by adding 150 mL of date vinegar, which had been previously produced using conventional method, and 50 g chickpeas. Water was added to the product prepared to complete 10 L. The samples in the jars prepared were covered with cheesecloth to be aired for 30 days. Furthermore, they were mixed twice a day to be aired. This process was continued for approximately 30 days until a vinegar mother appeared on the surfaces of the jars. After the formation of the vinegar mother following the fermentation process, filtration was performed from the raw material. Then, the jars were sealed and stored without exposing to light at room temperature for 6 months. Their analyses were then performed under laboratory conditions.

Analyses

While dry matter analysis of date vinegar samples was performed according to AOAC 930.15 in the oven (Ecocell 55, Germany), they were analyzed for pH values according to AOAC 981.1 with Hanna (HI 2215, Germany), for ash content according to AOAC 930,35 with an electromag ash furnace (M 1811, Turkey) and for density according to AOAC 985,19 (AOAC 2000a, 2000b, AOAC 2016a, 2016b). The soluble dry matter content of date vinegar samples was determined by a hand refractometer (Atago Refractometer N-1E, Japan) according to Haroun (2006), and conductivity was determined according to Aadil (2015). Alcohol determination was performed according to Taslipinar (2018). The color determination was performed according to Voss (1992), and total acidity determination was performed according to Anonymous (1990) and Unal (2007). The total antioxidant capacity and total phenolic content were determined according to Bertoncelj et al. (2007). Mineral matter analysis was performed in the microwave burning unit (Berghof Speedwave MWS-2, Germany) according to Kadas (2011). The sensory analyses of the samples were evaluated according to Taslipinar (2018).

RESULTS AND DISCUSSION

The physical and chemical analyses of date vinegar samples (Dry Matter, pH, Ash, Brix, Density, Conductivity, Alcohol Determination, Color, Total Acidity, Total Antioxidant, Total Phenolic, Mineral Material, and Sensory Analysis) are shown in Tables 1, 2 and 3.

As a result of the study, it was found that the mean density of date vinegar was 1.00±0.00 g/cm^3 and the mean Brix values were 4.90±0.00 °Brix (Table1). Similarly to the results of our study, Dabija and Hatnean (2014) found that the density of apple cider vinegar was 1.08±0.05 g/cm^3 and the Brix value was 3.60±0.00 °Brix.

In our study, the mean color values of vinegar samples were determined as L* (27.50±0.27), a* (1.58±0.27), and b* (1.61±0.17) (Table 1). In their study, Siddeeg et al. (2019) determined the color values of date vinegar as L* (45.44 ± 0.17), a* (- 0.33 ± 0.34) and b* (3.14 ± 0.33) (Siddeeg et al., 2019). It is considered that the difference between them was due to different date species used in the studies.

It was found that the dry matter values of date vinegar varied in the range of 2.45±0.04 g/L on average (Table 2). In the study carried out by Bakir et al. (2016), the dry matter values of grape and apple cider vinegar were found to be 3.8±0.30 and 4.3±0.40 g/L, respectively. It is considered that the difference between that study and the results of our study was due to the fact that water-insoluble dry matters (starch, cellulose, etc.) were less in date vinegar.

The mean pH values of vinegar samples were determined to be 3.44±0.02 (Table 2). In a study carried out by Zakaria and Mokhtar (2014), the pH value of apple cider vinegar was found to be 3.10±0.00 in parallel with our results.

The mean ash content of our samples was found to be 0.34±0.00 g/L (Table 2). In the study of Dabija and Hatnean (2014), the ash content in apple cider vinegar was found to be 3.25±1.25 g/L. This difference between the studies is considered to be due to higher mineral matter content of

Table 1: Physical analysis results of date vinegar.

Analyzes										
Samples	**Brix (°Brix)**	**Density (g/cm^3)**	**Colour**			**SensoryScores**				
			L*	**a***	**b***	**Colour**	**Aroma**	**Odor**	**Appearance**	**General appreciation**
Date vinegar	4.90±0.00	1.00±0.00	27.50±0.27	1.58±0.27	1.61±0.17	6.75±0.25	5.25±0.25	3.75±0.25	6.75±0.25	6.25±0.25

Table 2: Chemical analysis results of date vinegar.

	Analyzes							
Samples	**Dry matter content (g/L)**	**pH**	**Ash (g/L)**	**Conductivity (µS/cm)**	**Alcohol (%)**	**Total acidity (g/L)**	**Total antioxidant Teq (mL/L)**	**Total Phenolic ga (uL/mL)**
Date vinegar	2.45±0.04	3.44±0.02	0.34±0.0	4.92±0.04	-	11.88±0.12	10300.00±671.43	3310.37±44.44

Table 3: Mineral analysis results of datevinegar.

