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RESEARCH ARTICLE

EFFECT OF CONSUMPTION PATTERN OF YEMENI DATES ON GLYCEMIC INDEX AND GLYCEMIC LOAD

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Abstract

Date consumption is deeply rooted in Yemeni culture, yet its effect on glycemic response remains underexplored. This quasi-experimental study examined the impact of portion size and *Basmala* recitation on the Glycemic Index (GI) and Glycemic Load (GL) of Yemeni Sagai dates in 12 healthy adults. Participants consumed 2–6 dates, with or without *Basmala*, and postprandial glucose was measured at 0, 30, 60, 90, and 120 minutes. GI and GL were calculated using incremental area under the curve (iAUC) values with a 50 g glucose reference. Results revealed a non-linear relationship between portion size and GI, with smaller portions (2–3 dates) producing unexpectedly high or moderate GI values, while larger portions did not always increase glycemic response proportionally. GL analysis showed moderate values for 2–3 dates and high values for 4–6 dates, highlighting the importance of portion control. Consumption with *Basmala* significantly reduced GI (63.3 vs. 78.4) and GL (39.9 vs. 49.4) compared to no recitation ($P < 0.05$), suggesting that mindful or spiritual practices may influence glucose metabolism. These findings align with Islamic teachings advocating moderate, odd-numbered consumption of dates with *Basmala* and emphasize a holistic approach integrating cultural, spiritual, and nutritional guidance.

Keywords: Yemeni dates; Glycemic Index; Glycemic Load; Basmala; Postprandial glucose; Dietary recommendations; Sagai dates.

1. Introduction

Dates (*Phoenix dactylifera L.*) are a vital component of the Yemeni diet, deeply embedded in the culture, economy, and traditional food practices of the region [1], [2]. Rich in carbohydrates, dietary fiber, vitamins, and minerals, dates are a significant source of energy and have been recognized for their potential health benefits, including antioxidant activity and modulation of postprandial glucose levels [3], [4].

In Yemen, date palms are economically and culturally important, with over four million palms producing 55,000–58,000 tons annually across 14,464–14,955 hectares. The country has more than 321 cultivars, with 42 considered excellent, including Hamra, Mijraf, and Sokotri, mainly planted in Hadramaut and Hodeidah. Yemeni dates face threats from pests, diseases, and environmental challenges, while marketing remains local and hindered by labor, infrastructure, and financial limitations [2]. Sagai dates, a prominent Yemeni variety, are nutritionally rich, with low moisture, high carbohydrates, dietary fiber, and phenolic compounds. They exhibit functional properties such as antioxidant and prebiotic effects, highlighting their potential as a health-promoting food [5].

The glycemic index (GI) and glycemic load (GL) are key measures for assessing the impact of carbohydrate-containing foods on blood glucose levels. While GI reflects the rate at which carbohydrates raise blood glucose, GL accounts for both the quality and quantity of

carbohydrates, providing a more accurate estimate of a food's effect on postprandial glycemia [6], [7]. Previous studies have reported considerable variability in GI and GL among different date varieties across the Middle East and North Africa, influenced by factors such as ripeness, sugar composition, and preparation methods [6], [8], [9].

Research on date consumption in the region has also highlighted their potential role in managing type 2 diabetes and supporting metabolic health. For instance, studies have shown that consuming dates in controlled portions can lead to moderate postprandial glucose and insulin responses, suggesting their suitability as a functional food in diabetic diets [10], [11]. However, the majority of these studies have focused on individual varieties or standardized portions, with limited attention to the effect of different consumption patterns, such as the number of dates consumed, meal context, or sequence of consumption, on glycemic response [3], [12].

Understanding how consumption patterns influence the glycemic response to dates is particularly relevant in Yemen, where dates are often eaten in social, ritual, or habitual contexts, and portion size can vary widely[13]. Investigating these patterns can provide practical insights for dietary guidance and help optimize the inclusion of dates in healthful diets, particularly for individuals at risk of hyperglycemia or metabolic disorders. Thus, the present study aims to evaluate the effect of different consumption patterns of Yemeni dates on glycemic index and glycemic load in healthy adults, bridging gaps in current knowledge and informing culturally relevant nutritional recommendations.

