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ORIGINAL ARTICLE

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Assessment of Date Fruit and Derivative Consumption Patterns and Their Nutritional Contribution to Daily Intake in Biskra, Algeria

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ABSTRACT

Background: Date fruits nutritionally dense staples with a long history of dietary application, particularly in arid regions. Despite their recognized nutritional value, empirical data on actual consumption and their quantitative contribution to daily nutrient intake remain limited.

Aims: This study aimed to investigate the consumption habits associated with date fruits and their derived products, and to evaluate their contribution to the daily nutritional intake of the population in Biskra, Algeria.

Participants and Methods: A cross-sectional, face-to-face survey was conducted among a convenience sample of 108 participants residing in Biskra between 2022 and 2023. The questionnaire encompassed three sections: sociodemographic characteristics, consumption behaviors related to dates and their derivatives, and a 24-hour dietary recall.

Results: A total of 10 date cultivars and 19 derivative products were reported. *Deglet Nour* was the most frequently consumed cultivar (41%), while the most prevalent derived products were *Makroud* (22.4%), *Bradj* (21.1%), and *Rfis* (19.7%). The highest consumption percentage (34.69%) occurred during the afternoon snack period. The mean annual intake was estimated at 11.24 ± 14.88 kg/person, with an annual frequency of weekly consumption (60.19%). Participants from higher-income households exhibited significantly greater consumption of date-based sugar (p = 0.018), chocolate spread (p = 0.018), and chocolate bars (p = 0). Consumption of *Ziraoui* and *El Marsa* derivatives was significantly associated with participants originating from Batna and Oued Souf, respectively (p = 0.000 for both). The contribution of dates and their derivatives to daily dietary intake was 3.47% for energy, 5% for carbohydrates, 1% for proteins, and 1% for lipids. All participants reported consuming dates or their derivatives, with mean daily consumption of 3 ± 4 dates/day. Employees exhibited the highest daily contribution of dates to caloric (p = 0.022); carbohydrate (p = 0.032), protein (p = 0.023), and lipid (p = 0.027) intake among occupational groups.

Conclusions: This study emphasizes the substantial role of date fruits and their derivatives in the daily diets of the Biskra population and demonstrates that how consumption behaviors are influenced by certain sociodemographic factors.

Keywords: Date Palm Fruit; Dietary Intake; Food Preferences; Nutrition Survey; Sociodemographic Factors.

Article Information

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1 INTRODUCTION

Nutrition plays a fundamental role in maintaining good health and preventing disease. A balanced diet must supply the essential nutrients required for proper physiological function and overall well-being (Gupta, 2019). In recent years, scholarly interest has increasingly focused on exploring the potential emotional and physical health benefits of various natural foods within the context of a balanced diet (Kulkarni *et al.,* 2015; Sánchez-Villegas & Martínez-Lapiscina, 2018).

Fresh and dried fruits constitute a vital part of the human diet. Demand for these fruits has been steadily increasing (Seymour *et al.,* 1993) as they are rich sources of carbohydrates, minerals, and vitamins (Fulton *et al.,* 2016). Furthermore, the risk of disease declines with elevated fruit consumption (Al-Farsi *et al.,* 2005). For a balanced diet, fruits should comprise approximately 10% of the plate (Gupta, 2019). Fruit diversity varies considerably across regions. In arid and semiarid regions, particularly North Africa and the Middle East, date palm trees (*Phoenix dactylifera*) are widely cultivated (Chao & Krueger, 2007; Jain *et al.,* 2011).

Date palm fruits are recognized for their high energy content, attributable primarily to their sugar composition, which consists mainly of sucrose, glucose, and fructose. They also contain other components, including proteins

comprising twenty-three amino acids—among them essential amino acids—as well as lipids, vitamins, and other compounds, albeit in minor quantities. Compared with other fruits, these quantities appear to be comparatively higher (Al-Shahib & Marshall, 2003). Date fruits are additionally rich in fiber, particularly soluble fiber, which confers a range of health benefits. However, this composition may be affected by several factors, including date fruit cultivar, region, and climate (AlFaris *et al.,* 2021).

The consumption of date fruits can be classified into three categories. The first category is direct consumption, in which date fruits are consumed fresh, mature, or immature, without any processing. This category represents the primary mode of consumption, accounting for 90% of total consumption. The second category is indirect consumption, which refers to date fruits processed into derivatives. The most frequent derivatives include date syrup (Rob), jam, and pastries. This category accounts for only 2.5% of total date fruit consumption. The final category consists of animal feed, which utilizes edible date fruits and represents 7.5% (Shbbar & Kayuon, 1980).

