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The Impact Of Traditional Co-Consumption On Food Nutrient Composition Values

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ABSTRACT

Background and Objectives: The nature of each region and society including the weather and the soil type play an important role in human health. Various types of coffee and date are spread extensively in gulph county. Arabic coffee (Saudi coffee) is the most popular brand that consume with ajwa dates several times / day in Saudi society. The natural components of coffee and date have been studied separately. The main purpose of presented work was to specify the exact influence of arabic coffee and ajwa date on each other nutritional value when consumed together.
Materials and Methods: Chromatography technique with certified reference standards method has been performed to determine the calibration and the component quantities for our samples under investigation. The content of sugar and minerals is identified and quantified using gas chromatography and inductively coupled plasma mass spectrometry.
Results: Mineral and sugar content changes were identified in pure arabic coffee and ajwa date samples compared to the combined mixture. Pure samples and mixtures both showed the same abundance of minerals in the same order (K, Mg, P, and Ca). No sugars were detected in arabic coffee (<0.1%m/m). Glucose, fructose, and total sugar were declined for ajwa in the mixture than pure sample.
Conclusion: Arabica coffee contains no sugar and is high in minerals, whereas Ajwa contains both sugar and minerals, but their combined usage reduces their sugar and mineral content. The reducing amounts of minerals and sugar were within the range of values reported in the health requirements.

Key words: Arabic coffee, Ajwa, Certified Reference Standards, Inductively Coupled Plasma-Mass Spectrometry, Gas Chromatography- Mass Spectrometry.

INTRODUCTION

The characteristic of human being usually interacts with all surrounded factors include climate and geographical regions. Regions and societies have different traditions that also affect individual personalities, behaviors, and health conditions. Coffee is a popular lifestyle drink all over the world because to its distinct scent and flavor, as well as its benefits as a stimulant in improving mental efficiency (Cecilia et al., 2012; Poole et al., 2017). Gulph region especially Saudi Arabia have a traditional coffee style known as Saudi coffee (Arabic coffee). Traditionally the consumption of arabic coffee usually associated with all date types and served together (Al-Mssallem and Brown., 2013). Also, coffee and dates are type of the main hospitality custom in this region of the world. Date planted in different nation of the world such as Iraq, Egypt, Saudi Arabia, Pakistan, and Mexco, which exist in varied kinds for instance: khalas, barhi, beid, sukkary, safawi, anbara and ajwa. (Nadeem et al., 2019; Salomón-Torres et al., 2019, Anwar et al., 2022). Essentially, ajwa (Phoenix dactylifera L) is one of the most important type of dates that have a well-known religious and health values (Al Harthi, 2015; Ahmed et al., 2022). Moreover, its grown mainly and only in Saudi Arabia particularly in Al Medina city. It's a distinctive historic holy palm tree, their advantages have been illustrated before fifteen centuries in prophet Mohammed sunnah (Mallhi et al., 2014). Previous studies and analyses identified a substantial composition in ajwa date (Sumaira et al., 2017; Anwar et al., 2022). The significant impact of Phoenix dactylifera L on human health condition is derived from their bioactive molecules including sugar, flavonoids, vitamins, fibers, phenols, and minerals while very low level of protein was found (Assirey, 2015; Selvam, 2008; Vayalil, 2012). Enormous benefits of date fruits on disease therapeutic protocols were published that present a clear interaction between ajwa natural compositions with treatment plans (Vembu et al., 2012; Amir et al., 2020). The prevention and therapeutic role of ajwa on cardiac, diabetic, and lung inflammation cases were demonstrated (Al-Laith, 2009; Orabi and Shawky, 2014; Najafi, 2011; Al-Khalili et al., 2023).

With regards to arabic coffee, Saudi society use it as the main traditional drink and usually intake with different types of dates. Moreover, arabic coffee and ajwa are served together as traditional Saudi hospitality style and consumed together daily as a social and traditional custom (Al- Othman et al., 2012).

The beneficial influence of coffee on health function have been studied, significantly several phenol types with antioxidant impact were identified (Hamzaa and Osman, 2012; Sualeh et al., 2020). Volatile and non-volatile molecules, caffein, sugar, and minerals were identified in most coffee natures (Cecilia et al., 2012). Each coffee bean condition (e.g. preparing and crocking method, dry or wet coffee beans, roasted or green beans) exhibit different pattern of natural substances, or it may display similar elements with distinct amount (Butt & Sultan, 2011). Researchers demonstrate that the incidents of type2-diabets, Parkinson's, and cardiovascular diseases states were declined with moderate coffee consumption (Yashin et al., 2017; O'Keefe et al., 2013). Obviously, the assessment of natural compositions for ajwa and arabic coffee mixture haven't been investigated before.