2. Material and methods

1.1. Instruments

Blood glucose levels were measured using glucometers (Safe AQ) ensuring accurate monitoring of postprandial glucose responses. An analytical balance (Electronic kitchen scale) was employed to standardize the weight of date servings for each participant. Time-sensitive measurements were recorded using a Casio timer or a standard laboratory stopwatch.

1.2. Materials

Sagai Yemeni dates were procured from the local market in Yemen (Photo 1) and served as the primary test food. Standard glucose (anhydrous) was obtained from Sigma-Aldrich as standard. Sterile lancets (BD, Becton Dickinson) were used for blood sampling, along with alcohol swabs (3M Health Care) and sterile gloves (Ansell/Kimberly-Clark) to maintain hygienic conditions. Distilled water of laboratory grade, sourced locally, was used in sample preparations.

Photo 1: Sagai Yemeni dates

1.3. Study Design

A quasi-experimental study was conducted to evaluate the effects of Yemeni date consumption methods on glycemic response in healthy adults. The study specifically examined the impact of the number of dates consumed (even vs. odd) and the recitation of "Bismillah" prior to eating on Glycemic Index (GI) and Glycemic Load (GL). This design allowed for the investigation of traditional consumption practices in relation to measurable biochemical outcomes.

1.4. Study Participants

Twelve healthy adults were recruited for the study[14]. Inclusion criteria comprised ages between 18 and 50 years, a Body Mass Index (BMI) within the normal range (18.5–24.9), absence of chronic diseases including diabetes or metabolic disorders, and non-smoking status without the use of medications or supplements affecting glucose metabolism. Participants with allergies or gastrointestinal disorders related to dates, or who were using medications affecting glucose metabolism during the study, were excluded.

1.5. Date Preparation and Intervention

Sagai Yemeni dates were selected based on ripeness and nutritional quality. Participants were assigned to consume either an even or odd number of dates (2 – 6 dates) per session. On certain days, participants consumed six dates after reciting "Bismillah," while on other days they consumed six dates without reciting "Bismillah" beforehand.

1.6. Experimental Protocol

Participants fasted for 10–12 hours before each test session to standardize baseline glucose levels. Fasting blood samples were collected at 0 minutes, followed by the consumption of dates containing 50 g of available carbohydrates according to the assigned intervention. Blood samples were subsequently collected at 30-, 60-, 90-, and 120-minutes post-consumption. A 50 g glucose solution was used as a reference to calculate the standard Glycemic Index (Photo 2).