According to Al-Shahib and Marshall (2003) and Manickavasagan *et al.* (2012), date fruit consumption is estimated at approximately 10–30 pieces per day per person in date-producing regions, such as the Middle East. Egypt ranks first in worldwide date fruit production, contributing 18% of global production, followed by Saudi Arabia, Iran, and Algeria, with 16%, 13%, and 12%, respectively (FAO, 2022). However, no studies have investigated the actual contribution and consumption behaviors of date fruits and their derivatives, or the influence of sociodemographic factors on these behaviors. To the best of our knowledge, the present study represents the first to estimate the consumption preferences, behaviors, contribution, and daily intake of date fruits and their derivatives among the population of Biskra, Algeria.

The actual quantity of date fruits and their derivatives consumed remains poorly understood, especially in date-producing regions. In Algeria, the province of Biskra ranks first in terms of annual date fruit production, with 3,335,414 quintals (Direction de l'Agriculture de Biskra, 2022).

The present study examined the impact of certain factors on the consumption of date fruits and their contribution to daily intake. Its significance lies in several aspects. Estimating the quantity and types of dates and date derivatives consumed can provide valuable insights for agricultural planning, such as adjusting production levels, prioritizing the most consumed varieties, and improving economic returns. Understanding the circumstances of consumption supports the development of appropriate derivatives that align with consumer habits. Similarly, determining consumption frequency helps identify peak periods and seasons of high demand and can guide marketing and sales strategies. Finally, assessing the daily contribution of dates allows the evaluation of macro- and micronutrient intake, which can be employed to improve overall dietary recommendations.

The primary objective of the current study was to estimate the quantity of date fruits and their derivatives consumed in Biskra and their contribution to daily dietary intake.

2 Material and Methods

2.1 Study Design and Population

To estimate the actual consumption of date fruits and their derivatives, a survey-based research approach was conducted among 108 individuals living in the province of Biskra, Algeria, from November 2022 to November 2023. A convenience sampling approach was applied. Participants were selected from various locations within the study area based on their availability and willingness to take part in the survey. Each survey lasted between 15 and 90 min. According to Ali (2026), the minimum sample size required to permit meaningful generalizations is at least 100 participants.

The questionnaires were designed to collect various types of information from the surveyed individuals. The first section focused on sociodemographic factors. The second section addressed the consumption of date fruits and their derivatives, including the circumstances of consumption, quantity consumed per day, and frequency of consumption throughout the year. The third section comprised a 24-hour recall, which asked participants about the different portions of food consumed on the previous day. As participants were permitted to provide multiple responses, the relative frequency was calculated by dividing the number of times the term appeared by the total number of mentions, and then expressed as a percentage.

Face-to-face interviews with the surveyed individuals were carried out employing the survey and a manual of food portions and quantities. The interviews took place in a comfortable environment, ensuring the privacy and confidentiality of the information provided by the participants. To ensure the accuracy and completeness of the survey, participants were asked to verify their information. A triple-check protocol was implemented, whereby participants were asked to confirm their answers three times to ensure that they recalled as much information as possible about the food they had consumed and to maximize quantitative precision.

The quantitative data collected included information on the frequency of date fruit consumption, the quantity consumed per portion, and the different forms of date fruit

derivatives consumed. Daily nutritional intake was calculated using a food composition table created by the French Agency for Food, Environmental and Occupational Health and Safety (A.N.S.E.S.), with the addition of regional foods by the Institute of Nutrition, Food and Agri-Food Technologies (I.N.A.T.A.A.). Demographic data, including age, sex, origin, residence, education level, occupation, and health status, were additionally collected to obtain a comprehensive understanding of the relationships between sociodemographic factors and consumption habits.

2.2 Ethical Approval

For this type of study, formal written consent was not required. All participants were informed of the purpose of the study, and verbal informed consent was obtained prior participation. Participation was voluntary, and the confidentiality of personal respondent information was strictly maintained throughout the study.

2.3 Statistical Analysis

Following data collection, the data were entered into S.P.S.S. v25 and GraphPad v8 statistical software for analysis. Descriptive statistics, such as percentages, were calculated to summarize the consumption habits of date fruits and their derivatives, as well as their daily contributions. Statistical tests were then used to evaluate the influence of sociodemographic factors on the consumption and contribution of date fruits and their derivatives within the studied population.