METHODOLOGY

Sample Preparation and devices

All ajwa and coffee beans were obtained from Saudi market, and each type prepared in a manner appropriate to the device conditions applied for sample analysis. 0.5 ml of ajwa homogenous paste was mixed with 0.5 ml of coffee, data were the mean of triplicate technical injections assessed by Gas Chromatography (Agilent 7890B GC-FID System) with addition to Analytical Grade of Certified Reference standards and determine the concentrations by % m/m dry weight. The assessment of minerals was carried out by Inductively Coupled Plasma Mass Spectrometer (ICP-MS, Perkin Elmer Nexion 350D ICP Mass Spectrometer) and Synergistix Software (v 1.0). The specification of each mineral concentration completed using Certified Reference Standards.

For minerals and sugar evaluation

Arabic coffee preparing ratio was 15g of coffee for 237ml of hot Milli-Qwater, and then 30 ml of the mixture was analyzed as negative control. Ajwa samples A homogeneous ajwa paste was derived from 22 g of ajwa flesh (equal to 3 ajwa pieces). A glass rod and vortex (Corning® LSE™ vortex mixers) applied to mix the homogeneous paste with 30 ml of hot Milli-Qwater to prepare the negative control. Blank reagent samples were prepared as investigated samples.

For minerals quantification

The mixture sample of ajwa with arabic coffee was prepared by mixing of 2.5 ml of nitric acid (HNO3, 65% Supr apur®) with 1 ml of hydrogenperoxide (H2O2, 30% Suprapur®) was placed in a Teflon vessel (model xp-1500 plus, CEM Corporation, Matthews, USA). 0.5 ml of coffee with 0.5 ml of ajwa paste mixed well then added to the Teflon vessel as well. The Teflon vessel containing the ajwa / coffee mixture transferred to Hotblock (35-Well 50ml HotBlockTM digestor) at 150ºC for digestion purposes. When the mixture reached the room temperature, sample was diluted with 10 ml Milli-Qwater (18.2 MΩ), and then filtered with 0.45 µm syringe filters. For sample injection purpose, dilution ratio was 1:5 and 1:10 of 5% HNO3 to sample mixture. Finally, Mineral Certified Reference Standards (TCT Inorganic Ventures), 5% of nitric acid solution (HNO3, 65% Supr apur®) applied to dilute all Macro element under investigation to reach calibration levels to detect eluted elements in digested samples. The Standard Mode and kinetic energy discrimination mode (KED) was used as mode detectors at a confident clear mass to charge ratio with lowest interference to identify minerals under investigation (Na, K, Ca, P, Cu, Fe, Mn, Mg, and Zn).

For sugar measurement

Samples of Arabic coffee and ajwa was combined as a homogeneous paste of three ajwa fleshes (22g) mixed with 30ml of arabic coffee was vortexed (Corning® LSE™ vortex mixers) and sonicated for 60-70min (Q2000 Sonicator®) at 60°C. Sample mixed with 10ml of 96% ethanol and centrifuged at 3000-5000rpm for 20min. To reach final sample extraction, nitrogen stream was applied to dry the supernatant part that contain the sugars. The oximation and silylation procedure were produced, 50g of methyl hydroxylamine hydrochloride was added to a combination of 800µl of mixture sample with 800µl of sugar standard solutions incubated on heat plate for 60min at 85°C. On heat plate, 200µl of Silylation reagent (N,O-bis(trimethylsilyl) trifluoroacetamide) was added then incubated 40-50min at 80°C. Finally, samples were centrifuged at 8000× g and 25°C for 10min, and then 1µl was injected in the Agilent 7890B GC-FID System with Open Lab CDS Chem Station system (rev C.01 06). Carrier Gas: Helium Column Oven Temp: 80ºC, Injection Mode: Split mode, Detector: Flame ionization detector, while the GC-FID Parameters were adjusted (Gas chromatography column: ZB (30m x 0.25mm x 0.25µm)). The concentration of sugars under assessment process were identified from adding 10mg of calibration sugar standards to 800µl dried Pyridine (MERCK Index-No 613-002-00-7).