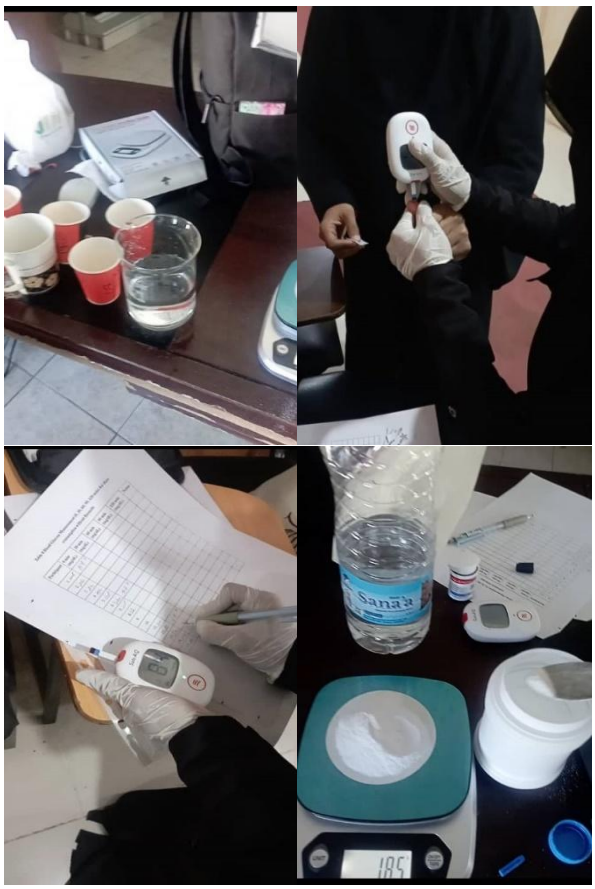

Photo 2: Photograph illustrating the experimental procedure

1.7. Total carbohydrate in Yemeni Sagai dates

The total carbohydrate content of Yemeni Sagai dates was calculated based on an individual date weight of 10.5 g and carbohydrate concentration of 76.5 g per 100 g [5]. Each date was found to contain approximately 8.03 g of total carbohydrate. Consequently, the carbohydrate content increased proportionally with the number of dates consumed: two dates provided 16.07 g, three dates 24.10 g, four dates 32.13 g, five dates 40.16 g, and six dates 48.20 g of total carbohydrate.

In this study, the carbohydrate content of each test portion was determined based on the actual sugar composition and weight of Yemeni Sagai dates rather than using a standard 50 g carbohydrate portion. The use of these naturally occurring carbohydrate amounts reflects real-life consumption patterns and ensures ecological validity, as participants would typically consume whole dates in customary portions rather than precise 50 g carbohydrate loads. Although standard Glycemic Index (GI) methodology uses 50 g of available carbohydrate to allow cross-food comparison, using the actual sugar content of date portions provides more relevant data on postprandial glycemic responses to practical serving sizes. This approach allows for the assessment of both the physiological impact of realistic date consumption and the influence of portion size on glycemic outcomes, which is particularly valuable when developing culturally tailored dietary guidance.

1.8. Measurements

The total blood glucose response was expressed as the incremental area under the blood glucose response curve (iAUC), ignoring the area below baseline, and was calculated according to the methods described by [15]. The means, standard deviations, and coefficient of variation of the IAUC were calculated for each subject's re peated reference food. The iAUC of all test foods eaten by each subject was expressed as a percentage of the mean IAUC of the reference food eaten by the same subject. The glycemic index (GI) of test foods was calculated using the formula:

$$GI = \frac{iAUC_{test\ food}}{iAUC_{reference\ food}} \times 100$$

where $iAUC_{test\ food}$ represents the incremental area under the glucose response curve for the test dates, and $iAUC_{reference\ food}$ represents the incremental area under the curve for the reference food, typically a 50 g glucose solution. Atkinson et al. [16] classified glycemic index (GI) values into three categories: low (GI $\leqslant$ 55), medium (GI 56 – 69), and high (GI $\geqslant$ 70).

Glycemic load (GL) was determined using the equation:

$$GL = \frac{GI \times \text{Net Carbohydrate Content (g)}}{100}$$

Dongo, [14]categorized the impact of foods on blood glucose based on glycemic load (GL) as follows: low GL (<10), medium or intermediate GL (10–20), and high GL (≥20).

1.9. Statistical Analysis

Data were analyzed using SPSS software (version 26) and are presented as mean ± standard deviation (SD). The least significant difference (LSD) test was applied to assess the effects of date quantity (even versus odd) and Bismillah recitation on glycemic index (GI) and glycemic load (GL).

1.10. Ethical Considerations

Written informed consent was obtained from all participants after detailed explanation of study objectives and procedures. Participant confidentiality was maintained throughout the study.

3. Result and Discussion

1.1. Postprandial Blood Glucose Responses to Date Consumption

The postprandial blood glucose responses of volunteers varied according to the type and quantity of date consumption compared with a standard glucose solution (Figure 1). Consumption of standard glucose led to a rapid peak at 30 minutes (124.25 mg/dL) followed by a

decline below baseline at 120 minutes (81.33 mg/dL), reflecting the expected rapid absorption of pure glucose. In contrast, all date consumption patterns produced lower and more gradual glucose peaks. Two to five dates elicited moderate peaks ranging from 100.67 to 113.08 mg/dL, while six dates and consumption with Basmala showed slightly higher peaks (111.08–113.42 mg/dL), but still below the glucose solution peak. By 120 minutes, glucose levels after date intake generally returned near or slightly below baseline, indicating a controlled glycemic response. These findings are consistent with previous studies showing that dates have a low-to-moderate glycemic index, with slower carbohydrate absorption than pure glucose, making them a suitable snack for maintaining stable postprandial blood glucose[15], [17].