3 Results

3.1 Description of the Study Population

The complete sociodemographic profile of the participants is presented in Table 1. With respect to age distribution, participants were divided into different age groups, with 50% being teenagers, 45.37% adults, 2.78% seniors, and 1.85% children. The sex distribution revealed that 82.4% were female and 17.6% were male. The distribution of origins varied, with 67.59% of participants originating from Biskra, 12.96% from Batna, and 19.44% from other origins. Half of the surveyed individuals resided in Biskra city. Education levels varied as well: 80.56% held a higher education qualification, 13.89% completed secondary education, and 3.7% completed primary education. The distribution of occupations revealed that 63.89% of the surveyed individuals were students. The participants' health status was generally acceptable, with 76.85% rating their health as good and 23.15% as moderate. Endocrine diseases were reported by 36% of participants with health conditions and were frequently associated with hypoglycemia, hyperglycemia, and thyropathy. Finally, the distribution of overall household income among the surveyed individuals was as follows: 74.07% moderate income, 14.81% low income, and 11.11% high income.

3.2 Date Fruit and Derivative Consumption

The survey on date fruit and derivative consumption provided significant information on consumption preferences. All surveyed individuals reported consuming date fruits and/or their derivatives. Among the participants, 91.70% reported consuming both date fruits and their derivatives, 4.60% reported consuming only date derivatives, and 3.70% reported consuming only date fruits. These results highlight the importance of date fruits in the diet and indicate their popularity among the Biskra population.

An examination of the most consumed date fruit cultivars and derivatives revealed distinct preferences within the studied population. Among the ten different date fruit cultivars cited (Figure 1), 40.80% of the surveyed individuals expressed a consumption preference for the *Deglet Nour* cultivar. The second and third most common cultivars were *Ghars* and *Mech Degla*, with 27.2% and 20% of participants consuming these cultivars, respectively. In addition, the full ripening stage of dates was the most common stage (82%), whereas only 18% of participants consumed dates at the fourth ripening stage (*Martouba*), represented by *Mnagar*.

Date fruit derivatives represent an essential component of the diet of date fruit consumers. Among the nineteen date fruit derivatives cited (Figure 1), date paste stood out because of its utilization in several culinary applications, representing approximately 71.6% of date fruit derivatives. In total, 22.4%, 21.1%, and 19.7% of the surveyed individuals consumed *Makroud*, *Bradj*, and *Rfis*, respectively. Furthermore, 12.6% of those surveyed incorporated date fruit syrup, commonly called *Rob*, into their diet, and 11.6% consumed *Rouina* in different formulations. This consumption of date derivatives illustrates the multiple utilization of date fruits as food derivatives in Biskra.

The consumption circumstances of date fruits and their derivatives are displayed in Figure 2. In total, 49.43% of the surveyed individuals reported consuming them as snacks, including 34.69% during the second snack; 33.25% of participants reported eating them with meals; and 37.58% consumed them in the afternoon.

The frequency of date fruit and derivative consumption varied as displayed in Figure 3. Approximately 60.19% of the surveyed individuals consumed date fruits and their derivatives at least once per week, indicating that they included date fruits and their derivatives in their regular weekly diet. Furthermore, 20.37% of the surveyed

Table 1. Sociodemographic Characteristics of the Studied Population

Characteristics	Total participants (Percentages)			
Age	Children 2 (1.85%)	Teenagers 54 (50%)	Adults 49 (45.37%)	Seniors 3 (2.78%)
Sex	Female 89 (82.4%)		Male 19 (17.6%)	
Origin	Algiers 4 (3.70%) Constantine 1 (0.93%) Ouled Djellal 5 (4.63%) Tlemcen 1 (0.93%)	Annaba 1 (0.93%) El Oued 1 (0.93%) Sétif 2 (1.85%)	Batna 14 (12.96%) Khenchla 1 (0.93%) Souk-Ahras 1 (0.93%)	Biskra 73 (67.59%) M'sila 3 (2.78%) Tizi Ouzou 1 (0.93%)
Residence	Biskra city 54 (50%)		Another municipality in Biskra 54 (50%)	
Education level	Primary 4 (3.70%)	Middle 2 (1.85%)	Secondary 15 (13.89%)	University 87 (80.56%)
Occupation	Employee 23 (21.30%) Unemployed 11 (10.19%)	Self-employed 1 (0.93%)	Student 69 (63.89%)	Retired 4 (3.70%)
Overall household income	Low 16 (14.81%)	Medium 80 (74.07%)		Good 12 (11.11%)
Health status	Bad 0 (0%)	Medium 25 (23.15%)		Good 83 (76.85%)
Diseases	Blood and immune system 5 (20%) Infectious 1 (4%) Skin 1 (4%)	Circulatory system 3 (12%) Genitourinary system 1 (4%)	Digestive system 2 (8%) Musculoskeletal system 2 (8%)	Endocrinal 9 (36%) Respiratory system 1 (4%