Analytical Grade of Certified Reference standards of sugars were purchased from Sigma (Sigma CAS Number: Fructose: 57-48-7, Glucose: 50-99-7, Sucrose: 57-50-1, Lactose: 64044-51.5, Maltose: 6363-53-7, Sorbitol: 50-70-4, Galactose: 59-23-4).

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RESULTS

1) Sugar detections

Sharp clear sugar peaks performed for standard sugars analysis Figure 1. Essentially, pure arabic coffee demonstrated no sugar contents related to standard peaks Figure 2A in contrast to the mixture samples Figure 2B. Our prior study revealed pure ajwa chromatogram analysis (Attiyah, 2023). Distinguish chromatogram sugar peaks were identified associated to standard detected peaks with different concentrations for each sugar and each sample. Apparently, glucose, fructose, and total sugar amounts were altered the concentrations in mixture of ajwa arabic coffee compared to pure ajwa Table 1. The concentrations of lactose, sucrose, and maltose was noted to be equaled for pure ajwa, and the mixture with coffee as well (<0.1%m/m) and scored a lowest sugar amounts Table 1 and Figure 3. No sugars were identified in arabic coffee. In ajwa sample the total sugar, glucose and fructose amounts were declined in the mixture model to reach 26.54, 15.3 & 10.40 respectively.

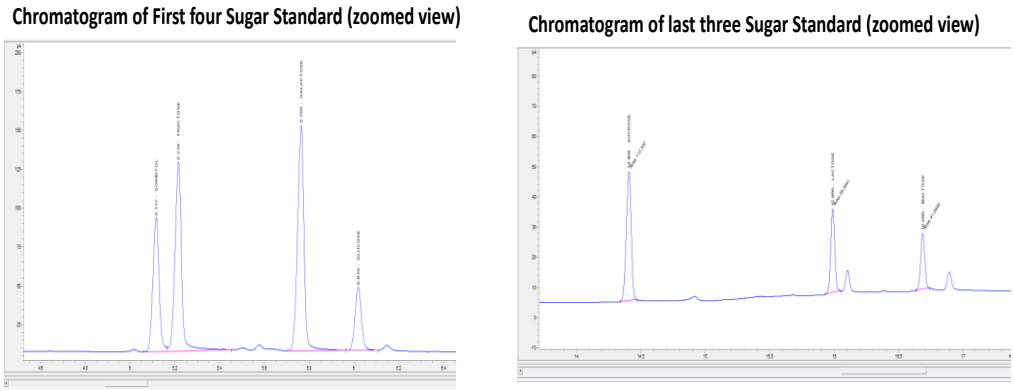
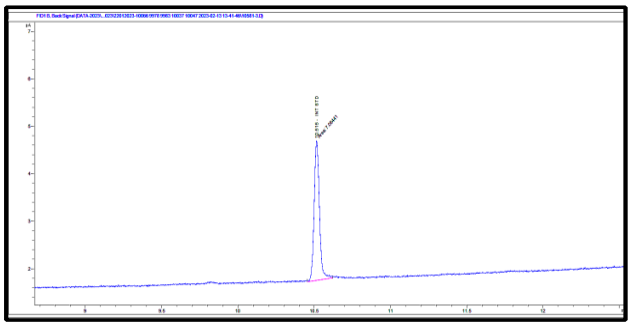


Figure 1: Chromatogram analysis of sugars**.** Internal standard analysis with sugar standard, Injection Mode was the Split mode, and the Detector: Flame ionization detector. Two graphs revealed the zoomed view for the first four and last three sugars as sharp peaks.

A) Chromatogram of Arabic coffee sample (showed Internal Standard only)



B) Chromatogram of the mixture (ajwa with arabic coffee)

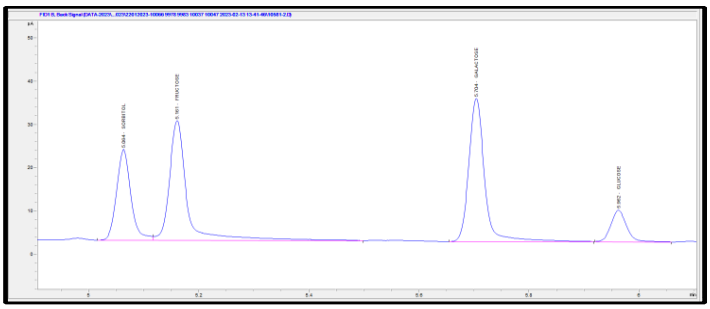


Figure 2: The chromatogram analysis of arabic coffee and the mixture samples. A) chromatogram analysis of pure arabic coffee sample (only Internal standard present and no sugars was detected). B) Chromatogram analysis of sugar profile found in the mixture (arabic coffee /ajwa).