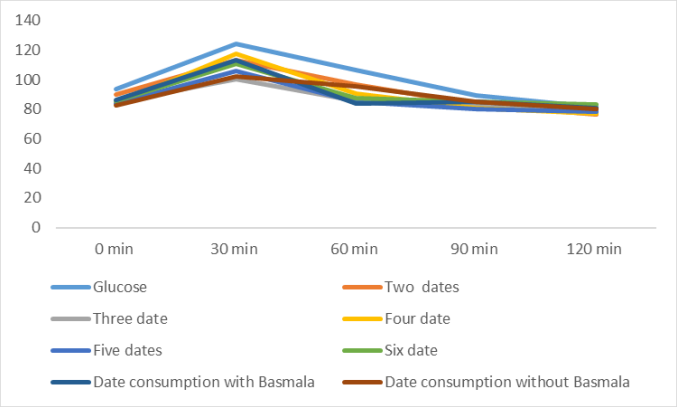

Fig 1: Glycemic Response to Dates versus Standard Glucose

1.2. Glycemic Index (GI) of Date Consumption

Table 1 presents the glycemic index (GI) values for different portions of Yemeni *Sagai* dates, tested among 12 healthy participants. The findings demonstrate a distinctly non-linear association between portion size and GI, suggesting that increasing the number of dates does not necessarily produce a proportional rise in glycemic response. For example, the consumption of two dates produced a high GI (70.1 ± 1.54), whereas three dates resulted in a markedly lower GI (38.4 ± 1.62). This pattern is unexpected, as larger portions typically deliver a higher glycemic impact due to increased available carbohydrates [18].

Similarly, the GI of five dates (52.2 ± 1.02) was lower than that of four dates (92.4 ± 2.62), while six dates produced a moderate GI (63.4 ± 1.32). Such variability has also been observed in prior research on date varieties, where differences in fiber structure, sugar composition, and ripeness contributed to fluctuating glycemic responses despite similar carbohydrate loads [17], [19].

This non-linear behavior may be explained by several mechanisms. First, dates contain varying proportions of glucose, fructose, and sucrose, each of which elicits a different metabolic response [15]. Second, their dietary fiber—particularly soluble fiber—can slow gastric emptying and reduce glucose absorption, thereby lowering GI in certain portion sizes [20]. Additionally, the food matrix effect plays a significant role, as the physical and structural properties of dates influence mastication, digestion, and enzymatic breakdown [21].

These results align with what is reported in the noble Sunnah of the Islamic faith, which indicates that the benefit of consuming dates lies in eating them in an odd number rather than an even one. In *Al-Matalib al-ʿAliyah* by Ibn Hajar, it is narrated from Anas (may Allah be pleased with him) that the Messenger of Allah (peace be upon him) preferred to break his fast with three dates, or with something that had not been touched by fire

Table 1: Glycemic index (GI) Values for Various Date Portions (2–6 Dates)

Food / Condition	GI % *	GI Category
Two dates	70.1 ± 1.54^{a}	High
Three dates	38.4 ± 1.62^{b}	Low
Four dates	92.4 ± 2.62^{c}	High
Five dates	52.2 ± 1.02^{d}	Low
Six dates	63.4 ± 1.32^{e}	Moderate

*Mean ± Standard deviations (n = 12).
Means in the same column with different upper-case letters are significantly different ($P < 0.05$).

Statistical analyses show that all GI values differed significantly ($P < 0.05$), confirming that portion size does exert a measurable influence on postprandial glycemia. However, the alternating pattern of high and low GI values across sequential portion sizes highlights the need to consider both carbohydrate quantity and intrinsic fruit properties rather than relying solely on conventional assumptions about dose–response relationships. These findings align with previous work demonstrating that the GI of dates can vary considerably even within a single cultivar depending on serving size and physiochemical characteristics[20].

1.3. Effect of Mindful Eating (Basmala) on the Glycemic Index of Dates

The current study investigated the effect of reciting *Basmala* (“In the name of Allah, the Most Gracious, the Most Merciful”) on the glycemic index (GI) of dates (Table 2). Results indicated that consuming dates with *Basmala* recitation produced a moderate GI value of 63.3 ± 1.43, whereas consuming dates without *Basmala* resulted in a significantly higher GI of 78.4 ± 1.58 ($P < 0.05$). These findings suggest that spiritual practices, such as reciting *Basmala* before consumption, may influence postprandial glycemic responses, potentially through psychological or stress-modulating effects that affect glucose metabolism [22]. From a nutritional

perspective, dates consumed with *Basmala* fall into a moderate GI category, which may be more beneficial for maintaining stable blood glucose levels compared to high-GI foods, thus supporting dietary recommendations for individuals concerned with glycemic control.