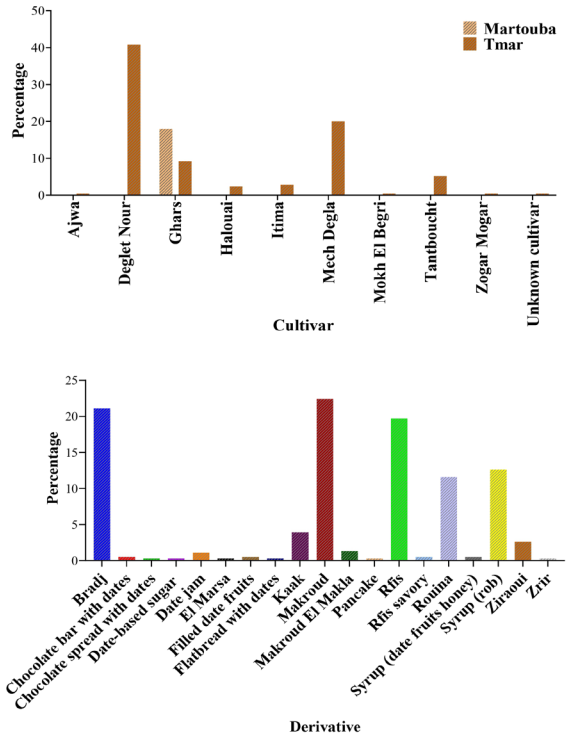

Figure 1. Percentage of Consumed Date Fruit Cultivars and Derivatives in the Biskra Population

individuals consumed them monthly, indicating a moderate consumption rate. A proportion of 12.04% consumed dates and their derivatives at least once per day.

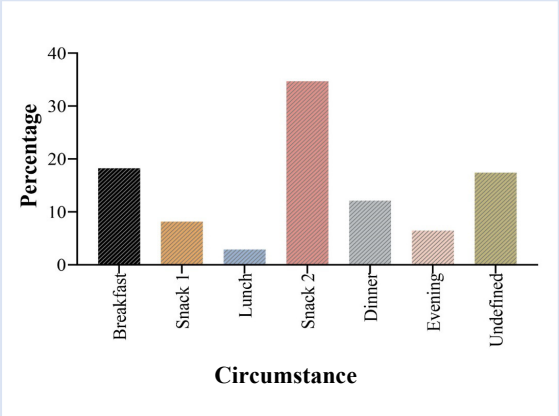

Figure 2. Consumption Circumstances of Date Fruits and their Derivatives

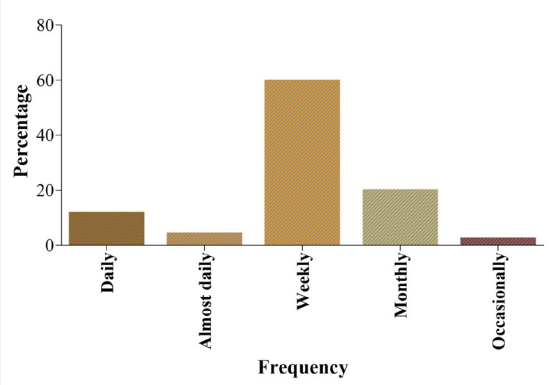

Figure 3. Consumption Frequency of Date Fruits and their Derivatives

An examination of the total quantity of date fruits consumed per kilogram (Figure 4) revealed several interesting findings. A total of 76.85% of participants consumed pure date fruits, without seeds, including dates and their derivatives, at an annual rate between 0.01 and 12 kg/year. In contrast, 0.93% consumed more than 84 kg/year. The mean date fruit consumption in the Biskra population was approximately 11.24 ± 14.88 kg/person/year, corresponding to approximately 10.12 ± 13.39 kg/person/year of dates without seeds. Direct date fruit consumption accounted for two-thirds of total consumption, with an average of 7.27 ± 9.24 kg/person/year. However, indirect date consumption, corresponding to dates processed into derivatives, represented 3.97 ± 8.82 kg/person/year.

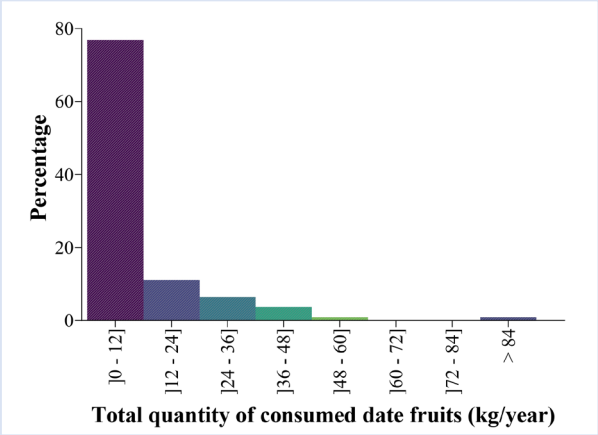

Figure 4. Percentage of Date Fruits Consumed in kg Per Year

The study estimated the quantity of date fruits consumed per kilogram over the past year. Most surveyed participants from Biskra (78.7%) reported an annual consumption of between 0.01 to 12 kg/year of date fruits, and the mean of date fruits consumption in Biskra population was 10.11 kg/year. When these data were converted into daily consumption, as presented in Figure 5, the estimated consumption per day was approximately one to four date fruits, with an overall average of three dates per day (3.08 ± 4.08 dates/day).