Sugar (m/m %)	Arabic coffee	Ajwa	Mixture
Galactose	<0.1	0.12	0.04
Glucose	<0.1	34.85	15.35
Sucrose	<0.1	<0.1	<0.1
Lactose	<0.1	<0.1	<0.1
Maltose	<0.1	<0.1	<0.1
Sorbitol	<0.1	25.89	10.40
Fructose	<0.1	1.8	0.75
Total Sugar	<0.5	62.66	26.54

Table 1. Exploring sugar determinations using Gas chromatography and Certified Reference standards

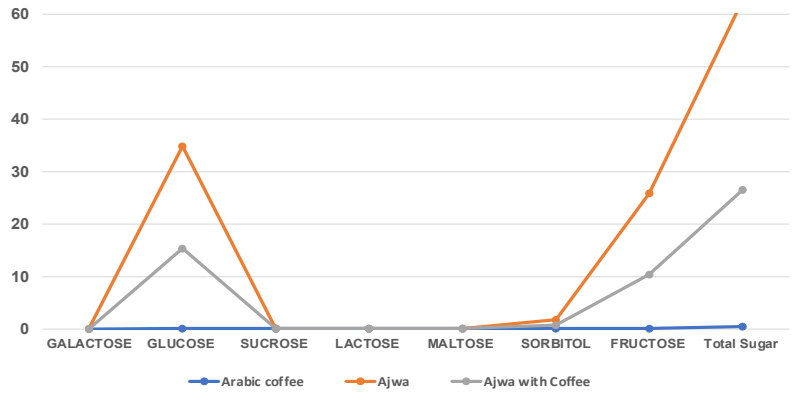


Figure 3: Ajwa and Arabic coffee and their mixture sugars concentrations.

2) Minerals

First: Mineral Certified Reference Standards and Calibration

The Certified reference material TCT Inorganic Ventures solution was a major aspect in the method applied in the present work. A minimum of matrix interference for mineral calibration curves was accepted by the calculation of regression of intercepts (intercepts=zero). The spearson's factors (r^2, ≥0.9998) was achieved from the straight line that obtained for all minerals under investigation (Attiyah, 2023). The stability of mineral concentrations may be shown across all analytical steps. The internal standard of the recovery % is presented by ICP-MS Figure 4.

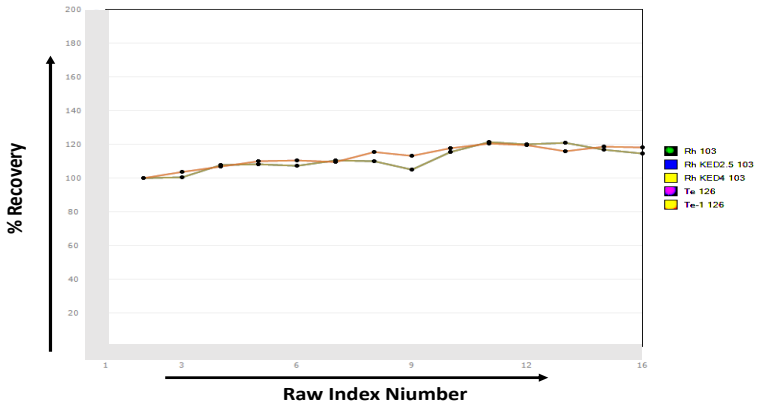


Figure 4: Accurate mass to charge ratio with the lowest interference used to achieve the calibration curves of involved minerals (Na, K, P, Ca, Cu, Fe, Zn, Mn & Mg).

