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Preparation and chemical characterization of Date syrup from underutilized Date Palm varieties

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ABSTRACT

The date palm (*Phoenix dactylifera* L.) is a valuable fruit tree renowned for its nutritional, commercial, and therapeutic benefits, especially in arid regions. In Pakistan, particularly Balochistan, large quantities of low-quality dates remain underutilized, leading to significant post-harvest losses and limited market value. This study focused on enhancing the value of these neglected dates from the Kech district (Turbat) by producing traditional date syrup, locally known as Sherg, through drying, soaking, boiling, filtering, and concentration processes. Comprehensive chemical analysis confirmed the syrup's nutritional richness and stability, with moisture content at 21.32 ± 0.65%, pH of 4.51 ± 0.06, ash at 2.03 ± 0.04%, and protein at 1.75 ±

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0.31%. High-performance liquid chromatography (HPLC) revealed that glucose (31.42 ± 0.71 g/100g) and fructose (11.53 to 30.03 g/100g) were the dominant sugars, while sucrose levels were comparatively low (2.76 to 26.12 g/100g). Mineral profiling highlighted significant amounts of potassium (2416 mg/kg), magnesium (223.83 mg/kg), calcium, sodium, iron, zinc, manganese, and copper, underscoring the syrup's functional potential as a natural source of vital micronutrients. Compared to other natural sweeteners like honey and maple syrup, date syrup demonstrated superior protein and mineral content, establishing it as a nutrient-dense, healthful alternative. These findings indicate that converting low-quality dates into shelf-stable, nutrient-rich syrup not only improves their economic value but also offers promising opportunities for local industry development. The study also identifies gaps in processing optimization and scale-up efforts for industrial production in Pakistan.

Key Words: Date palm syrup, Functional food, Nutritional composition, Underutilized dates.

Introduction

The date palm (*Phoenix dactylifera* L.) belongs to the Palmaceae (Arecaceae) family, which includes over 200 genera and 1,500 species, and is considered one of the earliest cultivated plants with a history spanning over 7,000 years. Originating in Mesopotamia, date palms have played a vital role as a nutritious food source across ancient civilizations and continue to hold significant cultural and nutritional importance, especially in Middle Eastern countries where they are regarded as a functional food due to their numerous health benefits (Kader & Hussain, 2009; Dawson, 1982).

Date palms thrive in arid environments with high temperature tolerance, making them well-suited for cultivation in semi-arid and desert regions including parts of the Middle East, North Africa, and South Asia. Various cultivars have been developed worldwide, some widely commercialized such as Deglet Noor, Zahidi, and Medjool, while others remain underutilized but hold potential due to their unique nutritional profiles (Huang, 2006; Nixon, 1951).

Dates contain a complex composition of carbohydrates, proteins, fats, dietary fibers, minerals, vitamins, and bioactive compounds, which contribute to their value as a nutrient-dense fruit and natural sweetener. The fruit undergoes multiple ripening stages hababauk, kimri, khalal, rutab, and tamer that influence its texture, sugar composition, and antioxidant content. The carbohydrate predominantly, the sugar content, containing reducing sugars such as glucose and fructose, their contents increase distinctly during fruit ripening process, which enhance the fruit's sweetness and nutritional appeal (Eltayeb, 1999; Al-Shahib & Marshall, 2003; Biglari, 2009).

Despite the importance of date palms around the world, research has mostly looked at well-known types. Underused local varieties have received little attention. This study aims to fill that gap by examining how to prepare and chemically analyze date syrup made from these underutilized date palm varieties. It will highlight their nutritional benefits and potential as alternative natural sweeteners that may offer health benefits. The local date palm varieties and their farming could be boosted by promoting the underutilized varieties which obviously create economic opportunities for farmers and

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encourage healthier habits of eating (Barreveld, 1993; Al-Farsi et al., 2005).
The present study was carried out with the aims to create a reliable way for making locally prepared date syrup from district Ketch (Turbat) underutilized varieties, to analyze the chemical composition, and to compare the nutritional quality with already reported ones.

Materials and Methods

Sample Collection

The underutilized Date fruits samples were collected from the district Kech (Turbat) in Balochistan province of Pakistan. Different date fruits were collected, the samples were selected such as by focusing on underutilized and/or known as lower-quality, with the purpose of improving the market value of selected varieties. This study intended to increase both the utilization and economic potential of these underutilized date varieties through the manufacture of date syrup.

Preparation of Date Syrup (Sherg)

The preparation of date syrup was carried out following a traditional local method. Initially, the date fruits were sun-dried over several days. After drying, the fruits were thoroughly cleaned using tap water and then soaked in water for 24 hours. The soaked dates were boiled and subsequently cooled. Seeds were removed by straining the mixture through a clean cloth. The resulting filtered liquid was reheated multiple times until it thickened to a dense, viscous paste, forming the date syrup.