	Analyzes											
Samples	**Na(ppm)**	**Mg (ppm)**	**K (ppm)**	**Ca (ppm)**	**P (ppm)**	**Fe (ppm)**	**B (ppm)**	**Mn (ppm)**	**Zn (ppm)**	**Al (ppm)**	**Ni (ppm)**	**Sn(ppb)**
Date vinegar	31.68±0.08	2.58±0.30	163.25±0.67	9.63±0.18	39.43±0.50	0.75±0.00	0.31±0.00	0.47±0.00	1.47±0.00	0.11±0.00	0.01±0.00	6.79±0.02

apple cider vinegar as compared with date vinegar.

The mean conductivity values of date vinegar samples were found to be 4.92±0.04 mS/cm (Table 2). In the study carried out by Siddeeget al., (2019), it was determined that the conductivity value of date vinegar was 3.10±0.15 mS/cm, which was lower than our results. This difference between the studies is considered to be due to the types of dates used in the studies, and production and post-production storage times.

No alcohol was detected in any of the vinegar samples after six months of storage (Table 2). In a study carried out by Bayram et al. (2018), it was found that the alcohol values of apple cider vinegar were below 0.5%. There is a difference between that study and our study. This difference between the studies is due to the difference in storage time after production.

In this study, the mean total acidity values of date vinegar samples were found to be 11.88±0.12 g/L (Table 2). In the study carried out by Dabija and Hatnean (2014), it was found that the total acidity value of apple cider vinegar was 6.45±2.55 g/L, which was lower than our results. The differences between the two studies were due to the differences in raw materials used in production, fermentation time and storage time after fermentation.

The mean total antioxidant and total phenolic values of vinegar samples were determined to be 10300.00±671.43 Teq (ml/L) and 3310.37±44.4 ga (uL/mL), respectively (Table 2). In their study, Bakir et al. (2016) determined that the total antioxidant values of grape and apple cider vinegar were 1624±244 and 1087±149 Teq (ml/L), respectively and their total phenolic content was 842±171 and 459±58 ga (uL/mL), respectively. There are differences between the values obtained as a result of our study and the results obtained due to the fact that date vinegar is rich in carotenoids, phytosterols, and bioactive components and that total antioxidant and total phenolic values are higher.

In the present study, the mean mineral material values of date vinegar were determined as Potassium; 163.25±0.67 ppm, Phosphorus; 39.43±0.50 ppm, Sodium; 31.68±0.08 ppm, Calcium; 9.63±0.18 ppm and Magnesium; 2.58±0.30 ppm, respectively (Table 3). In the study on the mineral matter content of apple cider vinegar, Dabija and Hatnean (2014) found the mineral matter values as Aluminum; 237.71 µg/L, Sodium; 37.69 µg/L, Calcium; 32.03 µg/, Strontium; 14.91 µg/L and Nickel; 13.41 µg/L, respectively. The difference between that study and the results of our study was

due to the fruits used as raw materials.

The mean sensory analysis scores (color, aroma odor, appearance, general appreciation) given to vinegar samples by the panelists were 6.75±0.25, 5.25±0.25, 3.75±0.25, 6.75±0.25, and 6.25±0.25, respectively (Table 1). Similarly, in a study carried out by Siddeeg et al. (2019), the sensory analysis color, aroma, odor, appearance, and general appreciation values of date vinegar were found to be 6.85, 6.90, 7.60, 7.50, and 6.00, respectively.

Conclusion

In this study, physical, chemical, and sensory quality properties of date vinegar produced using conventional method were determined.

In physical analyses, it was determined that there were differences only in color values, and it is considered that it was due to the fact that more than one varieties of date were used and the geography where it was grown was effective. In chemical analyses, dry matter, ash, alcohol, total acidity, and mineral values were found to be different from other studies. The difference between the studies was due to the differences in the types of dates used and storage conditions.

Furthermore, the total antioxidant and total phenolic values of date vinegar were found to be quite high. This feature is due to the fact that date fruit is rich in carotenoids, phytosterols, and group B vitamins.

At present, most of the diseases are treated using chemical and synthetic drugs. These drugs have side effects that seriously threaten human health. This result directs human beings towards natural, herbal treatment methods. In particular, the antioxidant capacity of date vinegar content and high total phenolic ratio suggest that it can be used in the treatment of many diseases. Furthermore, the fact that date vinegar is a strong source of phosphorus was determined in this study. It is known that the foods with the highest levels of phosphorus are sea products, goat's milk, and dairy products produced from it. For people who do not consume these foods, date vinegar can be recommended as an alternative source.

It has been determined that date vinegar is an extremely useful food for human health from many aspects, such as lowering bad cholesterol, having antioxidant properties, preventing cancer, diabetes and cardiovascular diseases, due to phytochemicals and phosphorus it contains. In addition to all these, it is clear that date vinegar with functional features should be promoted in a way to reach the large masses and, necessary studies should be conducted to move the production from home conditions to industrial dimension.

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