Moreover, these results align with Islamic teachings, which emphasize the importance of beginning daily activities, including eating, with the remembrance of Allah. According to Hadith, the Prophet Muhammad (peace be upon him) recommended beginning meals with *Basmala* [23], reflecting a holistic approach to health that integrates spiritual and physical well-being. While the mechanisms behind this observed reduction in GI remain speculative, it is possible that reciting *Basmala* enhances mindfulness and reduces anxiety or stress during eating, which could attenuate glucose spikes post-consumption [24]. This finding highlights an interesting intersection between religious practice and metabolic health, warranting further investigation in larger, controlled studies.

Table 2: Glycemic index (GI) Values for dates consume with and without Basmala Recitation

Food / Condition	GI % *	GI Category
With Basmallah	63.3 ± 1.43^{a}	Moderate
Without Basmallah	78.4 ± 1.58^{b}	High

*Mean ± Standard deviations (n = 12).
Means in the same column with different upper-case letters are significantly different ($P < 0.05$).

1.4. Glycemic Load (GL) of Date Consumption

The findings in table 3 showed that consuming two or three dates resulted in moderate GL values of 12.6 ± 0.76 and 10.4 ± 0.54, respectively, whereas four, five, and six dates produced significantly higher GL values of 33.3 ± 0.32, 23.5 ± 0.43, and 34.2 ± 0.74, respectively ($P < 0.05$). These results indicate that the portion size of dates substantially affects postprandial glycemic responses, with smaller portions producing more favorable glycemic outcomes [25], [26]. From a nutritional standpoint, low-to-moderate GL foods are preferred for maintaining stable blood glucose levels and reducing the risk of insulin spikes, whereas high GL intake can contribute to rapid increases in blood sugar, which is particularly relevant for individuals with diabetes or impaired glucose tolerance.

Interestingly, these scientific findings resonate with Islamic dietary practices, which traditionally encourage the consumption of dates in moderation and often in odd numbers, such as three, five, or seven, beginning meals with the recitation of *Basmala* [23]. Such spiritual practices not only carry religious significance but may also promote mindful eating and portion control, which can indirectly contribute to improved glycemic regulation. The integration of scientific and religious guidance thus highlights a holistic approach to dietary management, where cultural and spiritual traditions can reinforce modern nutritional principles.

Table 3: Glycemic Load (GL) Values for Various Date Portions (2–6 Dates)

Food / Condition	GL%*	GL Category
Two dates	12.6 ± 0.76^{a}	Moderate
Three dates	10.4 ± 0.54^{a}	Moderate
Four dates	33.3 ± 0.32^{b}	High
Five dates	23.5 ± 0.43^{c}	High
Six dates	34.2 ± 0.74^{b}	High

*Mean ± Standard deviations (n = 12).
Means in the same column with different upper-case letters are significantly different ($P < 0.05$).

1.5. Effect of Mindful Eating (Basmala) on the Glycemic Load of Dates

Results showed that consuming dates with *Basmala* recitation produced a GL of 39.9 ± 0.82, whereas consuming dates without *Basmala* resulted in a significantly higher GL of 49.4 ± 0.35 ($P < 0.05$), with both conditions classified as high GL (Table 4). These findings suggest that spiritual practices may influence postprandial glycemic responses, potentially by modulating psychological and physiological factors such as stress, mindfulness, and eating behavior, which can indirectly affect glucose metabolism [24].From a scientific perspective, a lower GL is generally favorable for maintaining more stable blood glucose levels and reducing the risk of insulin spikes, even when the overall category remains high [26].