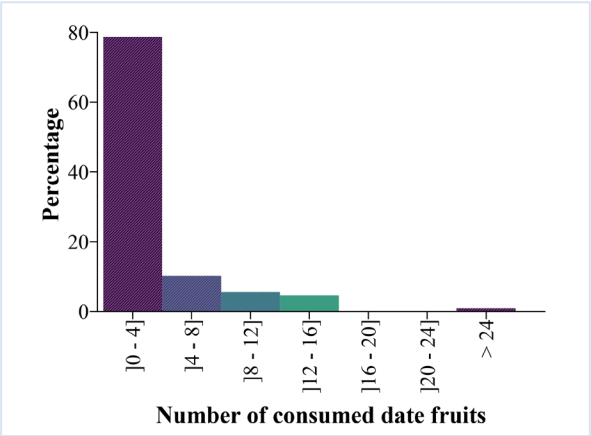

Figure 5. Percentage of Date Fruits Consumed Per Day

The results of this study revealed that combining date fruits with a variety of other foods is a common practice, as illustrated in Figure 6. A total of 70.70% of participants reported combining date fruits with other foods, with 44.22% combining them with dairy products such as milk or yogurt. Furthermore, 7.82% of participants combined date

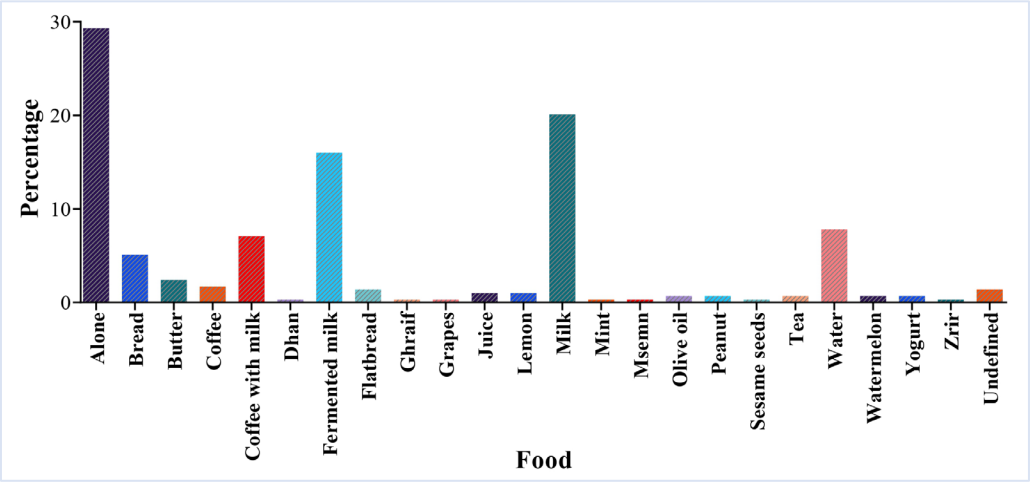

Figure 6. Percentage of Accompanying Foods Consumed with Date Fruits

fruits with water, and 29.25% reported consuming them alone.

3.3 Contribution of Date Fruits and Their Derivatives to Daily Intake

The survey additionally investigated the macronutrient composition of the diets of the studied population and the contribution of date fruits and their derivatives to daily caloric, carbohydrate, protein, and fat intake, providing an overview of the participants' nutritional habits as summarized in Table 2. On average, the surveyed individuals reported consuming 1647.66 ± 754.25 kcal/day. Carbohydrates made up a significant proportion of daily intake, with approximately 60% of participants' total calories originating from carbohydrates. Proteins, which are essential for various body functions, accounted for approximately 13.72% of daily caloric intake. In particular, participants consumed 56.51 ± 27.36 g/day of protein. Regarding fat intake, 24.56% of daily calories were attributed to fat, indicating its role as an energy source (Gupta, 2019). This corresponded to an average fat intake of 44.97 ± 29.65 g/day in the studied population.