Second: Minerals detection

Certified reference material TCT Inorganic Ventures and ICP-MS technique demonstrate mineral concentrations by mg/kg dry weight (data were the mean of triplicate technical injections). Three pieces of ajwa generate a homogenous paste, a mixture of 0.5 ml of coffee with 0.5 ml of ajwa paste were analyzed and obtained comparison results were presented in table 2. Obvious fluctuation of mineral levels was observed with highest mineral concentration identified for

potassium in all samples (K = (ajwa: 8722, mixture: 3738, coffee: 987 mg/kg). The other abundant minerals following K were as the following order: Mg, P, and Ca in both pure samples, but those produced with less amount in pure coffee than ajwa sample. In addition, the mixture sample provide a great mineral concentration with abundant order as follow: K, P, Mg, and Ca. Other minerals (Zn= 10.4, Fe= 4, Mn= 1.8, & Cu= 1.3 mg/kg) in the mixture condition obtained lower amounts than in pure ajwa sample (Zn= 22.7, Fe= 7.5, Mn= 8.2, & Cu= 4.3 mg/kg). Essentially, lowest mineral levels were produced by pure arabic coffee sample, and minimum concentrations among them were Na= <0.1, Cu= 0.6, Mn= 0.7 mg/kg, whereas other elements found with an adequate amount. Figure 5 showing a graph of the numerical mineral amounts.

Minerals (mg/kg)	Arabic Coffee	Ajwa	Mixture
P 32	50.3	647.4	261.3
Mg 25	74.0	857.4	238.9
Na 23	<0.1	24.1	20.5
K-1 39	987	8722	3738
Ca 43	35.4	638.7	220.0
Mn 55	0.7	8.2	1.8
Fe 56	1.3	7.5	4.0
Cu 63	0.6	4.3	1.3
Zn 66	6.2	22.7	10.4

Table 2. The detection of mineral quantities in investigated samples.

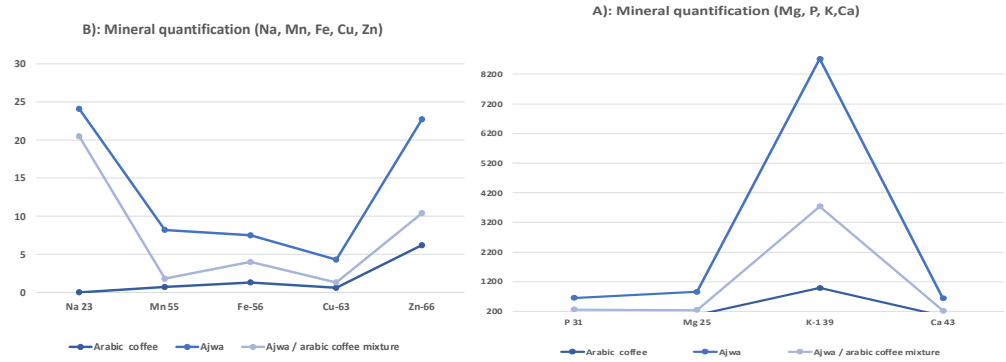


Figure 5: Graphical illustration of mineral quantities. A): Minerals with abundant existence amounts in all analyzed samples with highest concentration for K in ajwa. B): Display the variation of mineral with low concentrations among samples, Na in arabic coffee was the lowest between all other conditions.

DISCUSION

Dates have a strong nutritional profile and are incredibly nutritious, containing carbohydrates, proteins, fiber, and potassium. The unique phytochemical composition of ajwa dates has the potential to treat a wide range of diseases. Because of its high sugar, dietary fiber, vital mineral, and vitamin content, Ajwa date fruit stands out among all others (Mohamad et al., 2022 and Hossam et al., 2023).

Coffee is one of the most widely used stimulant beverages. For many people, drinking coffee is a way of life and a regular habit. Several studies have shown that drinking coffee helps to lower the risk of a variety of health issues (Zain et al., 2017). Arabic coffee gained an acceptable attention from researchers to investigate its influence on human health, especially, they pointed that there is no consistent evidence of a link between coffee drinking and negative health effects. (Poole et al., 2017). Arabic coffee is the most popular hot beverage in Saudi Arabia and is a part of Saudi culture.
Traditional lifestyles have a significant impact on people's health; health is influenced by a variety of elements, including dietary quality and quantity (Khalid et al., 2016; Nadeem et al., 2019). Because ajwa is a powerful healthy food and arabic coffee has both good and bad effects on human health, we wanted to investigate the effect of drinking arabic coffee with ajwa dates on each other's natural content value. This necessitates answering a crucial question: Does the combination have more sugar and mineral content than pure ajwa or coffee consumption?
The existing work revealed distinguish quantities of sugar and mineral for each condition. Each element under investigation obtained distinguish concentration patterns in the mixture condition than pure samples. All date types known

as a good source of sugars but ajwa is the least content of sugar among them. Monosaccharaides was the abundant sugar type in pure ajwa with suitable amounts that is safe for healthy individual to consume three to five pieces each day as reported in American Heart Association (AHA).