Determination of Chemical Composition

The chemical composition of the syrup samples was assessed according to standardized protocols from the Association of Official Analytical Chemists (AOAC, 1997):
Moisture content was measured by vacuum oven drying at 80°C.
Ash content was determined by incineration at 550°C.
Protein levels were calculated using the micro-Kjeldahl method, with a nitrogen-to-protein conversion factor of 6.25.

Determination of pH and Density

The pH values of the syrup samples were measured with a Basic 20 pH meter equipped with a glass-combined electrode following AOAC (1997) guidelines. Density measurements were conducted using 50 mL pycnometers calibrated with distilled water at 25°C. Filled pycnometers were equilibrated in a thermostatic water bath at 25°C (±0.1°C) before weighing with a Sartorius-GE412 analytical balance with four-digit precision (Germany) as per the method described by Cepeda and Villarán (1999).

Sugar Content Analysis

Sugars including glucose, fructose, and sucrose were quantified following AOAC (1990) procedures. Samples (2.5 g) were homogenized with 100 mL distilled water and centrifuged at 9,200 rpm for 10 minutes. The supernatant was filtered through a

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0.45 µm membrane filter, and 20 µL of the filtrate was injected into an Agilent 1200 HPLC system equipped with a Refractive Index Detector (RID) and an Agilent Zorbax Carbohydrate column (4.6 × 250 mm, 5 µm particle size). The mobile phase consisted of acetonitrile and deionized water (65:35 v/v) delivered isocratically at 0.8 mL/min. The column and detector were maintained at 30°C. Analysis time per sample was 10 minutes (Çalişkan & Polat, 2011).

Mineral Content Determination

Minerals including iron (Fe), manganese (Mn), calcium (Ca), zinc (Zn), copper (Cu), and magnesium (Mg) were analyzed using atomic absorption spectrophotometry (Shimadzu, Model AA670G) following AOAC (1997) protocols. Potassium (K) and sodium (Na) concentrations were measured using a flame photometer (Model 405 CORNING, England).

Statistical Analysis

All analyses were conducted in triplicate, and results are presented as mean ± standard deviation (SD). Significant differences among the syrup samples were identified using one-way analysis of variance (ANOVA). When significance was detected ($p < 0.05$), Tukey's Honest Significant Difference (HSD) test was applied for multiple comparisons. Data normality and homogeneity of variances were verified using the Shapiro-Wilk and Levene's tests, respectively, prior to ANOVA. Statistical analyses were performed using IBM SPSS Statistics (Version 25.0) or an equivalent software package.

Results and Discussion

This study aimed to evaluate the chemical composition of low-value date varieties from the Kech district (Turbat) and enhance their market potential by producing date syrup locally known as Sherg. The focus was on converting underutilized dates into a value-added product with improved nutritional and economic significance.

Chemical Composition of Date Syrup

Table 1 shows the chemical composition of the prepared date syrup from locally low grade / underutilized dates by adopting traditional methods.

Moisture Content

The moisture content of the prepared date syrup was measured at 21.32 ± 0.65%. The obtained value is distinctive for date syrups, then the reported value which is lower significantly than that of reported for fresh dates. Low level of moisture gives the date syrup a thick consistency an increase the shelf life and reduces microbial growth.

Date syrup in comparison to the natural syrup such as honey and maple syrup has higher moisture content, and this property gives it a stable texture. These obtained results are in consistent with those of Farahnaky et al. (2016), in which the authors reported that the moisture content of 24.07 ± 0.72% in commercially produced date syrup from Iran. Comparatively observed low moisture is important for product's stability and safety during storage.

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pH

The prepared date syrup showed slightly acidic pH of 4.51 ± 0.06, this acidic nature prevents microbial growth and enhances the flavor. Acidity also enhances the sweetness of the date syrup, which responds to provide sweet taste. It has been reported in a study published that the acidity helps the flavor and gives protection against microbial growth and resultantly the date syrup could be kept long without the need of preservatives (Badawi & Geneidi, 2019).

Ash Content

The results obtained show that the date syrup had a high ash content of 2.03 ± 0.04%. Higher ash content made date syrup a rich source of minerals, as well as other important dietary elements such as calcium, magnesium, and potassium, higher mineral contents increase the date syrup's nutritional value. The higher mineral content of date syrup positioned it as a functional food (Al-Farsi & Lee, 2008). The high ash content in date syrup position it upper part among the other common sweet syrups due to its higher nutritional properties.

Protein Content

Protein content in the prepared date syrup was observed at 1.75 ± 0.31%. Whereas the observed level is a bit low as compared to protein-rich foods, it is moderately higher than many plant-derived natural syrups. This modest protein presence, attributable to inherent amino acids in the date fruit, adds nutritional value beyond sweetness alone. Farahnaky et al. (2018) reported similar protein levels, reinforcing date syrup's role as a nutrient-rich sweetener. Such protein content is especially valuable when date syrup is used in foods like smoothies or yogurts, contributing beneficially to diet quality.