European and Mediterranean countries. This preference may be due to its texture, flavor, and moderate sweetness. Regarding date derivatives, most were sweet preparations (98.95%), whereas only 1.05% used date fruits in savory preparations, probably because their high sugar content makes them more commonly used in sweet recipes. However, bio transformed date fruit derivatives were not cited by the participants in this study.

The consumption circumstances highlight the adaptable nature of date fruits and their derivatives in the culinary practices of the study population, as they are consumed as snacks or fruits or incorporated into meals. These findings are in agreement with those of Qazaq and Al Adeeb (2010), who reported that almost all of the studied population in Al-Ain city consumed 41% of date fruits in the afternoon. This similarity is probably due to comparable date fruit consumption behaviors in these regions.

The weekly consumption frequency of dates indicates their use as a regular dietary choice, which may be explained by the presence of dates and their derivatives in the

Table 2. Daily Dietary Intake and Date Fruit Contribution in the Last 24-hour

	Energy (kcal)	Carbohydrates (g)	Proteins (g)	Lipids (g)
Global (Mean ± SD)	1648 ± 754	246 ±125	56.51 ± 27.36	44.97 ± 29.65
From date fruits and their derivatives (Mean ± SD)	57 ± 155	12.43 ± 35.03	0.41 ± 1.01	0.27 ± 1.07
Percentage of date fruits contribution	3.47%	5.05%	0.72%	0.60%

The study revealed relevant data concerning the contribution of date fruits and their derivatives to daily nutritional intake. In particular, the results indicated that approximately 32% of participants reported incorporating date fruits and their derivatives into their 24-hour daily intake. With respect to energy intake, date fruits and their derivatives accounted for approximately 3.47% of total caloric intake. Regarding macronutrient distribution, date fruits and their derivatives contributed significantly to carbohydrate intake, accounting for approximately 5% of total carbohydrate intake. In addition, approximately 1% of protein intake originated from date fruits and their derivatives, reflecting their protein content. Furthermore, approximately 1% of fat intake was derived from date fruit consumption.

4 Discussion

4.1 Consumption Habits of Date Fruits and Their Derivatives

According to Munier (1974) and Ben Mya *et al.* (2017), the *Deglet Nour* cultivar is one of the best cultivars for

households of Biskra throughout the year because of their abundance and long shelf life. According to Qazaq and Al Adeeb (2010) and Ismail *et al.* (2006), date fruit consumption is nearly daily, with frequencies of 53% and 63.1%, respectively. Cultural, regional, and demographic differences likely affect the frequency of date fruit consumption.

The quantity of dates consumed, 11.24 ± 14.88 kg/person/year, highlights their incorporation into daily diets. The high standard deviation may be explained by the wide variation in the results, as the maximum consumed quantity was 100.07 kg and the minimum was 0.049 kg. This variation may be attributable to individual preferences, with consumption varying considerably from one person to another. However, these findings differ markedly from the estimated quantity reported by FAO (2023), where the estimated consumption was 22.93 kg/person/year. Therefore, date consumption appears to be relatively low among the studied population. This difference may be due to competition with other fruits and sweets (Aleid *et al.,* 2015).

Faci (2017) reported that the average quantity consumed in Ouargla city was approximately 19.92 kg/person/year, with most individuals consuming less than 30 kg/person/year.

These differences may be explained by differences between the populations studied, as the estimated quantity may refer to Algerian and Ouargla citizens more broadly. The study period may also influence the quantity consumed. In addition, the method used to estimate the consumption of dates and their derivatives may have affected the results.

Furthermore, in our study, date fruit derivatives were included, and the quantity of dates consumed was recorded. Finally, only ten date fruit cultivars were cited in the present study, which may have affected the final results. To increase date consumption, processing dates into derivatives may be a suitable approach. These derivatives may also be more appreciated by consumers, as they have longer shelf lives than unprocessed dates (Aleid *et al.,* 2015).

In our findings, direct consumption represented 64.71% of the total consumed quantity, whereas derivatives represented 35.29%. This preference may be attributable to the fact that dates are easy and simple to consume and do not require effort or preparation time. It may also be related to the availability of dates, as the province of Biskra ranks first in date production quantity (Direction des Statistiques Agricoles et des Systèmes d'Information, 2019).

An average consumption of three dates per day illustrates the regularity and consistency of date fruit consumption, reaffirming its role as a crucial component of the diet in this population. Ten dates are consumed daily in the United Arab Emirates (Ismail *et al.,* 2006), and approximately seven are consumed in Al-Ahsa, Saudi Arabia (Al-Mssallem *et al.,* 2019). There is a significant difference among these findings, with date consumption among Biskra citizens appearing to be the lowest. Variations in cultural and dietary habits among these populations may influence the number of date fruits consumed daily.