The monosaccharide sucrose was undetectable (<0.1%m /m) in pure ajwa and mixture samples that caused by the transformation ability of sucrose to glucose and fructose (Vayalil, 2012; Rastegar et al., 2012 & Attiyah 2023). While galactose showed the least amount among monosaccharide (0.12%m/ m). The lower sugar concentrations were identified for the disaccharide's sugars (maltose & lactose) which explain that the total sugar amount mainly derived from monosaccharides (total sugar= 62.66 %m /m) offering ajwa with more positive values. Sorbitol sugar a type of alcohol sugar presented in pure ajwa sample by small amount (1.8%m /m) that describe the moderate sweet tase of ajwa than other dates (Ruiz-Ojeda et al., 2019). No alteration in sugar abundancy were identified in the mixture sample particularly for disaccharides with steady equal low amounts (sucrose = maltose = lactose =<0.1%m /m) for the three conditions under investigation. Obvious declined for glucose, fructose, and the total sugar amounts were obtained in the mixture sample than in pure ajwa that display the impact of arabic coffee on sugar contents for ajwa. This advantage seems to be a crucial for people using ajwa as a source of natural minerals, but high sugar level may negatively affect their health condition such as diabetic patients, elderly, and pregnant women. In contrast to previous study that indicated to the negative impact of arabic coffee consumption with Khulas dates in five healthy persons causing an increase of glycemic index (Al-Mssallem and Brown 2013). The variation between our findings and Al-Mssallem study in 2013 were mainly derived from date types under both investigations. Ajwa and Khulas dates are different in sugar and mineral amounts with more sugar was identified in Khulas (Al-Juhaimi et al., 2014) which explain the variant between data, also the study should involve more than five individuals to be more precise. Although, low glycemic index was produced when pairs of ajwa consumed as reported in 2020 (Al-alwan et al., 2020; Yargholi et al., 2021). Moreover, ajwa induced the production of monosaccharides for arabic coffee in the mixture than in pure coffee sample presenting a great increase of total sugar amount from <0.5 to 26.54 %m /m, and an excessive rise for glucose and fructose as well.

Pure samples exhibited different mineral concentrations which altered in the mixture condition. The alteration indicated to the impact of ajwa and coffee on each other content amounts in the mixture. The most abundant minerals within all samples were potassium with exceed concentration in pure ajwa which was compatible with previous study (Ayad et al., 2020). Additionally, potassium was reported as a predominant microelement in most date kinds with less amount of calcium and phosphorus that matching current data (Assirey, 2015). As well as pure arabic coffee sample produce perfect amount of potassium (K=987mg/ kg) and the mixture contained excellent potassium concentration too (3738mg/ kg). Considerably, high potassium concentration is a risky aspect for kidney patients and must be controlled to decrease mortality (Picard et al., 2020). Data achieved crucial information for kidney patients to decide to intake the mixture, or separately depend on potassium amount. The macronutrients (Ca, K, Mg, & P) were induced by an adequate amount from pure coffee sample, while micronutrients (Cu, Fe, Mn, & Zn) were detected to a lesser extent.

The characteristic of abundant mineral distribution order for each element in each sample remains the same as in the mixture but presented in different amounts. The dual influence showed that coffee contents caused a reduction of all mineral levels for ajwa in the mixture. While ajwa triggered and increase mineral concentrations for arabic coffee in the mixture. The consumption of ajwa with arabic coffee seemed to be not harmful for individual health whether used separately or together.

CONCLUSION

In conclusion, ajwa date fruit has the potential to become a key food ingredient. Shift alterations of sugar and mineral concentrations were identified in the present work. It was shown that drinking coffee with ajwa had a considerable influence on both sugar and mineral levels. Our study has offered a framework for additional investigation and more studies into the effectiveness of different identified therapeutic effects for health problems.

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