Sugar Profile

The sugar analysis revealed glucose (31.42 ± 0.71 g/100g) and fructose (11.53 to 30.03 g/100g) as the dominant sugars, consistent with literature showing these as the primary sugars in date fruit. Sucrose content was generally low (2.76 to 26.12 g/100g), varying widely likely due to differences in date variety, ripeness, and processing methods. The enzymatic activity of invertase during ripening and syrup processing is known to hydrolyze sucrose into glucose and fructose, explaining this distribution.

Sucrose levels varied significantly due to varietal differences and processing conditions, confirming findings from Al-Hooti et al. (1997) who emphasized the impact of cultivar and method on sugar content.

Glucose content matched closely with values reported by Al-Farsi et al. (2005) and Ahmed et al. (1995) across different date syrups, corroborating its consistent presence as the predominant simple sugar.

Fructose levels showed substantial variation and are a major contributor to the syrup's sweetness due to fructose's higher sweetening power relative to glucose. This variability is influenced by fruit maturity and processing, as noted by Al-Farsi et al. (2007).

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Table.1. Chemical and Mineral composition of date syrup

S.No.	Composition	Value (Mean ± SD)	Unit
	Chemical Composition		
1	Moisture	21.32 ± 0.65[b]	%
2	pH	4.51 ± 0.06	-
3	Ash	2.03 ± 0.04[b]	%
4	Protein	1.75 ± 0.31	%
	Mineral Composition		
5	Copper (Cu)	4.28 ± 0.1	mg/100g DW
6	Manganese (Mn)	2.42 ± 0.1	mg/100g DW
7	Iron (Fe)	11.21 ± 0.2	mg/100g DW
8	Zinc (Zn)	1.91 ± 0.1	mg/100g DW
9	Calcium (Ca)	443 ± 0.3	mg/100g DW
10	Magnesium (Mg)	223.83 ± 1.3	mg/100g DW
11	Potassium (K)	2416 ± 16	mg/100g DW
12	Sodium (Na)	339 ± 3.6	mg/100g DW

Values are means ± standard deviations of triplicate measurements. Different letters in the chemical composition rows indicate significant differences ($p < 0.05$).

Mineral Content

The mineral analysis highlighted a broad and nutritionally valuable mineral profile (Table 1), confirming date syrup not only as a sweetener but also as a rich source of essential minerals:

Potassium was the most abundant mineral (2416 mg/100g), vital for fluid balance, nerve function, muscular contractions, and cardiovascular health, consistent with findings by Al-Farsi and Lee (2008).

Calcium (443 mg/100g) supports bone health and nerve signaling, with levels higher than many commercially available syrups.

Magnesium (223.83 mg/100g) contributes to enzyme activation and muscle function, aligning with reports by Karim et al. (2011) on magnesium's dietary importance.

Iron (11.21 mg/100g) is essential for oxygen transport and energy metabolism, beneficial for populations prone to iron deficiency.

Copper (4.28 mg/100g) and Manganese (2.42 mg/100g) play crucial roles in metabolism and antioxidant defense.

Zinc (1.91 mg/100g), although low, contributes to immune function and wound healing.

Sodium (339 mg/100g) was moderate, unlikely to pose health risks when consumed in reasonable amounts.

This mineral richness enhances the functional food potential of date syrup, offering meaningful contributions to nutritional health beyond simple sweetness.

Conclusion

This study successfully demonstrated the conversion of low-value and underutilized date varieties from Kech (Turbat), Balochistan, into Sherg nutrient-rich date syrup

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with significant functional and nutritional potential. The syrup exhibited stable pH and moisture content conducive to shelf stability, along with elevated levels of vital carbohydrates, proteins, and minerals, particularly potassium and magnesium.

Compared to other natural sweeteners such as honey and maple syrup, date syrup showed higher protein and mineral contents, positioning it as a nutrient-dense, health-beneficial alternative. These findings support its use as a functional food that can improve food security, reduce post-harvest losses, and create income-generating opportunities locally. There are a lot of challenges which remain to be addressed for standardizing the syrup production, which could ensure the final product consistency, and grading up the product's industrial demand. Future research is needed to focus on improving extraction techniques, studying bioactive compounds, and assessing consumer acceptance in larger markets. Scaling up the above-mentioned areas will help turn the date syrup from a handcrafted product into a viable commercial functional food ingredient.

Recommendations

To enhance syrup production, it is vital to adopt modern traditional processing methods. These measures will also enhance yield, retain bioactive compounds intact, and maintain syrup's consistency. Market opportunities can be increased by establishing national standards for quality and safety as well as by diversifying products into beverages, nutraceuticals, and natural sweeteners. Promoting date syrup as a healthier substitute for other sweeteners requires market research and consumer awareness initiatives.

Clinical research is required to confirm its nutritional and medicinal benefits, but large-scale industrial production in areas like Balochistan, backed by the government and stakeholders, can strengthen local economies. Last but not least, including eco-friendly processing, cold storage, and enhanced supply chains will reduce post-harvest losses and encourage the long-term usage of underutilized date types.

Conflict of Interest

Author declares no conflict of interest

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