The combination behaviors of the studied population indicated that the consumption of dairy products with dates, which contain high amounts of carbohydrates, complemented the nutritional composition of dairy products, which are rich in proteins and lipids. This finding provides insight into food choices, with the combination of date fruits and dairy products contributing to balanced nutritional intake (Ahmed *et al.,* 1995; Elkhouly *et al.,* 2021). According to Benchelah and Maka (2008) and Manickavasagan *et al.* (2012), the majority of individuals consume date fruits with either coffee or dairy products.

4.2 Influence of Sociodemographic Factors on Date Fruit Consumption Preferences

To investigate the potential influence of sociodemographic factors on date fruit consumption, various statistical tests were performed. Regarding the influence of participants' origin on the type of date fruit derivatives consumed, a significant effect was observed according to the chi-square test (χ^2). The *El Marsa* derivative ($p = 0$) was most frequently consumed by participants originating from Oued Souf, whereas the *Ziraoui* derivative ($p < 0.05$) was most frequently consumed by participants originating from Batna. These findings support the effect of origin on date fruit derivative consumption, with culinary traditions related to origin likely being the main reason.

Rouina derivative was more consumed with both groups of adults ($p = 0.028$) and students ($p = 0.031$), and *Makroud* was more consumed by female with $p = 0.002$. Overall household income was also dependent on the type of date fruit derivative consumed according to the χ^2 test, with $p = 0$, 0.018, and 0.018. Participants with high overall household income consumed the most date-based chocolate, date chocolate spread, and date sugar, respectively. The cost of these derivatives may be considerably higher than that of other date fruit derivatives.

The circumstances under which dates were consumed were also influenced by particular demographic groups. Females exhibited a greater tendency to consume dates in the evening compared with males ($p = 0.022$), whereas students reported consuming dates and their derivatives at breakfast, during the second snack, and in the evening ($p = 0$, 0.009, and 0, respectively). With regard to participants holding a university education, consumption occurred at breakfast and during the first snack ($p = 0$ and 0.003, respectively). The energy content and availability of dates may account for the patterns of consumption observed at these times.

In the context of the influence of sociodemographic factors on the quantity of date fruits consumed per day and per year, the nonparametric Kruskal-Wallis test was applied. Regarding the impact of age groups on the quantity of date fruits consumed per day and per year, no significant effect was observed, with $p = 0.310$ per day and $p = 0.310$ per year, both > 0.05. All age groups consumed similar quantities of date fruits. This could be attributable to the richness of date fruits in carbohydrates and can therefore contribute to daily energy intake across all age groups. The natural carbohydrates in date fruits are rapidly absorbed after consumption and provide instant energy to the organism (Manickavasagan *et al.,* 2012). These findings are not consistent with those reported by Al-Mssallem *et al.* (2019), Ismail *et al.* (2006), and Qazaq and Al Adeeb (2010), who observed that age group influenced the quantity of date fruits consumed per day and that adults consumed the highest quantities of date fruits.

With respect to the other factors, including sex, region of residence, origin, overall household income, and health status, no significant effects were observed on the quantity of date fruits consumed. These results are relative to those of

Ismail *et al.* (2006), who reported that sex did not influence the quantity of date fruits consumed. However, Qazaq and Al Adeeb (2010) reported that sex exhibits an influence, with males consuming more dates per day than females. Regarding occupation, no significant influence was revealed ($p = 0.146$); however, Ismail *et al.* (2006) reported that occupation significantly affected the number of dates consumed per day, with employees and unemployed individuals consuming more dates per day than students. Food cultures in these populations may be responsible for this difference.

4.3 Contribution of Date Fruits and Their Derivatives to Daily Intake

Regarding the total daily caloric intake of the studied population, the one-sample Wilcoxon test revealed that the observed value was significantly different from 2,800 kcal/day, and the null hypothesis was rejected ($\rho = 0 < 0.05$). This suggests that the average daily caloric intake of the studied population was below the reference value. According to Gupta (2019), to maintain a balanced diet with appropriate daily intake of calories, carbohydrates, proteins, and fats, the recommended average daily caloric intake is approximately 2,800 kcal/day, although this may vary according to factors such as age, sex, and activity level. Carbohydrates constitute the body's principal source of energy and generally account for the majority of daily caloric intake, with 60% of total calories obtained from them. Proteins are essential for repairing and building tissues and for various other physiological processes. A daily intake of one gram of protein per kilogram of body weight is recommended. Fats additionally play a crucial role, including fat-soluble nutrient transport and energy supply. Fat intake accounts for approximately 20% to 30% of total daily caloric intake.