From an Islamic viewpoint, the act of reciting *Basmala* before consuming food is a Sunnah, strongly recommended in Hadith, and is believed to bring blessings and barakah [23]. Beyond spiritual significance, this practice may encourage mindful and deliberate eating, which aligns with modern nutrition science emphasizing the importance of mindful consumption for glycemic control. Therefore, the study illustrates a meaningful intersection between religious practice and metabolic health, highlighting how traditional spiritual rituals can complement scientific strategies for managing postprandial glycemic responses.

Table 4: Glycemic Load (GL) Values for dates consume with and without Basmala Recitation

Food / Condition	GL%*	GL Category
With Basmallah	39.9 ± 0.82^{a}	High
Without Basmallah	49.4 ± 0.35^{b}	High

*Mean ± Standard deviations (n = 16).
Means in the same column with different upper-case letters are significantly different ($P < 0.05$).

4. Conclusion

In conclusion, this study demonstrates that both portion size and the recitation of *Basmala* significantly influence the glycemic index and glycemic load of Yemeni Sagai dates. The results reveal a non-linear relationship between date portion and GI, indicating that larger servings do not necessarily produce higher glycemic responses, likely due to variations in sugar composition, dietary fiber content, and the food matrix. Smaller portions, particularly two to three dates, were associated with more favorable postprandial glycemic outcomes, emphasizing the importance of portion control for metabolic health. Additionally, consuming dates with the recitation of *Basmala* significantly reduced both GI and GL compared to consumption without *Basmala*, suggesting that spiritual or mindful eating practices may modulate postprandial glucose responses. These findings align with Islamic dietary teachings that recommend moderate, odd-numbered consumption of dates with *Basmala*, highlighting an intersection between traditional spiritual practices and modern nutritional science. Overall, the study underscores the potential benefits of integrating cultural, religious, and scientific principles in promoting glycemic control and holistic health.

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مقالة بحثية

تأثير نمط استهلاك التمر اليمني على المؤشر الجلايسيمي والحمل الجلايسيمي

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المُلخّص

يعد تناول التمر جزءًا متأصلًا في الثقافة اليمنية، ومع ذلك فإن تأثيره على الاستجابة الجلايسيمية لم يُدرس بشكل كافٍ. هدفت هذه الدراسة شبه التجريبية إلى تقييم تأثير حجم الحصة وقراءة *البسملة* على المؤشر الجلايسيمي والحمل الجلايسيمي لتمور الصقعي اليمنية لدى 12 من البالغين الأصحاء. استهلك المشاركون 2–6 تمرات، مع أو بدون قراءة *البسملة*، وتم قياس مستويات السكر في الدم بعد الوجبة عند 0 و30 و60 و90 و120 دقيقة. وقد تم حساب المؤشر الجلايسيمي والحمل الجلايسيمي باستخدام قيم المساحة التراكمية تحت المنحنى مع محلول 50 جرام من الجلوكوز كمرجع. أظهرت النتائج وجود علاقة غير خطية بين حجم الحصة والمؤشر الجلايسيمي، حيث أظهرت الحصص الصغيرة (2–3 تمرات) قيمًا مرتفعة أو متوسطة بشكل غير متوقع، في حين أن الحصص الأكبر لم تؤدِ دائمًا إلى زيادة متناسبة في الاستجابة الجلايسيمية. وأظهر تحليل الحمل الجلايسيمي قيمًا متوسطة لتناول 2–3 تمرات وقيمًا عالية لتناول 4–6 تمرات، مما يبرز أهمية التحكم في حجم الحصة. كما أدى تناول التمر مع قراءة *البسملة* إلى انخفاض كبير في كل من GI (63.3 مقابل 78.4) و GL(39.9 مقابل 49.4) مقارنة بعدم القراءة ($P < 0.05$)، مما يشير إلى أن الممارسات الواعية أو الروحية قد تؤثر على استقلاب الجلوكوز. تتوافق هذه النتائج مع التعاليم الإسلامية التي توصي بالاستهلاك المعتدل للتمر وبأعداد فردية مع قراءة *البسملة*، وتؤكد على نهج شامل يدمج الإرشادات الثقافية والروحية والتغذوية.

الكلمات المفتاحية: التمر اليمني؛ مؤشر الجلايسيمي؛ الحمل الجلايسيمي؛ البسملة، الجلوكوز بعد الوجبة؛ التوصيات الغذائية؛ تمر صقعي.

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