The contribution of dates to carbohydrate intake was considerable, accounting for approximately 5% of total carbohydrate intake. This reflects the natural sugar richness of date fruits (Ayad *et al.,* 2020), which renders them a popular and healthier alternative to refined sugar. In addition, protein intake from dates was approximately 1%, reflecting their protein content. Although date fruits constitute not a principal source of protein, they contain 23 amino acids, such as essential amino acids that are vital for health (Ashraf & Hamidi-Esfahani 2011; Ayad *et al.,* 2020; Naushad & Lichtfouse, 2019). Moreover, fat intake from dates was approximately 1%. Date fruits possess a low-fat content but provide beneficial fatty acids in reduced quantities, including essential fatty acids such as linoleic acid (Ayad *et al.,* 2020). According to the FAO (2023), the daily energy intake provided by date fruit consumption was approximately 128.67 kcal/person/day, which differs from our findings. The results of the present study indicate a minor contribution of date fruits, particularly to carbohydrate intake, to the daily intake of the Biskra population. Date fruits are accessible and natural foods that can contribute to total daily caloric intake.

4.4 Influence of Sociodemographic Factors on the Contribution of Date Fruits to Daily Intake

To study the influence of sociodemographic factors on the contribution of dates to daily nutritional intake, a series of nonparametric statistical tests was applied. The findings indicated that all sociodemographic factors, including age, sex, origin, residence, education level, overall household income, and health status, exhibited no significant effect on the percentage contribution of date fruits to daily caloric, carbohydrate, protein, or lipid intake. However, occupation category displayed a statistically significant influence on caloric ($p = 0.022$), carbohydrate ($p = 0.032$), protein ($p = 0.023$), and lipid ($p = 0.027$) contributions according to the Kruskal-Wallis test.

According to Dunn's test, for all types of daily nutritional intake studied, the employee category ranked first, with high contribution percentages for calories (9.12%), carbohydrates (12.89%), proteins (1.65%), and lipids (1.44%). This may be because employees, owing to their prolonged working hours, consume dates and their derivatives to meet part of their energy needs. In addition, date fruits and their derivatives are easy to consume and are rapid sources of sugar and energy (Manickavasagan *et al.,* 2012).

5 Conclusions

The findings of the present investigation on date fruit consumption provide significant data about the consumption habits and preferences of date fruit consumers. Since *Deglet Nour* was identified as the most consumed cultivar (41%), we recommend prioritizing its production and ensuring its availability. Less consumed cultivars could be promoted through awareness campaigns or incorporated into derivatives, particularly the most commonly consumed derivatives, such as *Makroud*, *Bradj*, and *Rfis*, or into other derivatives with potential health benefits.

In terms of consumption circumstances, date fruits and their derivatives were principally consumed during the afternoon, suggesting the necessity for tailored marketing and packaging strategies, such as ready-to-eat products that could replace less healthy snacks. Furthermore, consumption frequency and quantity can guide agricultural planning and market supply to align with peak demand. Given the nutritional contribution of dates to daily energy, carbohydrate, protein, and lipid intake, they should be promoted as a healthy and sustainable dietary component that

can replace less nutritious alternatives and support public health.

Certain sociodemographic factors, such as origin and overall household income, exert a significant effect on the consumption of date fruit derivatives. Participants with high overall household income were more likely to consume date sugar, date-based chocolate bars, and date chocolate spreads compared with other participants. *Ziraoui* and *El Marsa* derivatives were consumed only by participants from Batna and Oued Souf, respectively. The highest contributions of date fruits and their derivatives to daily nutritional intake were observed among employees.

To enhance the rigor of future nutritional assessments, the development of a web-based platform designed to integrate traditional food items into a 24-hour dietary recall system is strongly advised. Such a digital instrument would facilitate accurate estimation of daily dietary intake, broaden participant reach across diverse populations, and permit self-administered completion at the respondent's convenience. Based on the empirical findings of the present study, further investigations are warranted to comparative evaluate the health-promoting properties of the most widely consumed date cultivars—specifically *Deglet Nour*, *Ghars*, and *Mech Degla*—alongside their primary derived products. In particular, processed foods such as *Makroud*, *Bradj*, and *Rfis* should be systematically compared with *Rouina* and *Rob* to elucidate the physiological impacts associated with distinct culinary transformation techniques. Such comparative analyses would aid in identifying high-value nutritional products, providing evidence-based dietary recommendations, and incentivizing sustainable local production. Furthermore, future research should assess the post-processing bioactivity and nutritional integrity of these derivatives while simultaneously optimizing their processing technologies. Finally, scientific and technological efforts should aim to adapt these traditional formulations to contemporary consumer preferences, eating contexts, and functional snacking behaviors.

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